COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT A. S. White

FLIGHT NO. 8 COPILOT V. H. Shepard

DATE OF TEST 24 March 1965 FLIGHT TIME 1:40

1.0 PREFLIGHT AND TAXI

The external preflight was accomplished with Mr. White, then the EE Bay inspection was completed while White checked both capsules. The EE Bay was in excellent shape with all switches, handles, and circuit breakers in proper position. (The Freon reset button and light were not marked properly--this should be done as it is part of the crew's inflight emergency procedure, E-59.) The pressure suit was then donned and the cockpit was entered shortly after 0900.

After hooking up the communications, the volume of mobilecom was excessively low and was accompanied with a loud hum. Radio reception on 361.4 was no change. Finally, loud and clear (slight normal hum) reception was achieved by disconnecting external power and using the airplane's emergency generator. The interim inspection was then completed using external power. The crew was ready to start engines near 1015; however, instrumentation problems delayed this until 1049.

The following quantities were observed at engine start:

FUEL TOTAL 244,000 lbs.

Tank 1 -	24,000 lbs.	6R	38,600	NH_3	540 lbs.
Tank 2 -	29,600 lbs.	7L	10,500	H_2O	4500 lbs.
Tank 3 -	33,700 lbs.	7R	9,900	O_2	18 liters
Tank 4 -	37,300 lbs.	8L	9,400	LN_2	Full +
Tank 6L -	38,500 lbs.	8R	10,300		

The engines were started in rapid order with no difficulties; however, a delay was encountered in checking the bleed air. Steam was not observed at the right shoulder with Bleed Air in AUTO. (This is probably normal and the check should be moved to N-15 after Coolant Circ is turned ON. Also, Cabin Air, Manual, Hot may help to expedite this check.) When ground power was disconnected, the loud hum remained; and after several radio and interphone checks with the pilot, the copilot made a sole-searching decision to continue--not compromising safety of flight.

After hydraulics were serviced, the following levels were observed:

Time	P_1	P_2	U_1	U_2
1100	175	176	163	162
1115	178	155	175	160
1140	-	135	165	-

The pilot taxied slowly and no roughness was encountered. However, when brakes were used to slow the airplane to less than 10K for data and during the stop prior to taking the runway, extreme shaking of airplane was encountered. This was the roughest brake chatter ever experienced by this pilot in an airplane.

Fuel observed at 1140 prior to taking runway:

FUEL TOTAL 230,500 lbs.

Tank 1 -	24,300	6R	31,200
Tank 2 -	29,700	7L	10,700
Tank 3 -	33,600	7R	10,000
Tank 4 -	37,500	8L	9,500
Tank 6L -	31,300	8R	10,600

All tank pump switches had been in AUTO from shortly after engine start, except tank 8 was OFF.

2.0 TAKEOFF

The brakes were given to the copilot just prior to throttle advance and the pedals were bottomed out and held until release signal. The airplane lurched forward at brake release and no yawing was observed. The clock was started at brake release and 100K was observed at 15 seconds, which was considered excellent acceleration compared to the handbook's 17.5 (20K wind) seconds. All engines checked satisfactory during the roll, and shortly after takeoff the gear was retracted. The takeoff attitude was not excessive and appeared normal. The cockpit motions in the turbulence up through the scattered cloud layer were random and uncomfortably jerky having an up and down and slightly predominantly sideways motion. (The B-58 classified the turbulence as light.) During this turbulence, the master caution light kept blinking and ADS #4 was vibrating from 4 to 4.5 mils with an occasional increase to 5 mils which probably was activating the master caution light. This vibrating reduced to less than 4 mils above the cloud layer in smooth air.

3.0 CLIMB

After the gear and flaps were retracted, the airframe buffet decreased markedly and reduced further near 370K between .7 and .8 Mn. At .9 Mn all buffet had disappeared. The Bypass was opened to 200 sq. in. just after going supersonic. Door control was good; however, it was difficult to set areas closer than ± 10 sq. in. Also, the right indicator would oscillate ± 15 sq. in. for 15 to 20 seconds after releasing the wheel.

Near 1.25 Mn, climbing at 36,000 ft., a noise was reported by the pilot which was felt in the floorboards by the copilot. It was of acoustical nature and appeared to disappear shortly.

While the wingtips were being lowered, the Bypass was opened further to 400 sq. in. The water was turned on, pitot and defog turned off at 1.7 Mn, then the throat mode switches were placed in AUTO. Both throats closed from 1.67 to 1.72 ± .01 Mn rapdily with no overshoots or residual oscillations. Both throat Mn readouts tracked the airplane's indicated Mn exceptionally well for the remainder of the flight.

Near 1.8 Mn the No. 2 utility pump indicator turned amber and the ground indicated pressure was 2000 psi with No. 3 starting to cavitate. Shortly before this incident, Utility No. 1 level was 200 and the level of 200 was holding. Power was reduced to near the 70 degree mark and a turn was started home. However, ground had confidence in the pump and compensator and with low ADS vibration, advised us to continue.

After 2.2 minutes at MIN A/B, power was advanced to MAX A/B. Later No. 4 engine EGT was observed in T_2 cutback at 875°C at 166°F total temperature. Shortly after this near 52,500 ft., the Mn tape became erratic; however, the throat position did not follow. Later the copilot's altitude tape was observed stuck near 57,000 ft. with the flag out. Six and one-half minutes after the No. 2 engine pump indicator turned amber, the indicator returned to green. For the record, the cabin recorder switch was on during the pitch flutter pulse at 2.0 Mn, 55,000 ft.

4.0 INLET CONTROL

4.1 2.0 Mn - 55,000 FT.

Approaching 1.95 Mn, 53,000 ft., the shock position needles were observed in the field of view. (Previously they were out of view in the extreme top of the RED.) Closer inspection revealed the shock moving aft in the lower red at this time. Total temperature was observed to be 195°F at 1.96 Mn, 53,000 ft.

The shock continued to move aft as acceleration progressed and was near .75 to .8 (lower red) at 2.0 Mn with Bypass reading 400 sq. in. The test was commenced by closing the bypass from 400 sq. in., and buffet was encountered as doors were passing through 200 sq. in. Near 120 to 130 sq. in. the pilot classified the buffet as moderate and advised the copilot to stop closing the doors. The doors were then opened and buffet disappeared at 250 sq. in. A five-second pause was accomplished at 400 and 700 sq. in. during the opening process. Ten seconds of data were gathered at top of the XXXX*. Then the Bypass was closed pausing at 700, 400, and 200 for five seconds, then 60 sq. in. for 10 seconds (C/N 2462). Bypass was not fully closed because of airframe buffet level. Bypass doors then were opened to 400 sq. in. for acceleration to 2.1 Mn.

Following data observed during above test:

Shock Position		Bypass Area	
L	R	L	R (R cal)
yellow	-	600	-
Top of Green	Mid Yellow	700	700
Top XXXX	Top XXXX	780	850 (780)

On all occasions both needles were very sensitive and jumpy from bottom of green to top of XXXX. The right needle would become sensitive before the left, probably because the right wheel was moved first in order to equalize shocks before moving both down together toward top of XXXX. This resulted in the right shock leading the left. Also, the right area readout would oscillate after the wheel was released as described above (3.0 CLIMB) causing apparent shock instability in the sensitive lower green and white area.

4.2 2.1 Mn - 55,000 FT., NORMAL PERFORMANCE

While accelerating in MAX A/B, engines No. 1, 3, and 4 nozzles were reading 90 to 92 percent; other engines were below 90 percent. All EGT's were in T_2 cutback. The throat followed the Mn acceleration excellently within ± .01 or better. The test was started (C/N 2627) by closing bypass from 400 to 200 sq. in. and pausing 10 seconds--buffet again was present. Pilot reported the buffet slowed the airplane down. The doors were then opened pausing at 400 and 700 sq. in. for 5 seconds. Then attempting to position the shocks at top of XXXX, the right needle became jumpy and sensitive at 750 sq. in. While aligning the shock position needles together, one needle appeared to bottom out in the bottom of the white and, therefore, opening of doors was stopped at 730 and 750 sq. in. left and right respectively for 10 seconds. The inlet pressure ratio gages

*XXXX - CROSSHATCH

755 cal

indicated 1.10 and 1.08, L & R respectively. The doors were then closed, pausing at 700, 400, and 200 sq. in. The pilot classified the buffet at 200 sq. in. as moderate. Both inlet pressure ratio gages indicated 1.14 at this door position. During both closing and opening the left area indicated 700 sq. in. with the shock steady at top of green.

4.3 2.1 Mn - 55,000 FT., LOW PERFORMANCE

The bypass was then positioned to 300 sq. in. (C/N 2880) where the buffet was not apparent and the Duct Perform switch was moved to LOW. The throat Mn immediately and rapidly decreased to 1.96 (L) and 1.94 (R). The bypass doors were then opened pausing at 400 and 700 sq. in. for five seconds, then the shocks were positioned near the top of XXXX. The left started oscillating at 990 sq. in. from bottom of XXXX to middle of white on the shock position indicator, then 10 seconds of data was obtained at this point with the right reading 1060 steady in bottom of white area. Both inlet pressure ratio gages indicated 1.05. The doors were then closed to position the shock at the top of the green. Area then indicated:

L (sq. in.)	R (Cal)
850	960 (865)

With this inlet position the pilot accomplished a stability set, and during left sideslip maneuver the right shock position was observed to move around with airplane yaw and settled out in the XXXX at full right rudder. No movement was observed on the left shock position indicator; however, it could have moved while watching the shock movement on the right indicator. The bypass was closed to 400 sq. in. (C/N 3568) after the stability and control set. The airplane was decelerated to 2.0 Mn. A time history (C/N 3724) was then obtained of changing from low to normal performance by moving Duct Perform switch to NORM. Both throat Mach schedule readouts changed rapidly from 1.85 to 2.0 Mn with no overshoots or residual oscillations.

5.0 PURGE AND FLUTTER TESTS

At 2.0 Mn, 55,000 ft., with cabin altitude reading 6000 ft., the scoop was extended with the Cabin Air switch, and after one minute the cabin altitude indicated 28,500 and after two minutes cabin had stabilized at 29,500 ft. Then the switch was held in REPRESSURE (C/N 4030) for 10 to 15 seconds and cabin altitude increased slowly to 40,000 ft. where PURGE was selected again. This was repeated with the same results; then with the Bleed Air switch in OPEN, the cabin air switch was held in REPRESSURE again (C/N 4152) with same results. The test was discontinued and the cabin air switch was repositioned to PURGE. The scoop out emergency procedures were

commenced; however, the ground overruled and four flutter points were obtained in the descent with the scoop open. While descending through 44,000 ft. to accomplish the third flutter point, the EE temperature was observed at 36°F. After the flutter point near 43,000 ft., 1.6 Mn, 500K, the pressure suit started to expand somewhat and cabin altitude was observed at 32,000 ft.

6.0 LANDING

With utility No. 2 level reading 190, the gear was lowered (28 seconds). The flaps were lowered resulting in a left flap pressure caution light. Turning final utility No. 1 level was observed steady at 100, utility No. 2 appeared pegged out near 205. It was turbulent, light moderate, and the pilot reported lateral trim problems when lined up five or six miles out. Fuel was checked and wing tanks were essentially even. The pilot appeared to work hard on final approach, and the airplane was flying in approximately five degree crab to the right. Just prior to chase's 50 ft. call, airspeed was decreasing normally through 215 KIAS.

Throughout the flare there was a very noticeably short period (less than one-half second) longitudinal "whipping" motion of the nose and it was distracting; however, it did not appear to bother the pilot for the touchdown was very smooth--a "grease job!" Approximately five seconds before touchdown, the landing camera was turned on; this caused excessive noise in the interphone and communication was impossible. The pilot's lips were watched for chute deployment which was accomplished immediately after nosewheel touchdown. Landing camera had to be turned off shortly thereafter in order to hear the pilot.

During latter part of landing roll, below 40K, the following was accomplished:

1. Aux Cool - ON
2. Refr. - OFF
3. Recirc. Fan - Checked ON
4. Cabin Air - REPRESSURE

As the switch was placed in REPRESSURE, the scoop was felt to close; however, airflow was not apparent and the crew air shutoff handle had to be pushed down and visor opened to determine that airflow was present. The visor had to be lowered immediately because of excessive ammonia fumes. It was not learned until reaching runup pad that the chute had not deployed.

7.0 FUEL SYSTEM

The fuel system was operated in the automatic mode except that tank 8 was left off until tank seven emptied, then tank 8 switch was placed

in AUTO. Eight A was observed to feed to 15,000 lbs., then 1C started feeding as advertised after sump level reached 27,600 lbs. In other words, all automatic functions (except the switch in lower 1B, which was not allowed to function) operated satisfactorily.

Sequence strips were used most of the time to determine sequence; however, an excessive amount of time was devoted to tank readouts in order to determine when to shutoff empty fuel tank pumps. One cannot tell accurately enough from the strips or from that tank readout when the tank has stopped feeding. You must go further and readout the sump or the next tank to precisely find out what is happening. You must determine accurately for one cannot afford to leave significant amounts of fuel nor can one afford to leave empty tanks' pumps on. Furthermore, when the "next" tank readout is determined, this does not tell one immediately if it is feeding or if the preceding tank has stopped. A later reading must be taken to determine positively if the selected tank is feeding. This process requires absolutely too much of the copilot's time and until a third station is installed, fuel tank low or pump pressure lights should be installed.

There appears to be insufficient clearance between the fuel tank readout selector knob and tank 8 fuel pump switch, especially with pressure suit gloves on as this pilot's thumb or forefinger touched the switch on several occasions.

The following fuel quantities were observed at shutdown:

FUEL TOTAL 30,500 lbs.

Tank 1	- 1700 lbs.	6R	1,000 lbs.
Tank 2	- 450 lbs.	7R	2,000 lbs.
Tank 3	- 18,200 lbs.	7R	650 lbs.
Tank 4	- 1500 lbs.	8L	300 lbs.
Tank 6L	- 2200 lbs.	8R	200 lbs.

8.0 CONCLUSIONS

1. Copilot spends excessive time determining hydraulic fluid levels and determining when to turn empty fuel tank pumps off.

2. Fuel tank low caution lights should be installed next to the respective fuel tank pump switches.

3. Tank 8 fuel pump switch should be guarded to prevent inadvertent actuation when operating the individual tank readout selector knob.

4. Brake chatter at slow speeds was excessive and unsatisfactory.

5. Shock position needles were overly sensitive in the white and crosshatch regions. The slope of shock pressure ratio vs. bypass area was steeper than .10 scale model tests.

6. Visibility was restricted in cruise flight; however, it was satisfactory on final approach.

7. Fuel system operates excellently in automatic mode.

8. AICS automatic throat operated excellently.

VH Shepard

V. H. Shepard
Copilot

COPILOT'S FLIGHT REPORT

AIR VEHICLE	XB-70A #1 (001)	PILOT	A. S. White
FLIGHT NO.	11	COPILOT	V. H. Shepard
DATE OF TEST	28 April 1965	FLIGHT TIME	1:43

1.0 PREFLIGHT AND TAXI

Prior to taxi, fuel in tank 1 was lowered to 29,000 pounds and taxiing was accomplished using sump fuel only. Also, prior to taxi, the left throat was biased open from 2.435 to 2.40 Mn with the standby switch, then opened with the manual wheel to 1.68 Mn for takeoff. The left wheel was not bottomed-out in the aft direction for the remainder of the flight.

Taxiing was normal; however, the ride felt rougher when compared to the previous flight. The right brake was very rough upon application. The left brake was relatively smooth.

2.0 TAKEOFF

The takeoff was normal and proceeded as planned. All engine instruments were normal during throttle advance from 70 degrees to maximum A/B and throughout the roll. Acceleration from 100 to 170 KIAS was exactly as published, in the handbook, for no-wind conditions.

3.0 CLIMB

While climbing near 40,000', 1.7 Mn, automatic throat was selected on both inlets. The left throat lagged the airplane Mach number by .03 and right throat maintained airplane Mach number. Upon reaching 2.05 Mn, both shock position needles were bottomed-out by opening the bypasses to 780 sq. in. The right needle was bottomed-out in the lower white. Then bypass was closed to position the shock near top of the green (.65 normal shock pressure ratio) and near 2.2 Mn with both shock pressure ratio needles positioned accurately at .65 - left and right bypass were 640 and 600 sq. in. respectively. The start was not obvious and the only positive indication was the unstart lights did not illuminate when activated near 2.17 Mn. It was noticed during the acceleration that both shocks tended to travel aft.

Both vertical scale Mach tapes decreased rapidly to 0.4 Mn while climbing near 2.21 Mn; however, the throat Mn readouts did not follow the erratic tape and the right throat was reading correct airplane Mn. The left throat was lagging .04 behind the right. Shortly thereafter the Mn tape started functioning properly but again near 2.3 Mn the tape ran

away in the decreasing direction. After the tape remained at .4 Mn for a short time, the tape again operated satisfactorily.

4.0 INLET NORMAL SHOCK CONTROL

While positioning the shock aft, in order to select LOW inlet performance for stability and control testing at 2.35 Mn, 55,000', the shock position needles were controllable but sensitive in the upper green -- then as the bypass was opened further, the needles were not controllable from middle of green to the "bottomed-out" position. If the needles were not "bottomed-out", the needles would wave around, approximately one cycle per second, from top of green to middle of white (.45 to .65) without touching the bypass wheels. With the shock just bottomed-out, LOW performance was selected and before bypass wheels could be rolled aft, both shocks jumped into the red as the throat opened; however, unstarts did not occur. An attempt to control both needles at the bottom of the green was impossible but, by closer inspection and averaging out needle position, one could tell if the needle was oscillating about the lower green or mid-white areas. However, the slope of shock position to bypass area was so steep one could not easily select a midpoint of oscillation with wheel control.

5.0 LONGITUDINAL ACCELERATED BUFFET - 1.45G 2.35 Mn, 55,000'

At the end of the wind-up turn, light buffet was felt in the airplane, as the pilot called out 1.45G - both shocks appeared normal oscillating near bottom of the green.

6.0 INLET CONTROL 2.4 Mn, 60,000'

For a matter of record, the climb from 55,000' to 60,000' was accomplished in LOW performance as the writer failed to select NORMAL performance because of concentrating on the fuel indication malfunction (See 9.0).

The test was started by positioning both shocks aft to a "bottomed-out" position with both throats on automatic, normal schedule. Bypass read 610 and 620 sq. in. left and right respectively. Then bypass was opened to 820 sq. in. with the left leading the right. Light buffet (originating from the aft end of the airplane, engine instruments were normal) was felt at this 820 sq. in. position. The shocks were returned to the crosshatch for the next test and the right inlet was placed in manual-throat at 2.2 Mn and the shock was positioned near bottom of green.

6.1 Left Bypass Unstart - Normal Performance

Data were obtained of unstarting the left inlet by closing the bypass with the throat in automatic, normal performance. As the shock progressed forward 430 sq. in. were observed at top of the green (.65 shock pressure ratio) and the unstart occurred at 280

sq. in. with a loud noise and shaking of the airplane. The pilot reported airplane motions were insignificant and both left unstart caution lights were on. Engines were normal and, after ten seconds the bypass was opened to position the shock in the crosshatch (550-600 sq. in.). The secondary shock was observed to move aft and bottom-out near 500 sq. in. and the left unstart light remained on. The inlet did not start until manual throat was selected which opened the throat to 2.2 Mn.

6.2 Left Bypass Unstart - Low Performance

With the data still running, automatic throat, low performance was selected on the left inlet and 800 sq. in. were observed with shock bottomed-out near the crosshatch. Then bypass was closed slowly and unstart occurred at 380 sq. in. Engines were normal and after ten seconds bypass was opened and five seconds of data were obtained of the start at 650 sq. in.

6.3 Left Throat Unstart

With the data still running, the left throat was closed, alternately using bypass to maintain the crosshatch until the throat reached 2.4 Mn. Then bypass was closed to 440 sq. in. to position the shock at the top of the green. Throat was then closed slowly until the unstart occurred at 2.49 throat Mach Number. Inlet pressure ratio was observed at 1.25 before and during unstart - no change. After the throat opened to 2.2 Mn, the shock was positioned near bottom of the green.

6.4 Right Throat Unstart

The right throat was then closed to 2.4 Mn (airplane Mach Number 2.44), and bypass closed to position the shock at .65 pressure ratio (500 sq. in.). Prior to this the shock was observed bottomed-out in the white at 580 sq. in. The throat was then closed, unstart occurred near 2.5 throat Mach number and after ten seconds the throat was opened slowly to 2.3 throat Mach number. Bypass was opened alternately to keep the shock in the green; however, small throat movements made the shock sensitive and difficulty was encountered in keeping the shock out of yellow (.65 - .70). The unstart light did not go out, even though the shock was bottomed-out at 730 sq. in. and, while talking to the pilot about the situation, the unstart light went out without any bypass movement. The data was turned off and automatic, low-performance was selected for a steep turn -- the throat readouts were 2.15 and 2.22 left and right respectively at 2.37 airplane Mach number.

6.5 Inlet Maneuvering Tolerance

Data were obtained of full rudder sideslips, left and right, and a

windup turn to 1.4G with both inlets in automatic, low performance and shocks near bottom of the green. During the left rudder sideslip the left shock was observed to move back and bottom-out in the aft yellow (below .35). No unstarts occurred during these tests.

6.6 Right Bypass Unstart - Normal Performance

Data were obtained of unstarting the right inlet by closing the bypass from 600 sq. in. where the shock was observed bottomed-out in the white. The right throat was automatic, normal holding 2.42 Mn at 2.41 airplane Mach number. As the shock moved forward, top of green was observed at 460 sq. in. and unstart occurred at 280 sq. in. The engines were checked and #5 was observed to be abnormal running near 730° C EGT, 100%. The bypass was then opened and MIL power selected, EGT still indicated low and the throttle was retarded; however, EGT remained at 730°C and rpm did not decrease. Then the throttle was positioned back to MIL and the engines were unlocked. Number 5 then appeared to operate normally at idle, where 1080 sq. in. of bypass were required to bottom-out the shock. The engine was advanced to MIL power and all readings were normal; however, the afterburner would not light. Therefore, the engine was left at MIL power. It was observed that the Throat Panel Extend caution lights came on when the engines were unlocked and the throats were greater than 2.2 Mn.

7.0 PITCH AXIS FAILURE

Shortly after a longitudinal dynamic test above 2.3 Mn, 60,000 ft. the pilot remarked of having the control column against the forward stop without seeing corresponding airplane response. The inlet was in automatic throat, low performance and the bypass doors were closed to position shocks in the lower red in order to get a nose down pitching moment. Decreasing the bypass area appeared to help and the inlets did not unstart with this extreme forward position.

8.0 INADVERTENT UNSTART

While descending below 60,000 near 2.3 Mn in automatic throat, low performance, shocks in the lower red, normal performance was selected and in anticipation the bypass wheels were rolled forward too quickly and both inlets unstarted. In other words, with shocks above .65 on the flat part of the curve, one must wait for the shock and not anticipate shock movement as must be done when shifting from normal to low performance with shocks on the steep part of the curve.

9.0 FUEL INDICATION MALFUNCTION

With approximately 120,000 pounds of fuel remaining, both individual and total fuel readouts were inaccurate; individual was hung up at

62,700 pounds (tanks 3, 4 and 2 were checked) and total was reading some high 200,000 figure. After several minutes tank seven did not appear to be moving, and tank two appeared empty; therefore, tank seven fuel pump was switched from AUTO to ON and tank seven sequence strip movement was observed shortly thereafter. Therefore, manual fuel operation was utilized remainder of flight. Later, total fuel readout started operating satisfactorily; however, it returned to 239,000 in approximately 30 minutes and remained for remainder of flight. Individual readout started operating correctly near end of flight but was intermittent until latter part of final approach - then readout was satisfactory until engine shutdown where 11,700 pounds remaining was observed in tank three.

10.0 GENERAL

Just prior to leaving the cockpit, the oxygen lever was found in the OFF position, and probably resulted when the AICS package power switch was turned off. This oxygen lever should be guarded to prevent inadvertent shutoff in flight.

The following readings were observed at engine shutdown:

NH_3	H_2O	LN_2	P_1	P_2	U_1	U_2
380	3500	7/16	180	199	70	198

11.0 INLET SUMMARY

Starting the inlets at Mach 2.0, is not readily apparent from cockpit instrumentation as the shock position indicator appears to be "bottoming-out" from secondary normal shock pressures with the primary normal shock still hung up near the inlet lip. First positive indication of started inlets was that unstart lights remained out above 2.17 Mn and shock needles were jumping around. Unstarts were obvious, being accompanied with a loud noise, then light shaking of the airplane. Airplane motions appeared to be insignificant which was very encouraging. Unstarts resulting from bypass closure were aspredicted and a noticeable increase in thrust was apparent. Unstarts resulting from throat closure appeared to occur at a larger throat than predicted.

Restarting also required a larger throat than predicted and the start was mainly indicated by the unstart light going out; however, buffet did appear to decrease as the throat and/or bypass were opened.

The shock position indicator was not "flyable" below 0.6 pressure ratio because of high sensitivity, responsiveness, and probably poor damping. Also excessive time was spent with the indicator bottomed-out and supplemental instrumentation such as a downstream shock limit caution light would be highly desirable.

The rate of throat movement when changing performance was excessive and resulted in excessive shock movement before bypass area could be changed. Therefore, this pilot got in the habit of bottoming out the shock position needle before switching from NORMAL to LOW performance, then anticipating shock movement forward, probably opened the bypass in excessive amounts.

12.0 CONCLUSIONS

1. Shock position instrument was too sensitive and responsive between .6 (upper portion of the green) and .4 (near bottomed-out position).

2. To prevent excessive opening of bypass doors, a downstream shock limit caution light should be incorporated.

3. Throat moves too fast when shifting mode of performance resulting in almost impossible control of shock when shifting from NORMAL to LOW performance unless shock is excessively "bottomed-out" prior to switchover.

4. Throat Panel Extend caution light should not be wired into RPM Unlock switch.

5. Duct performance switch should be placed near bypass wheels so that eyes and thumbs may not leave shock position and bypass wheels respectively for a performance switchover.

6. The copilot's oxygen lever should be protected with a guard.

V H Shepard

V. H. Shepard
Copilot

COPILOT'S FLIGHT REPORT

AIR VEHICLE	XB-70A #1 (001)	PILOT	A. S. White
FLIGHT NO.	14	COPILOT	V. H. Shepard
DATE OF TEST	1 July 1965	FLIGHT TIME	1:44

1.0 PREFLIGHT

The preflight and cockpit checks were accomplished in accordance with the pilot's abbreviated check list, then both throats were biased open from 2.46 and 2.43 Mn, left and right respectively, to 2.40 Mn with the standby switch. Data were obtained before and after the biasing. The right throat was very sensitive and was almost impossible to set within .01 Mn; also, hunting of the right throat (± .01 Mn, 10-15 second period) was observed.

2.0 TAKEOFF AND INITIAL CLIMB

The takeoff was normal and the acceleration was timed from brake release to 150 KIAS. The observed time was one second better than the published no-wind handbook information. Moderate turbulence that had been observed on the previous flights was not present, which was due to the early hour--0650--and light, moderate buffet was felt until the gear was retracted. While accelerating near 400 knots, an acoustical noise commenced which could be felt in the floorboards and was of such magnitude that the pilot retarded the throttle and pulled the nose up to decrease the speed. The amplitude of the noise decreased with decreasing speed; and upon re-acceleration, the noise did not reoccur. While climbing at 1.7 Mn, automatic throat was selected on both inlets. At 1.95 airplane Mach number, left and right throats were observed at 1.90 and 1.935 Mn respectively.

3.0 ACCELERATION 2.0 to 2.4 MN - MANUAL THROAT AND BYPASS

Upon reaching 2.0 Mn, both inlets were started and shocks were positioned near .65 SPR (shock pressure ratio). After refining the throat wheels to 2.05 Mn, manual throat was selected near 2.08 Mn. Throats were then maintained within ± .02 airplane Mach number; and as both shocks were being moved forward towards .7 SPR (bottom red), the left inlet unstarted near 2.2 Mn. The first impression was the right inlet had unstarted when positioning the right shock forward; however, the caution lights indicated the left inlet and the pilot felt a slight increase in buffet. (A review of the tape subsequent to the flight revealed that the airplane was in a turn of which the writer was not aware; therefore, the unstart was probably a result of flying high performance in the turn.) The inlet was restarted with normal procedure by opening both bypass doors, then opening both throats to 2.0 Mn.

The unstart lights were observed to extinguish during throat opening. The inlet was placed back on schedule at 2.2 Mn, and the shocks were controlled near .67 SPR rather than .7 during the remainder of the acceleration to 2.4 Mn.

4.0 ACCELERATION 2.4 to 2.8 MN - AUTOMATIC THROAT AND MANUAL BYPASS

At 2.4 Mn automatic throat was selected and the shock was controlled at .675 SPR (mid yellow). At 2.5 Mn, 38,000 ft., 377° total temperature, both bypass areas were observed at 490 sq. in. At this point the pilot called out cabin altitude of 7,000 ft. and remarked that he was cold. The temperature selector was found in full manual cold and the heat was increased to manual position No. 3. At 2.6 airplane Mach number, the left and right throats indicated 2.565 and 2.560 Mn respectively. The acceleration appeared to be excellent. Now the shocks were allowed to drift aft with increasing airplane Mach number to the scheduled .6 SPR (upper green) required from 2.6 to 2.8 Mn. As the shocks reached .65 SPR (top of green), 370 and 390 sq. in. left and right bypass were observed. Near 2.68 the writer became a little anxious as the shocks were not moving aft as anticipated and the bypass doors were then opened to position the shock at .6 SPR. At this SPR, bypass was observed at 410 and 380 sq. in. left and right, and slight rumbling was felt in the airplane. This rumbling was different from classical airframe buffet in that the frequency was lower and appeared to be more of a noise than a feel sensation. At 2.71 airplane Mach number, 530 KIAS, 54,300 ft., 468°F total temperature, throats were observed at 2.665 and 2.655, left and right respectively. The pilot again remarked that the cabin was cold and the manual selector was repositioned from 3 to 5.

Malad City, Idaho, was reached and the shocks were positioned at .5 SPR (bottom of the green) so that a turn to the south could be accomplished. As the shocks were moved aft, the shock position needles started oscillating ± 10° below 0.6 SPR; and at .5 SPR, the needles oscillated approximately .45 to .55 SPR having a period of approximately one cycle per second. This amplitude was at least one-half of the amplitude observed during Flight No. 11. Also, it appeared that the slope of shock position vs. bypass was less steep at this Mach number in that bypass sensitivity appeared less. Positioning the shock at .5 SPR was not difficult, and averaging out the oscillations was easily accomplished. Mild rumbling was felt at this shock position. During the initial part of the turn the airplane was holding Mach number in NORMAL duct performance. A 60-mile radius turn was predicted around Ogden, Utah; however, the TACAN mileage indicated the radius was larger and the bank angle was increased. Speed then decreased during this tighter turn to 2.6 Mn. During the latter part of the turn the pilot commented that it was warm in the cockpit and the heat control was reduced from 5 to a manual 3. After rolling out of the turn, the airplane accelerated rapidly from 2.64 to 2.80 while controlling the shock from .6 to .65 SPR.

During the acceleration at 2.73 Mn with the shock positioned at .6 SPR, bypass was observed at 370 and 380 sq. in. left and right. The engine pressure ratio gages were reading 1.75. Again, the pilot complained of being warm and the heat control was decreased further to position No. 2.

5.0 PERFORMANCE AND STABILITY - 2.8 MN

The first test point was obtained by closing the bypass until the shock was positioned forward near .675 SPR, and closing of the bypass pitched the airplane nose down to 0.8 G. Bypass areas of 290 and 260 sq. in., left and right respectively, were observed at 2.85 Mn and stabilized data were obtained at 2.845 Mn, 508 knots at a counter reading of 3984. With the data still running, the bypass was opened to 320 and 340 left and right, which positioned the shock at .65 (top of the green); and the pilot adjusted the throttle to obtain fairly stabilized data at 2.84 Mn. At this Mach number the throats were observed at 2.815 and 2.795, left and right respectively. Bottom of the green was selected where mild dynamic lateral-directional maneuvers were accomplished. No difficulty was encountered in holding the Mach number. In fact, when the speed was observed to be decreasing, a very small change in bypass appeared to control speed effectively. That is, a decreasing Mach number could be stopped immediately by closing the bypass without an increase in throttle.

After the dynamic maneuvers were completed, the shock was moved aft to .4 SPR (top of CROSSHATCH) where "bottoming out" occurred. Then the doors were opened to approximately 80 sq. in. more than the CROSSHATCH position to prepare the inlet for the low performance throat change. As LOW performance was selected, the throats were observed to open up slowly to 2.73 and 2.63, left and right respectively, at 2.83 airplane Mach number. Near the end of the throat opening, the shock position needles moved forward and oscillated in the white. This pre-setting of the bypass prior to selecting LOW performance was almost exactly the bypass area required for the new throat position. CROSSHATCH plus 100 sq. in. of bypass was not selected because of the moderate rumbling at CROSSHATCH plus 80 sq. in. During the longitudinal dynamic, directional static, and the directional dynamic test no difficulty was encountered in maintaining the Mach number in low performance mode; however, the writer had to concentrate on maintaining a correct shock position during the maneuvering. The airplane decelerated during the windup turn and 2.75 Mn was observed as the pilot called out 1.45 G. Airplane speed decreased rapidly in the turn.

6.0 RAM PURGE

At approximately 2.64 Mn, military power was selected with the inlet in low performance--shocks positioned in CROSSHATCH. Just prior to selecting PURGE, the shocks were positioned to approximately .6 SPR and NORMAL performance was selected. The right throat closed rapidly

on the old schedule, and while closing the bypass the writer became confused and almost forced the left shock out of the inlet because it was operating at the new slow throat rate. These two different throat rates when going from LOW to NORMAL duct performance must be eliminated prior to the next flight. During deceleration the shocks moved forward continuously; and if not watched closely, they would move forward near the red area. In other words, the copilot cannot spend too much time on other duties when controlling the shocks during deceleration or an unstart will occur.

7.0 FUEL MANAGEMENT

Prior to taxi, tank 1 was lowered to 34,500 lbs. by transferring into the sump tank which had been depleted during initial engine starts, system checkout, and military power runs. Prior to takeoff, tank 8 was lowered to less than 13,500 left and right, then tank 6 was positioned to AUTO and the sump was observed to increase, then all switches were placed in AUTO for takeoff. After the gear was retracted, tank 1 was positioned to ON and 2, 4, and 7 were positioned OFF. While accelerating at 32,000 ft. tank 6 was turned off five minutes after the sump had started down. In order to control the aft c.g. movement, it was programed to turn tank 1 to AUTO with 3500 lbs. remaining in the tank. A quick check was made when 149,000 lbs. remained and tank 1 still indicated 7500 lbs Shortly thereafter tank 1 was checked and it was empty; therefore, tank 7 was turned on and 5,000 lbs. was transferred to the sump to compensate for the mismanagement of tank 1. Then tank 1 was turned off and 2, 4, and 7 were placed in AUTO. Tanks 4 and 7 were turned off within a minute or so of going empty; however, tank 2 probably fed for five minutes after being empty. If it had not been for the chase call out, the pumps probably would have run for another five minutes or so. After the gear was lowered, tank 6 was turned on for two minutes and transfer of fuel appeared to be negligible.

The following fuel quantities were observed just prior to shutdown:

Tank	Lbs.	Tank	Lbs.
1	1,200	6R	1,100
2	300	7L	1,700
3	11,100	7R	1,200
4	100	8L	400
6L	2,500	8R	200

Total: 20,500

8.0 INLET SUMMARY

Control of the normal shock in the .4 to .6 shock pressure ratio range was greatly improved over Flight No. 11 for two reasons: (1) The amplitude of the shock position oscillation was decreased by a factor of three, and (2) bypass wheel sensitivity had decreased to an acceptable level. Control of the shock above .6 SPR was excellent; however, sluggishness was apparent above .675. For turns, maneuvering and turbulence where shock positions below .6 generally were required, constant monitoring and control were required because of constant shock movement both fore and aft.

Shock position appeared to have a significant effect on airspeed control and appeared to be a better speed control device than the throttles.

Bypass door operation produced significant pitching moments on this flight. On one occasion above 2.8 Mn, the pilot observed 0.8 G for less than 100 sq. in. change in area. On previous flights the pitching moments were negligible.

Manual throat and bypass operation from 2.08 to 2.4 Mn was a full-time job, especially in attempting to fly high performance which required positioning the shock near the throat and controlling the throat within ± .02 Mn. This manual operation coupled with a manual fuel sequence and other duties was an excessive workload. For future manual operation, the fuel system should be operating in automatic mode.

An unstart of the left inlet occurred in the manual mode near 2.2 Mn, and the left shock was last seen near .66 to .675 SPR with no further bypass movement. In level flight the unstart should not have occurred until the shock was in excess of .75; therefore, the unstart was probably caused by the reduced windward inlet tolerance during a right turn.

9.0 GENERAL

Pressure suit operation was excellent; however, because of a combination of fogging (due to a cold cabin and visor heat off) and flying into the early morning sun, the face plate was opened during manual control of the inlet. Later on, with a warmer cabin and visor heat positioned at FULL, the face plate was closed and no fogging was encountered.

The approach and landing were flown from the right seat. For a big delta, the airplane handled excellently on approach and very little rudder was used, which was a surprise, as all simulator approaches require much rudder and little aileron to prevent excessive lateral directional wandering. Glide slope and speed were no problem, and visibility was good; however, approach speed was higher than

handbook speed. Near 220 KIAS, the airplane did not appear to be on the backside of the power required curve. Flare was slow and gentle and very little flare was required because of the flat approach. As far as height was concerned, no problem was encountered. Even though height was called for, the pilot said nothing, so it must have been O.K. Pilot helped during touchdown and it was a soft "feeling" landing. Last speed observed before touchdown was 178 KIAS. Pilot then took over, and chute was deployed immediately as the landing was long.

10. CONCLUSIONS

1. The airplane had more than adequate excess thrust at 2.8 Mn with the normal shock at .6 SPR.

2. Normal shock was easier to control below .6 SPR because the amplitude of the shock position oscillation was decreased by a factor of three.

3. The slope of shock position versus bypass area was less than observed at 2.4 Mn.

4. The copilot's workload was excessive during manual inlet operation because of having to cope with an out-of-sequence manual fuel operation.

5. The airplane was much easier to fly on approach than the simulator.

6. Bypass doors (shock position) were a better speed control device than the throttles above 2.7 Mn.

Van H Shepard

V. H. Shepard
Copilot

XB-70 FLIGHT 1-15 27 July 1965

COPILOT COMMENTS

INTRODUCTION: The flight was scheduled for 0700 hours takeoff. The primary purpose of the flight was to heat soak the airplane for approximately 20 minutes during flight at 2.80 Mach; disengage FACS at 2.60, 2.70 and 2.80 Mach; obtain airspeed check with B-58; and evaluate the wheel brake changes.

The airplane was airborne at 0706 and landed one hour and forty-three minutes later. The flight went extremely well and all test objectives were accomplished even though a fuel leak from tank 6 caused a requirement to leave the landing gear extended until all fuel in tank 6 was depleted.

PREFLIGHT AND FLIGHT PREPARATION: I arrived at the airplane around 0345 and everything appeared to be progressing normally. After a walk around inspection, I attended an engineering and maintenance status briefing. The airplane status was the same as briefed the day before. At approximately 0450, Mr. White and I entered the physiological van where we donned pressure suits. I was in the cockpit at 0530 with all connections fastened and my pressure suit checked out. Five minutes later Mr. White had completed his checkout also.

IN THE COCKPIT PRIOR TO TAXI: The starting gross weight was approximately 539,000 pounds which included an indicated 263,500 pounds of fuel. Both inlets were set as planned to 2.43 Mach with the control wheels and then biased to 2.40 Mach with the standby switches. Engine starts began at 0609 and all engines were running normally at idle power by 0618 hours. The maximum EGT encountered during 1st peak was 550 degrees. The only problems encountered were a slow acceleration from 35% to idle RPM on #1 engine and sticking primary hydraulic status indicators on engines 1 and 2. The #1 status indicator had been sticking during engine runs and this condition was expected. A small glycol leak was reported in the right wheel well, therefore, the gear doors were opened for an inspection. The ground crew determined that the leak was not excessive and the gear doors were closed again. Tank #1 was turned on to refill tank #3 and to reduce the nose gear load. Approximately three minutes elapsed before any transfer could be detected. No reason for the delayed fuel transfer was found since tank #3 was down to 28,400 pounds and should have accepted the fuel. The transfer was stopped with 34,400 pounds remaining in tank #1. All engines checked satisfactorily during military power runs although #6 showed high engine vibrations until the throttle was rapidly retarded and advanced (bodied).

The #6 engine vibration remained higher than any of the other engines throughout the flight but was within acceptable limits. The hydraulic systems were serviced to 160% prior to disconnecting hydraulic GPU's.

TAXI: The airplane was taxied from the run station at ~~0638~~ 0648. During the taxi out, data was recorded when the airplane was stopped from approximately 25 knots speed with light to moderate braking with the selector in normal. Moderate chatter occurred below about 5 knots. During the westbound travel at around 20 knots speed on the main ramp area, the airplane seemed to get in frequency with the spacing of the concrete blocks and a continuous moderate frequency oscillation was felt in the cockpit. It was of no particular consequence although it was distracting. When the fuel level in tank #3 dropped to 24,000 pounds, tank #6 was turned to automatic and refilled tank #3. During the stop on the runway, brake data was again recorded. The brake chatter was mild. The ground crew observed the flight control movements and made a visual inspection of the airplane. A previously reported hydraulic leak in the right main gear strut that had been fixed prior to taxi out was checked OK.

TAKEOFF AND INITIAL CLIMB: The indicated fuel quantity six minutes prior to brake release was 251,500 pounds. All fuel tank switches were set to automatic. The airplane compass heading indicated 45 degrees instead of the correct 43 degrees when lined up on the runway. The engines were set two at a time into A/B and brake release occurred at 0706 hours. The brake release was relatively smooth and the throttles were advanced to max A/B. All engines checked good and the acceleration appeared satisfactory. Thirty-five seconds were required to attain 150 knots speed. Rotation was initiated at 194 KIAS and lift off occurred at 210 KIAS. This lift off was about 4 knots lower than planned and the initial climb and acceleration rate was noticeably slow. After reaching about 225 KIAS, both the climb and acceleration rate seemed to increase considerably. During the initial climbout, the master caution flashed on momentarily several times but the reason could not be determined. After a satisfactory hydraulic check, the flaps were retracted and the climb continued at 260 KIAS with the landing gear still extended. Upon turning off the "aux cool" switch, the EE temperature increased to 80 degrees. The "aux cool" switch was turned back on and it was found that the "cooling circ" switch had been inadvertently left off. It was turned on and the "HEFER" switch recycled. "Aux cool" was again turned off and the EE temperature was normal for the remainder of the flight. Four minutes after takeoff, the #1 UHF transmitter failed. The receiver was still OK. The #2 UHF was set to the primary frequency and the mission continued with excellent communications.

CLIMB AND ACCELERATE: With max A/B power set and holding approximately 260 KIAS, there was light airframe buffet. The climb was continued to

20,000 feet where power was reduced slightly to hold the altitude until tank #6 was emptied. An airspeed check with the gear extended near 20,000 feet showed 268 KIAS on the XB-70 and 259 KIAS on the B-58. Within one minute after level off, tank #6 had stopped feeding with 3500 pounds remaining and tank #4 had begun to transfer. The landing gear was retracted and locked up in 22 seconds. Max A/B was reset and the wing tips set at 25 degrees. As the airplane climbed at .95 Mach, the windshield ramp was raised to the "high speed" position. After reaching 32,000 feet, a level acceleration was begun and the airplane was supersonic at 0728. The bypass doors were set to 200 and the FACS turned on. The TACAN locked on Coaldale and the sonic boom measuring station at that location was flown over at an altitude of 32,000 feet while still accelerating near 1.3 Mach. I flew the airplane for about six or seven minutes during this period and noted that with the nose ramp up, it is very easy to let a wing drop when occupied with other cockpit duties. Constant attention to the attitude indicator is required since there is no outside horizon reference except on the side the pilot is seated. The bypass doors were set at 400 and the wing tips lowered to 65 degrees near 1.4 Mach. The throats were set to automatic near 1.7 Mach. The throats controlled excellently throughout the flight and when the airplane was at 1.94 Mach, they were 1.92 left and 1.94 right. After reaching 575 KIAS, a constant IAS climb was initiated to 50,000 feet and thereafter the indicated speed was gradually decreased to 525 KIAS at 66,000 feet. This was 2.8 Mach. The inlets were started near 2.1 Mach and at approximately 2.2 Mach, the shocks were fairly steady in the lower yellow at bypass settings of 550L and 610R. At 545 KIAS, 59,000 feet (approx 2.4 Mach), the bypasses were opened slightly to move the shocks into the upper green prior to turning right just south of Rome, Oregon. The shock indicators became extremely sensitive throughout the green area and oscillated plus or minus $\frac{1}{4}$ inch without any bypass door movement. The throttles were retarded slightly to hold 2.6 Mach in the turn and with a 20 degree right turn at 63,000 feet the bypass doors were 420L and 450R with shock positions in the mid to high green. The bobweight was set to "free" at 2.6 Mach and an airspeed check at the pilot's station showed 522 KIAS on the tape instruments versus 518 KIAS on the pneumatic instrument. During the turn between 60 degrees and 150 degrees heading, the glare from the sun caused both pilots considerable trouble. At one point, it was impossible for me to see the shock and throat indicators until I lowered my head below the top of the instrument panel. The thought occurred to me at that time, "if we are going to have any emergency I hope it waits until I can see".

FACS OFF TESTS AT 2.6, 2.7 and 2.8 MACH: The bypass doors were opened slightly to move the shocks down to the lower green area prior to turning the FACS off. The shock position indicators became even more oscillatory and the bypass door opening caused a light airframe buffet. While still in the turn, all FACS were turned off at 2.6 Mach without any noticeable tendency for divergence from the flight path or attitude. When the FACS were turned on again, there was a small "thump" in the airframe as the augmentation re-engaged. During the acceleration from 2.60 to 2.70 Mach, the master caution light flashed on several times for no apparent reason. At 2.70 Mach, while still turning slightly, the FACS were turned off and again the airplane stability appeared to be very good. The pilot made pitch, roll and yaw inputs to see if any type of oscillation would occur but the airplane showed no tendency for an oscillation to become excited. When the FACS were turned on, the airframe "thump" was felt again. The shocks were set at .6 SPR to accelerate to 2.80 Mach. The shocks cannot be set exactly at .6 SPR because of the needle oscillation but they can be averaged reasonably well. The bypass door settings were 360L and 375R at approximately 2.75 Mach. The throats continued to control extremely well in automatic and showed 2.78L and 2.75R with 2.79 airplane Mach. After reaching 2.80 Mach, the shocks were reduced to lower green and the FACS turned off. Stability on all three axis appeared good. When the FACS were turned on again, the airframe "thump" did not occur and the data should be checked to ascertain that the FACS did actually disengage when the switch was turned off.

2.8 MACH HEAT SOAK AND DUCT PERFORMANCE: At 0758 the airplane reached 2.80 Mach while southbound over Bonneville, Utah at 66,000 feet. The total temperature was 506°F. The shocks were moved from .6 SPR to top of green for duct performance data. The shock indicators stabilized on the line between green and yellow and at 2.82 Mach, the bypass doors were 310L and 320R (C/N 3720). The highest speed of the flight occurred here when we went momentarily to 2.83 Mach. Total temperature indicated 516°F. The shocks were lowered to .6 SPR and the bypass doors were at 340L and 360R (C/N 3758). The shocks were then lowered to where they oscillated plus or minus ¼ inch around the lower green area. With an airplane Mach of 2.80, the throats were 2.81L and 2.77R and the bypass doors were 390L and 390R (C/N 3791). At this time, the airplane had been at 2.80 Mach for 4 minutes and was 140 miles north of Morman Mesa, Utah with 72,000 pounds of fuel remaining. The throttle angle was around 95 degrees. When the bypass doors were opened to set the shocks at the cross-hatch position, the throttles were advanced to max A/B to hold the speed. The flight plan called for setting the shocks to the cross-hatch position and then opening the bypass doors 100 square inches more, however, light to moderate airframe buffet occurred with the shocks set in the cross-hatch position. It was decided not to open the bypass doors any further. They were at 470L and 470R. The duct performance switch was moved from "NORMAL" to "LOW" (C/N 3873) and

the throats went to 2.68L and 2.62R. The shock positions moved up to the lower green when the throats were changed to "LOW". The duct performance switch was reset to "NORMAL" and the shocks reset to .6 SPR for 2.80 Mach cruise. The throttles had to be retarded after "NORMAL" was reselected. A stabilized point was obtained (C/N 4095) at 2.80 Mach with throats 2.80L and 2.76R and the bypass doors 340L and 350R. Total fuel was 63,000 pounds and the throttle angle was 95 degrees. The bypass doors had not been moved for about two minutes prior to that time. Once the airplane is fairly well stabilized, the bypass doors require very little copilot manipulation. While still holding 2.80 Mach, the bypass doors were moved into the lower green area in preparation for a right turn. The turn was started 89 miles north of Needles and with an 18 degree bank angle, the speed and altitude were steady with 100 degrees throttle angle and bypasses 390L and 380R. I flew for two minutes at 2.80 Mach and the airplane appeared very stable. It was, however, easy to gain or lose a few hundred feet of altitude. The airplane did not seem to be over sensitive either laterally or directionally. The mission objective of 20 minutes at 2.80 Mach was attained at 0758 with 44,500 pounds of fuel remaining.

DECELERATION AND DESCENT: All throttles were retarded to military power for deceleration after the shocks' positions were set in the cross-hatch area. The bobweight was locked below 2.60 Mach. The bypass doors were set at 930L and 880R to position the shocks in the green at 2.10 Mach prior to unstarting the inlets. The inlets unstarted around 2.0 Mach without any noticeable change in flight characteristics or noise level. All throttles were retarded to 40 degrees at 2.0 Mach. I began flying the airplane around 1.50 Mach and flew the remainder of the flight, including the landing. The bypass doors were closed to 400 at around 1.4 Mach but the wing tips remained at 65 degrees until 1.28 Mach in an attempt to allow the photo chase airplane a chance to obtain photos. I did not detect any significant change in flight characteristics when the wing tips were moved from 65 to 25 degrees. As the airplane became subsonic, the bypass doors were closed and 1, 3, 4 and 6 throttles retarded to idle. FACS was turned off for the remainder of the flight. Below 20,000 feet, the windshield ramp was raised causing the noise level to increase. When the wing tips were raised to "UP" at approximately 325 KIAS, there was a very noticeable increase in roll power and lateral sensitivity. The slight overcontrolling tendency was overcome within a few seconds.

APPROACH AND LANDING: The speed was reduced below 200 KIAS and the landing gear extended at around 12,000 feet. It locked down in approximately 30 seconds and the U_1 quantity dropped to 78%. All other hydraulic quantities and pressures were satisfactory. The flaps were then extended. The Tower reported wind was 210 degrees at 6 knots with 04 the active runway. The

total fuel was 27,000 pounds with 17,700 pounds in tank #3. Best flare speed was computed as 194 knots IAS. The airplane was turned in on final approach about four or five miles out at approximately 3,000 feet above the ground. The air was smooth and it was very easy to establish the desired final approach speed of 210 KIAS. The landing camera was turned on at approximately 200 feet. Speed was gradually reduced to 194 KIAS over the end of the runway and a smooth touchdown occurred at 180 KIAS. Both lateral and pitch control were positive during the flare and no overcontrolling tendency was encountered. After touchdown, the nose was lowered and the drag chute deployed. Both chutes inflated, normally. Light braking was first initiated at approximately 130 knots but the helicopter immediately called out, "heavy smoke from the left brake". The brake application was discontinued and the smoke stopped. Each time the brakes were applied, the smoke could be seen. The chute was jettisoned around 50 knots and the airplane was stopped with very little braking.

AFTER LANDING: After clearing the runway, data was taken with the engines at both idle and military power. During taxi in, brake checks using aft brakes only were accomplished with "auto" and "manual" selections. Brake chatter occurred on all stops and the brakes would lock almost every time the brakes were applied. After taxiing to the run station, all engines were shutdown at 0906 with 10,300 pounds of fuel remaining in tank#3.

SYSTEMS:

1. Environmental: The system worked extremely well. The cabin temperature selector was set in automatic at about the 11 o'clock position shortly after engine start and left at that position until 1.4 Mach where it was set on position 2, as called for on the checklist. The cabin was comfortable throughout the flight and when both pilots raised their visors at around 20,000 feet prior to landing, the cabin was still comfortable. No further adjustments were made after setting position 2. The copilot's vent flow appeared to be low prior to takeoff. This is the second flight that this problem has been encountered. The EE temperature was 45 to 50 degrees during most of the flight. The only time it went higher was when the coolout circulation switch was inadvertently left off prior to takeoff. It had gone up to 80 degrees when "aux cool" was turned off but came down rapidly when all switches were properly set.

2. Fuel: The fuel system was set in automatic prior to takeoff and operated perfectly. The unuseable fuel in tank 6 (3700 pounds) and tank 7 (3800 pounds) is excessive. All other tanks fed out very well. The #1 fuel tank was slow to transfer when turned on after engine start.

3. Hydraulic: All quantities remained steady throughout the flight until the landing gear was extended when U_1 dropped to 78%. The P_2 pressure guage had an oscillation between 4000 and 5400 pounds that appeared to be an electrical short.

4. Expendables: The water, ammonia, LN_2 and liquid oxygen consumption was satisfactory. There was 1000 pounds of water remaining even though only 2000 pounds were serviced prior to flight.

5. The following systems were satisfactory:

Engines	Wing Fold	TACAN
Fuel	Nose Ramp	IFF
Electrical	Landing Gear	Oxygen
Hydraulic	Drag Chute	Fire Detector
Environmental	Nose Wheel Steering	Flight Instruments
Flight Controls	AICS	Instrumentation

CONCLUSIONS:

1. This was an extremely successful flight. Twenty minutes of sustained 2.80 Mach flight was accomplished. The maximum speed and altitude attained were 2.83 Mach and 67,000 feet. Maximum observed total temperature was 514°F.

2. The airplane accelerated to planned mission speed with little difficulty. There appeared to be ample power remaining to reach 3.0 Mach.

3. The automatic inlet control worked very well although there was approximately .02 to .03 difference between the left and right throat indications.

4. Controlling the shock positions this flight was less effort than on previous flights. The shock position indicators are still too sensitive in the green area and must be averaged rather than setting an exact value. After the 2.80 Mach cruise was established, there was no requirement to move the bypass doors.

5. Flight characteristics appeared to be very good and airplane response during approach and landing was satisfactory.

6. Opening the bypass doors to position the shocks to the cross-hatch position causes light airframe buffet. Further opening of the bypass doors will increase the buffet.

7. When the nose ramp is up, constant reference to the flight instruments is required to prevent an inadvertent bank.

8. Glare on the pressure suit face plate is completely unacceptable when flying into the sun.

9. Brake chatter is still objectionable.

MAINTENANCE DISCREPANCIES:

1. A fuel leak in the right gear well from tank #6 was leaking excessively.

2. The UHF #1 transmitter failed shortly after takeoff.

3. The copilot's radio and interphone jackbox is tied into the pilot's headset.

4. The primary hydraulic status indicator for #1 engine was sticking and unreliable.

5. The primary hydraulic status indicator for #2 engine was sticking just after engine start.

6. A small glycol leak developed in the right wheel well prior to taxi out but was determined to be acceptable for flight.

7. The #1 fuel tank did not begin transferring until three minutes after the switch was turned on prior to taxi out.

8. The #6 engine vibrations were high until the engine was "bodied".

9. The master caution flashed on two times during the flight for no observable reason.

10. The left brake appeared to be grabbing when applied during landing roll.

11. The primary 2 hydraulic system guage oscillated between 4000 and 5400 pounds and appeared to be an electrical short in the guage.

12. The flaps would not retract after landing.

13. The pilot's tape recorder did not record "hot interphone" conversations.

14. The left inlet has a honeycomb "void" which was discovered after flight.

RECOMMENDATION:

1. Correct the maintenance discrepancies noted.

2. Improve the shock position indicating system to allow more precise shock positioning.

3. Provide some method of eliminating glare from the pressure suit face plates.

4. Continue with efforts to reduce brake chatter and wheel skidding tendencies at low speed.

5. Have more successful flights like this one.

COPILOT'S FLIGHT REPORT

AIR VEHICLE	XB-70A #2 (207)	PILOT	V. H. Shepard
FLIGHT NO.	3	COPILOT	A. S. White
DATE OF TEST	18 August 1965	FLIGHT TIME	1:58

1.0 TAKEOFF AND CLIMB

The primary purpose of this flight was pilot familiarization with the airplane characteristics. This was Mr. Shepard's first opportunity to make a takeoff and his control of the airplane was excellent.

During the climbout at approximately 370 KIAS, the low-frequency hum and vibration in the floorboards was encountered just as it is in Ship #1. It was the copilot's opinion that this phenomenon could have been caused by the nosegear camera installation in Ship #1; but since Ship #2 exhibits the same characteristics, that theory now seems questionable.

During the latter part of the climb to 32,000 ft., in mild turbulence with augmentation off, a small left sideslip was encountered. It was probably brought on by the turbulence. The strong positive dihedral of the airplane caused it to roll to the right. The pilot interpreted this as wing heaviness and counteracted the roll with left aileron. This increased the sideslip due to the very high level of yaw due to aileron. At a point between 5 and 6 degrees of left sideslip, rudder was applied against the sideslip and the aileron released. The airplane immediately recovered from the maneuver. This maneuver is explained in detail herein only to emphasize again that sideslip is not easy to recognize visually in this airplane. The result can be misinterpreted and can lead the pilot to the wrong corrective measures. This seems to be more critical in this No. 2 airplane because of the strong positive dihedral, but in either case the sideslip indicator should be monitored carefully, especially when flying with augmentation OFF.

2.0 SYSTEMS OPERATION

The fuel system operation was normal and satisfactory with the following exceptions: (1) Fuel leaks back into the tanks after they have been emptied, interrupting the normal automatic sequence, and (2) tank 7 tape and individual readout drove down very rapidly for approximately 20 seconds at one point in the flight; thereafter it indicated normally.

The hydraulic system operated satisfactorily except that the fluid level in utility No. 2 system decreased abnormally during the flight. The record of the utility No. 2 fluid level is indicated in the table below:

Before T.O.	165%
T.O. + :24	165%
+ :27	150%
+ :41	140%
+ :52	130%
+1:10	110%
+1:35	90%
+1:41	gear down
+1:42	130%
+1:50	100%
After Landing	109%

3.0 APPROACH AND LANDING

The pilot made a low approach and go-around, remained in the traffic pattern, and made a full stop landing after the second approach. His control of the airplane was excellent; and although the landing was a little short of the intended touchdown point, it was a very good landing.

A. S. White
Copilot and Aircraft Commander

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT V. H. Shepard

FLIGHT NO. 3 COPILOT A. S. White

DATE OF TEST 18 August 1965 FLIGHT TIME 1:58

CHASE AIRCRAFT AND PILOTS

Chase 1 - TB-58 #662 - Lt. Col. Fulton/Col. Cotton
Chase 2 - F-104 #315 - Capt. Marrett/DeLong (NAA Photo)
Chase 3 - F-104 #763 - Capt. Livingston
C-130 #132 - Major Jones

PURPOSE OF FLIGHT

1. Pilot Checkout
2. Stability and Control Tests at 1.4 and 1.2 Mn, 45,000 ft.
3. Airstarts at .9 Mn, 25,000 ft.

1.0 PREFLIGHT AND TAXI

The cockpit was entered at 1040 and the interior inspection was accomplished in accordance with the pilot's abbreviated check list. The following data was observed at 1045:

H_2O	-	4400 lbs.
NH_3	-	525 lbs.
EE Temp.	-	62°F
Total Temp.	-	79°F

The right engines were started in the following abnormal order: 5, 6, then 4 so that engine #5, which had a history of hot starts, could be started first. Engine #5 started normally well below 680°C. The left engines were started in a normal order of 3, 1, then 2; however, #2 was started with external hydraulics disconnected and with the flight control exercised to lower the hydraulic pressure. Difficulty was encountered in getting 15 per cent on #2. The start was slow, but well under 680°C. All engines were running at 1123 and taxi was begun at 1151.

Taxiing speed was maintained between 15 and 20 knots and the airplane had to be braked periodically to prevent exceeding 20 knots with engines at IDLE. Also, near 20 knots, the airplane's motion frequency became in phase with the ramp disturbance frequency which increased the cockpit motion to an uncomfortable level. This motion was decreased as brakes were applied and speed decreased. Braking

action was smooth with an occasional washboard effect when using the right brake. The airplane was brought to a stop on the runway and mild brake chatter was encountered under 5 knots.

2.0 TAKEOFF AND INITIAL CLIMB

The engines were checked at 70-degree throttle angle, then the brakes were released at 1220 and maximum A/B was selected on all engines. The acceleration check from brake release to 150 KIAS was satisfactory. Rotation was started slowly at 183 KIAS and liftoff probably occurred slightly under the planned 205 KIAS. Near 210 KIAS, the nose was lowered to one degree above the horizon because of slight over-rotation and slow acceleration. The nose was lowered further near 215 KIAS and satisfactory acceleration was observed at 220 KIAS. Slight lateral and longitudinal overcontrolling was noticed for a short time after takeoff, but the writer easily adapted to the lateral system and it became apparent that turbulence was influencing the longitudinal overcontrol. The gear and flaps were retracted at 250 KIAS and the airframe buffet changed from light moderate to light. The trim was not changed during flap retraction and a pull force of approximately 25 pounds was observed stabilized at 265 KIAS (C/N 411) with flaps up.

Throttles were retarded to Mil power and the acceleration and climb were continued. At 370 KIAS a mild to moderate hum commenced which was felt in the rudders and bloorboards. The hum gradually disappeared as altitude increased. Good forward visibility was observed at 385 KIAS. Light buffet was still present in 1 G flight and increased to light moderate at 1.15 G.

3.0 CLIMB

The airplane was climbed at 400K and near 15,000 ft., maximum A/B was selected in order to clear clouds ahead. All airframe buffet disappeared at .86 Mn and 20,000 ft.

Shortly thereafter longitudinal overcontrol occurred in moderate turbulence and the floorboard hum commenced as the airplane pitched over near .85 G. This hum only lasted a few seconds after 1 G flight resumed. In order to stay out of thunderstorm cirro stratus clouds, a mild push-over and reduction of power was accomplished. During this maneuver near .90 Mn, 25,000 ft., the airplane was observed going out of trim laterally. The instructor pilot remarked, "Watch the sideslip." The sideslip was observed near 5 - 6 degrees left and immediately the left rudder was applied and aileron against the lateral out-of-tolerance was released. The sideslip reduced rapidly. Shortly thereafter at .95 Mn while attempting to control the + 2 degrees of sideslip in moderate turbulence, first with rudder, then aileron, the writer appeared to make things worse. Even after all controls were released, the airplane motions continued. The instructor pilot took the controls

and complained of the airplane wallowing for no apparent reason. At this time, FACS were engaged, then the tips were lowered to 25 degrees. The airplane stopped wallowing around when FACS was engaged; however, the rudder pedals exhibited excessive vibration.

4.0 STATIC DIRECTIONAL, .95 MN, 32,000 FT., WINGTIPS 25 DEGREES

Wings level, sideslips were accomplished in very light airframe buffet by slowly and steadily increasing right rudder to near 3/4 deflection where 3 degrees of sideslip was observed. The gradient was moderate and positive with no shallowing of force vs. sideslip observed. Control during the sideslip was satisfactory, and ailerons caused no trouble. Dihedral was very slightly positive and required very little aileron at 3 degrees sideslip. The release was slow to zero sideslip and a dynamic maneuver was not accomplished.

5.0 ACCELERATION AND CLIMB TO 45,000 FT.

During the acceleration to 460 KIAS, considerable nose down trim was required from .95 to 1.1 Mn, then the gradient was shallow to 1.2 Mn. At 1.32 Mn the following pace data was observed during a constant airspeed climb to 40,000 ft.:

	A/S (KIAS)	Alt. (Ft.)	Mn
XB-70 (VSI)	458.5	37,280	1.32
B-58 (662)	463.5	37,100	1.31

6.0 STABILITY AND CONTROL, 1.4 MN, 45,000 FT.

With the tips at 25 degrees, pitch augmentation was turned off and a pullup and release was accomplished--damping was excellent, reducing to near 1/10 amplitude in one cycle. Then a wings-level sideslip was accomplished to 3 1/2 degrees with a release from 2 degrees, damping was deadbeat. Then all augmentation was turned off and a release from 2 degrees sideslip damped to within 1/10 amplitude in 3 cycles. The static directional gradient was positive, and dihedral was only slightly positive. Augmentation was then engaged and the rudder pedal vibration returned, but was not as noticeable as that observed and felt at .95 Mn.

The tips were then lowered to 65 degrees and a mild nose-up trim change occurred and more power was required to maintain the Mach number. No lateral trim change occurred. The airplane handled satisfactory. Pitch augmentation was then disengaged and a pullup and release was accomplished--damping to within 1/10 amplitude in 3/4 cycle. All FACS were then disengaged in moderate turbulence (B-58 classified as light). In this turbulence the airplane demonstrated a mild neutral directional oscillation $\pm$ 2 degrees, and in trying to damp the oscillation it would only get worse. FACS was engaged, then disengaged, and the same trouble was encountered. No further data was obtained and FACS was engaged.

7.0 STABILITY AND CONTROL, 1.2 MN, 45,000 FT., WINGTIPS 1/2

Data was obtained of a pullup and release with pitch augmentation off; however, the run was repeated because only 1.15 G was obtained. Longitudinal damping was excellent being similar to that observed at 1.4 Mn. Then a sideslip was accomplished using right rudder to approximately 3 degrees, and during the end of this maneuver all controls were released from 2 degrees of sideslip to obtain directional dynamic data with yaw and roll dampers on. The resulting directional oscillation was essentially deadbeat after one-half cycle.

With all augmentation off, another steady state left sideslip was accomplished to 3 degrees. Then the rudder angle was reduced to stabilize at 2 degrees--all controls were released where at least 3 cycles were required to reduce to 1/10 amplitude. The period was long--in excess of 5 seconds. Still with all FACS off a windup turn to the right was accomplished.. The gradient was strongly positive and no shallowing was observed.

8.0 DESCENT

All throttles were retarded to IDLE, except 3 and 4 were maintained at 87 per cent, and a descent was begun. The wingtips were raised near .9 Mn, 27,000 ft., and a slight pitch down and no lateral trim change was observed. As soon as the outboard elevons were activated, mild lateral sensitivity became apparent, which the writer adjusted to in a very short time.

9.0 AIRSTARTS

After stabilizing at .8 Mn, 25,000 ft., data was obtained of engine No. 1 shutdown from an idle rpm of 65 per cent. After the rpm stabilized near 33 per cent, airstart was turned on and the throttle was moved to IDLE (C/N 4882) wherein the nozzle was observed to open up slightly. After 30 seconds the throttle was moved to OFF because of no airstart and the windmill rpm was observed at 31.8 per cent.

The speed was then increased to .9 Mn and two airstarts were accomplished at a windmill speed of 38 per cent with negative results. After the airstart ignition was cooled, the airstart switch was turned on at C/N 5491. The throttle was placed at IDLE (36 per cent windmill rpm) at 26,400 ft. Twenty-three seconds after the throttle was placed at IDLE, the engine accelerated rapidly with a slight increase in EGT and then the EGT went back down to 125°C. The engine was running stabilized at 65 per cent, but appeared to have an incomplete combustion start because of the low temperature; however, as the throttle was moved forward, the rpm responded normally indicating that it was a good start. The total temperature was 44°F during the start.

Between the first and second airstart attempts, a very mild pitching oscillation (2 second period) was observed while flying hands off. The data was turned on at C/N 5036, then as pitch augmentation was disengaged, the pitch oscillation disappeared.

10.0 LOW APPROACH AND LANDING

The landing gear and the flaps were lowered normally and one low approach was accomplished by attempting to fly within 10 ft. of the runway in order to get experience in height judgment. The approach was flown at 215-220 knots and the airplane appeared relatively easy to fly about all axes. Power response and speed control were excellent. No lateral-directional problems were encountered even though all augmentation was off. Due to light to moderate turbulence in the traffic pattern, the writer was somewhat distracted from his duties; but once it was learned that the excessive shake and motions in the cockpit did not disturb the airplane's flight path, the writer learned to ignore these motions. The wave-off was started with 28,000 lbs. of fuel remaining, and midway on the downwind 26,000 lbs. of fuel remained. At this point it was decided to make a full stop. Again, no difficulty was encountered in lining up with the runway and arriving at 210 knots just prior to flare just short of the runway. Power was reduced slightly and the flare was accomplished resulting in holding the airplane off near 3 ft. from the runway. Shortly after this, approximately 2,000 ft. down the runway, a normal touchdown occurred. The nosewheel was lowered to the runway and a slight bit of right rudder was required to maintain the center line. Rudder control was excellent. Rudders were centered which allowed a slight drift during nosewheel steering engagement. Braking was light and easy and no difficulty was encountered in bringing the airplane to a stop. Approach and landing visibility was good. After taxiing 3 1/2 miles from the end of the runway, one of the right hand tires (#6) blew out at approximately 10 knots just prior to turning into the run pad. This "explosion" shook the airplane considerably.

11.0 CONCLUSIONS

1. Brake chatter below 5 knots was unsatisfactory; however, considerable "babying" of the brakes was required to prevent classifying the brakes as unacceptable.
2. Continuous attention must be directed to the sideslip indicator with augmentation off, wingtips up, and above .85 Mn or excessive sideslip angles would result because of correcting the dihedral effect with aileron. The insidious part of the characteristic was that large sideslip angles would develop and the only feeling was one of lateral unbalance.
3. The airplane flies better with wingtips at 1/2 than with wingtips at full down at 1.4 Mn, 45,000 ft.
4. Longitudinal static and dynamic stability were excellent at all Mach numbers tested including landing and approach speeds.

5. Engine #1 was difficult to air start at 25,000 ft. requiring four attempts.
6. The airplane reacts excessively in light to moderate turbulence resulting in a rough ride.
7. Lateral control power was excessive with wingtips up.
8. Approach and landing characteristics were surprisingly very good.

12.0 RECOMMENDATIONS

1. That further investigation of the lateral-directional characteristics at high subsonic speeds with wingtips up be accomplished to determine at what lower speed the wingtips be lowered for routine normal flights. This investigation should include less than one G flight.
2. That lowering of the wingtips from one-half to full down be delayed to a higher Mach number.

13.0 DISCREPANCIES

1. Engine #3 stayed slightly above 1000°C for at least 5 seconds after lighting the afterburner.
2. Excessive rudder pedal buzz when yaw augmentation turned on .95, 32,000 ft.
3. UTL #2 fluid level decreased excessively during first part of flight to 110%.
4. Tank 1D would not feed in automatic.
5. Pitch augmentation demonstrated mild longitudinal oscillation at .9, 25,000 ft. and disappeared when pitch augmentation disengaged.
6. Mild steady pitching transient (nose-up) occurred when standby pitch trim cycled from ARMED to ALT ARMED to ARMED. Also, primary trim would not operate after cycling.
7. Tire #6 blew out while taxiing to run pad.

Van H. Shepard

Van H. Shepard
Pilot

Climbing with tips up through 25,000 ft., .88 Mn.

410 pulling power back; pushing nose down to go under a cloud.

Al: Look at your side slip, boy, look at your side slip.

Shep: I noticed that, Al. I started getting a lateral unbalance. Seems like the wing was getting heavy to me.

.95 Mn, 28,000 ft.

Al: Watch it! Watch it!

Shep: I'm not doing anything.

Al: Not quite so rough, Shep. Just go in real slow.

Shep: Do you fly mainly rudder, Al?

Al: Yea.

Al: Don't bang the rudder in against it or the aileron. Are you doing that?

Shep: No.

Al: Well I'm not either.

Al: Watch that aileron now. There is something screwy here. Turn the augmentation on. Put the wingtips down, put the wingtips to 1/2.

Shep: Feel that in the rudder. Is that nibble in the rudder normal?

Al: Seemed to me that thing was wallowing back and forth for no good reason.

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT A. S. White

FLIGHT NO. 2-7 COPILOT V. H. Shepard

DATE OF TEST 5 October 1965 FLIGHT TIME 1:40

CHASE AIRCRAFT AND PILOTS

Chase 1	TB-58 #662	-	Col. Cotton/Lt. Col. Fulton
Chase 2	F-104 #315	-	Capt. Gentry
Chase 3	T-38 #197	-	Maj. Sorlie/Schrader (NAA Photo)
Helicopter	H-21 #855	-	Maj. Honnaker
Rescue	C-130 #132	-	Col. Jacobs/Capt. Wolverton

PURPOSE OF FLIGHT

1. Automatic AICS operating during starts and unstarts, normal and low performance.
2. Checkout of the standby AICS.
3. Stability and control at 2.3 Mn.
4. Ram purge operation at Mach 2.
5. Airstarts at .8 Mn.

1.0 PREFLIGHT AND TAXI

After normal pilot preflight, engines were started at 1100 in preparation for a 1200 takeoff. The power-on preflight was normal; except that when the emergency generator check was made, both right-hand buzz lights were illuminated by the emergency generator. The phase voltages on the emergency generator were 116 volts on Phase A, 117½ volts on Phase B, and 118½ volts on Phase C.

Because of the wind conditions and the ramp location of the B-58 chase airplane, the airplane was taxied to Runway 22 for takeoff. During the brake check while taxiing out, the left-hand brake was grabbing and would not release immediately after pedal release causing some skidding of the tires on the left-hand bogie The tires were inspected prior to takeoff and found to be in satisfactory condition, although one layer of cord had been worn off.

2.0 TAKEOFF AND CLIMB

During the takeoff run the acceleration check showed the airplane 8 knots slow 37 seconds after brake release; however, it was decided to continue the takeoff. This discrepancy in performance is minor and is probably due to the slight up-hill direction of the takeoff. Lift-off occurred at 207 KIAS. The acceleration after

takeoff was slow compared to previous takeoffs; however, this was a warmer temperature than on the previous flights.

Immediately after takeoff, hydraulics and electrics were checked and found satisfactory and the gear and flaps were raised. At .6 Mn the wingtips were lowered to one-half and the data turned to continuous in order to record the action of the bypass doors and throats during the acceleration and climb. The acceleration and climb to 1.95 Mn was normal. The bypass doors and throats performed as per schedule. The details of this action will be covered in the copilot's report.

Power was reduced at 1.95 Mn in order for the copilot to set the right-hand duct to STANDBY in a safe condition before acceleration to 2.3 Mn where the left-hand duct was scheduled for the duct tests. After setting the right-hand AICS control mode to STANDBY, moving the throat to 2.1 Mn, and setting the bypass at 800 sq. in., power was again advanced and the airplane accelerated to 2.3 Mn at 55,000 ft. As the airplane accelerated, the left-hand throat apparently started just above 2.1 Mn. The right-hand throat apparently was started, but the shock position remained in the top of the green even though the bypass doors were opened to 1020 sq. in.

Upon reaching 2.3 Mn and just prior to going to low performance, the left-hand inlet unstarted. The unstart lights came on and both pilots heard and felt the unstart. The duct restarted automatically and the copilot reset the left-hand duct. Within a minute or so the left-hand duct unstarted again, and again the pilots saw the unstart light and heard and felt the unstart, and this time the VIBRATION HIGH light came on on engine #2. The engines were immediately checked and #2 engine was in an over-temp condition. All the throttles on the left-hand side were pulled to idle and #2 was shut down. The right-hand throttles were then reduced to military and the deceleration started. A third unstart light was encountered and this occurred as the airplane decelerated below 2.2 Mn.

Without benefit of close observation of the action of the bypass doors and throat ramps, the pilot was left with the impression that the system is not operating properly and that the copilot is unduly burdened with the operation of this automatic AICS, and that further development is needed before this system performs more reliably and efficiently than the manual system in Ship #1.

By coincidence, on both of the last two flights the automatic fuel sequencing has malfunctioned at approximately the same time as the inlet operation is taking place. In each case, tanks have ceased to replenish the sump tank and the sump tank was depleted and below the normal low sump level.

3.0 APPROACH AND LANDING

The return trip from 100 miles north of Elko, Nevada, was made at .9 Mn, 28,000 ft., and was uneventful. Approach and landing were normal and satisfactory.

4.0 DISCREPANCIES

1. Engine and ADS vibe indicators on #5 and #6 peak out intermittently at 60 to 70 per cent.
2. NH_3 and WATER light blinks during brake chatter and turbulence.
3. Tank 2B continues to feed with tank 4. Tank 4 will not hold high sump.
4. Fuel leaks back into Tank 2, keeping 1 and 7 OFF.
5. Fuel leaks back into 1C and stops 8B.
6. Tank 8A strip indicator is not synchronized with fuel used.
7. LH shock position indicator inaccurate.
8. LH bypass readout drifts.
9. Emergency generator checks at 118.5 V. on Phase C.
10. LH did not release immediately after pedal release.
11. #2 engine overtemp (1000+°C for unknown time).
12. U_2 hydraulic system reduced to 70 per cent (fluid quantity) at one time during flight.
13. BUZZ lights came on when emergency generator turned ON.

A. S. White
Aircraft Commander

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT A. S. White

FLIGHT NO. 2-7 COPILOT V. H. Shepard

DATE OF TEST 5 October 1965 FLIGHT TIME 1:40

1.0 TAKEOFF

The takeoff acceleration was eight knots short at the allotted time required for 150 KIAS. The takeoff was continued as a margin of 10 knots was arbitrarily decided upon before aborting. Remaining part of the takeoff on Runway 22 was normal, but acceleration after unstick appeared slow.

2.0 AUTOMATIC AICS - 0.6 to 1.95 MN

Near .6 Mn, the reset switch was pressed, then AUTO was selected. No transients were observed. Both throats started scheduling at 1.12 Mn and the left bypass readout was observed drifting open near 60 sq. in. At 1.43 Mn the left bypass started opening from 90 to 470 sq. in. The right opened shortly thereafter to 360 sq. in. The remaining part of the acceleration was normal. Throats were observed at 1.95 and 1.96, left and right, at 1.95 airplane Mn.

3.0 LH INLET AUTOMATIC START AND SHOCK CONTROL

The RH inlet was placed in STBY at 1.95 Mn and was manually positioned to 2.1 Mn and 800 sq. in. The LH inlet was checked at AUTO-NORM and the acceleration was started. LH bypass was observed opening near 2.1 Mn to 860 sq. in., then decreased to near 820 $\pm$ 20 sq. in.; however, the shock was bottomed out. The right shock was observed oscillating in the upper green and the RH bypass was opened to 1080 sq. in. to prevent an unstart; however, there was little effect on the shock position.

The LH inlet appeared to be on shock control at 2.22 Mn as the bypass was oscillating 680 to 720 sq. in. The throat also was oscillating. At 2.3 Mn the left inlet was closed by selecting a minus one inch with the deviation knob. It was difficult to see a throat change because of throat oscillations; therefore, the deviation was returned to zero, then reapplied. The throat appeared to close from 2.28 to 2.33 Mn. A turn was commenced during the setting of the deviation; and while waiting for the airplane to steady out in a constant bank angle, the left inlet unstarted.

4.0 LH INLET AUTOMATIC RESTART

The left inlet restarted immediately and stabilized at 1340 sq. in. and 1.93 throat Mach number. Engines were normal and the unstart light was extinguished. The AICS reset light was then pushed and the inlet returned toward schedule. Another unstart occurred and both bypass and throats appeared to travel in the wrong direction; i.e., throat kept closing, the bypass closed. Moderate buffet was felt as bypass was closing through 400 sq. in. The bypass then started opening at slow rate. Shortly thereafter, the pilot indicated trouble with #2 engine. As the pilot shut down the engine, STBY was selected on the LH inlet and the doors opened rapidly to 2200 sq. in. Doors were then closed to 800 sq. in. and the deceleration was started with both inlets in STBY.

5.0 FUEL MANAGEMENT

The same trouble was encountered as on the previous flight; i.e., excessive time was spent in trying to determine why the automatic sequence was not being followed. Some of the problems noted were: (1) Tank two feeds ahead of strip 4B. (2) Tank five would not feed automatically. (3) Tank seven shuts off prematurely. (4) Fuel leaking back into tanks two and one shuts off tanks seven, one, and eight. In fact, only two strips out of ten fed properly in automatic.

6.0 PRIMARY HYDRAULIC PUMP STATUS LIGHTS

With one engine shut down, the other two primary pump status lights blink all the time during the approach phase of the flight. This keeps flashing the master caution lights and was very annoying. The low pressure actuation point on the pumps should be lowered to near 1500 psi to prevent this light flashing in light turbulence.

7.0 CONCLUSIONS

1. Both shock position indicators are erratic and inaccurate.
2. Automatic restarting appeared to function satisfactorily.
3. Automatic downstream shock control appeared to control satisfactorily with no engine problems with throat opened seven inches from normal schedule.
4. Throat appeared to oscillate excessively during NORMAL shock control.
5. Automatic inlet displayed wild gyrations shortly after the reset switch was pushed and appeared to travel in the wrong direction upon receipt of the second restart.
6. Bypass doors travel at excessive rates when standby mode was selected.
7. Low pressure hydraulic pump status light actuation point should be reduced to near 1500 psi.

8. Manual fuel sequence would require much less time than that required to operate this fouled-up automatic system.

8.0 RECOMMENDATIONS

1. That the data obtained be studied thoroughly before next flight and the necessary changes be made to prevent an overtemperature on another engine.
2. That manual fuel sequence be utilized until the fuel system is remedied.

Van H. Shepard
Copilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT A. S. White

FLIGHT NO. 2-8 COPILOT V. H. Shepard

DATE OF TEST 11 October 1965 FLIGHT TIME 1:55

CHASE AIRCRAFT AND PILOTS

Chase 1	TB-58 #662	-	Col. Cotton/Lt. Col. Fulton
Chase 2	F-104 #315	-	Capt. Evenson
Chase 3	T-38 #197	-	Maj. Sorlie/Schrader (NAA Photo)
Helicopter	H-21 #855	-	Capt. Flannagan/Maj. Honnaker
Rescue	C-130 #132	-	Col. Fetty/Capt. Fredricks

PURPOSE OF FLIGHT

To perform:

1. Inlet starts and unstarts (normal and low performance)
2. Ram purge operation
3. Subsonic airstarts

1.0 PREFLIGHT AND TAXI

The preflight for a scheduled 1230 takeoff was delayed due to High Range and TM availability. Engine starts began at 1207 and were satisfactory, except for engine #2 which failed to ignite on the first two attempts. Airstart ignition was used on the third attempt. The engine started, but the initial peak EGT was 710°C.

After engine starts had been accomplished and control systems checked out, the hydraulic fluid levels were serviced. After removal of the hydraulic GPU's, the P_2 and U_2 fluid levels slowly decreased to approximately 70 per cent less than the original serviced levels. Since both of these systems use the same cockpit gauge, it appears that there is an error in the gauging system. The GPU's were reconnected and the levels raised to their original values for flight. This required releasing N_2 head pressure in both systems.

During the taxi phase the airplane pulled to the right slightly, even though the TTO button was actuated and the ground crew reported the rudders streamlined before the start of taxi. Apparently the zero nosewheel position does not correspond with zero rudder position.

The brake chatter encountered while stopping on the runway was moderate and appeared to be coming mainly from the left gear.

2.0 TAKEOFF AND CLIMB

When Mil Power was selected for the engine check, #2 engine went through a temperature transient as if the A/B was lit. The throttle was reduced slightly and then placed back at the Mil Power detent. The transient did not occur again. This may have been caused by a rigging problem in the quadrant.

The temperature for takeoff was approximately 90°F. Handbook data indicated that the airplane should accelerate to 150 KIAS in 38 seconds from brake release with the engines in overspeed (104 per cent). Maximum A/B was used for the takeoff, but overspeed was not used. The acceleration check showed the airplane at 140 KIAS at 38 seconds; however, since the engines were apparently operating normally, the takeoff was continued. For future use, the pilots should have an accurate airspeed calibration, handbook data for 100 per cent engine RPM, or should use the overspeed provisions when hot day conditions exist.

Rotation began at 185 KIAS and the airplane flew off the ground at 207 KIAS.

The initial climb to 32,000 ft. was normal. Tank 8R had picked up considerable fuel during the engine run, taxi, and early flight phases, and this was apparent in the lateral trim of the airplane. With the wingtips at the one-half position, the rudder trim was out slightly also.

The acceleration climb was stopped at 1.95 Mn while the RH duct was placed in STBY with the throat at 2.1 and the bypass doors at 800 sq. in. The throttle angle caused the airplane to accelerate and the pilot was hesitant to reduce throttles to the minimum A/B stop because of the minimum A/B instability.

3.0 MISSION TESTS

3.1 AICS OPERATION

The detailed operation of the inlet ducts will be described in the copilot's report; however, the pertinent pilot observations and opinions are presented herein. The longitudinal trim changes associated with the automatic operation of the bypass doors are much more disturbing during the automatic operation in Ship #2 than during the manual operation of the doors in Ship #1. This is apparently due to the fact that the trimmer doors move to the extreme positions at a high rate.

The magnitude of the copilot's workload (fuel system management and AICS operation) and the short allowable time in an engine overtemp condition make it mandatory for the pilot to concentrate his attention on engine parameters during the inlet tests.

The above conditions, coupled with the fact that it is very important for the pilot to maintain zero sideslip during the inlet tests, load the pilot down to the point that navigation becomes a burden. The lack of horizon visibility increases the difficulty of airplane flight path management--particularly in turns, since the operation of the ducts causes random airplane disturbances and the pilot's attention is necessary concentrated on the engine instrument. It is suggested for future flights that the critical inlet tests be reserved for the straight line portions of the flight plan, if at all possible.

3.2 RAM PURGE OPERATION

The ram purge operation was programmed for Mach 2 at 55,000 ft.; however, upon decelerating to that Mach number, the inlet ducts had not yet unstarted and the deceleration was continued because the pilot did not desire to be doing a ram purge test at a critical point in the inlet duct operation. The cabin air switch was placed in the PURGE position at 1.9 Mn. The cabin altitude stabilized at 28,000 ft. The cabin air switch was placed in the REPRESSURE position, and just below 1.8 Mn, the scoop closed and the cabin pressurized normally.

3.3 SUBSONIC AIRSTARTS

The airplane was stabilized at .8 Mn at 25,000 ft. and #5 engine was shut down. The rpm on #5 engine stabilized at 29½ per cent and an airstart was attempted. The technique used was airstart switch ON, throttle to IDLE for 30 seconds. No light occurred. Throttle OFF, airstart switch OFF for 15 seconds. This procedure was repeated until the airstart switch had been on for a total of 90 seconds, after which a two-minute cooling period was required. The engine did not start in these three attempts. The speed was then increased to .9 Mn at 25,000 ft. and three more attempts using the same technique were unsuccessful. The airplane was then descended to 20,000 ft. holding .9 Mn, and at 20,000 ft. one more attempt to start the engine was unsuccessful, since the sump tank level was below 21,000 lbs. At this time it was decided to discontinue the airstart attempts, although one more attempt was made during the descent at approximately .7 Mn between 12,000 and 11,000 ft. RPM at that time was down to 22 per cent on engine #5.

4.0 APPROACH AND LANDING

The landing was made with #5 engine out and without altitude call-out from the chase airplanes. The drag chutes were deployed when the nosewheel was lowered and appeared to work satisfactorily. Brakes and nosewheel steering were satisfactory except for mild brake chatter below 20 knots and just prior to turning off the runway.

While taxiing in, engines #1 and #6 were shut down so that the airplane was parked on the engine run pad with engines 2, 3, and 4 running. The stop on the engine run pad was absolutely smooth; i.e., no brake chatter. This is the first time the airplane has ever stopped without some brake chatter. The reason is unexplainable at this time, but delightful to encounter.

5.0 DISCREPANCIES

1. Engine #2 required airstart ignition to start on ground (710° initial peak).
2. Cabin temp mode selector needed to be cycled before operation.
3. P_2 and U_2 quantity decreased about 70 per cent after GPU's removed.
4. In TTO position (rudders neutral) pilot is required to hold slight left rudder to maintain straight path on runway.
5. Attitude indicators jitter $\pm 1^{\circ}$ throughout flight.
6. Tank 8R filled during flight, causing wing heavy condition until Tank 8 fed out.
7. Utility status light on #1 engine on during latter part of flight. Could not reset master caution light.
8. LH shock aft light rigged too close to bypass closed position.
9. RH bypass doors drifting open after going to STBY during latter part of flight.

A. S. White
Aircraft Commander

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT A. S. White

FLIGHT NO. 2-8 COPILOT V. H. Shepard

DATE OF TEST 11 October 1965 FLIGHT TIME 1:55

1.0 TAKEOFF

Takeoff fuel was observed at 237,000 lbs. Takeoff acceleration check was 10 knots below target using Runway 4. Time was calculated using overspeed (104 per cent) handbook data; however, the takeoff was accomplished using 100 per cent, which would account for a part of the discrepancy. Instrument correction and position error were not applied.

2.0 AUTOMATIC AICS CLIMB

Automatic AICS was selected on both inlets near 0.6 Mn. No transients were observed. Throats started scheduling at 1.11 and 1.13 Mn, left and right respectively. Bypasses opened to 370 and 400 sq. in. at 1.42 and 1.46 Mn, left and right respectively. Both throats were reading 1.96 Mn at 1.95 airplane Mn. The right inlet was then placed in STBY and the throat was closed manually to 2.1 Mn and the bypass was opened to 800 sq. in., which bottomed the shock. The right inlet started at 670 sq. in.

3.0 AUTOMATIC SHOCK CONTROL - LH INLET

The airplane was accelerated from 1.95 Mn with the left inlet in AUTO-NORM and +2.0 deviation applied to the throat. Throat was observed at 1.83 just above 1.95 Mn. The bypass started opening at 2.05 Mn and the shock started moving aft. The maximum area observed was 880 sq. in. and shock control was evident as the doors oscillated slowly (5-10 second period, ± 10 sq. in.) around 850 sq. in. Shock position was in the yellow (.65 - .70 SPR). At 2.25 airplane Mn, the left shock was observed slightly above 0.7 SPR with the bypass near 740 sq. in. and the left throat was oscillating from 2.13 to 2.18. The left throat deviation was decreased to + 1.6, then shortly thereafter to + 1.3 to keep the throat within 0.1 airplane Mn.

With the bypass controlling the shock (680 - 720 sq. in.) from the normal manifold, LOW was selected. The throat opened moderately fast and deviation was removed. The bypass opened slowly and stabilized. The following were observed during left inlet downstream shock control test:

Throat Deviation	Throat Mn	Bypass-Sq.In.	Remarks
0	2.15	1100 ± 10	
+1.0		1200	
0			Shock Pos.Top XXX(.4 SPR)
-1.0	2.23	1045 ± 5	2.30 Airplane Mn
+1.0		1150 - 1190	

NORMAL was then selected and the bypass closed slowly while the throat closed faster. Normal shock control was satisfactory and the deviation was increased to + 1.4--throat readout 2.21 and bypass was 790 to 820 sq. in. Deceleration to 1.95 Mn was accomplished using this + 1.4 throat deviation.

During the deceleration, the right bypass was opened from 800 to 950 sq. in. to reposition the shock from .72 to near .4 SPR. This was done to prevent an unstart.

The left bypass opened at 2.02 Mn, taking the inlet off shock control. The inlet unstarted at 740 sq. in. and the fixed bypass reading was 620 sq. in. (Should have been near the original 370 sq. in. bypass area.) The left inlet was then placed in STBY. Throat and bypass were manually adjusted to 2.1 Mn and 910 sq. in. The left inlet started at 780 sq. in. The right inlet was manually reset to 1.95 and 410 sq. in., then AUTO was selected.

4.0 AUTOMATIC SHOCK CONTROL - RH INLET

The airplane was then reaccelerated from 1.95 Mn with right deviation set at + 1.5. The right inlet started at 2.12 Mn when the bypass opened. Automatic shock control was observed when the bypass decreased from a maximum of 870 to 850 ± 20 sq. in. The shock position was in the yellow (.65 - .70 SPR). The right throat deviation was decreased to + 0.9, then shortly thereafter to zero deviation to maintain the throat within 0.1 airplane Mn. At 2.25 Mn, the right throat was 2.15. At 2.29 Mn, the left shock was observed at .55 SPR with a fixed 910 bypass, and the right shock was being controlled at .68 (top yellow) SPR with 650 sq. in. of bypass area.

LOW performance was then selected and both the throat and the bypass opened. Satisfactory and stable downstream shock control was observed in the right inlet. The following were observed:

Throat Deviation	Throat Mn	Bypass-Sq.In.	Remarks
0	2.12	1080	Light buffet
+1	2.08	1150 ± 15	Shock position 0.3 SPR 2.30 Airplane Mn
0		1090	Shock position 0.42 SPR
-1	2.18	950 ± 10	Shock position .35 - .40
+1.1		1120	

Normal mode was then selected and the shock was observed being controlled near .68 SPR and the throat readout was 2.19 at 2.31 airplane Mn. Throat deviation was decreased to + 1.0 and the deceleration was begun. The airplane decelerated slowly using 70-degree throttle angle. The left bypass was opened from 910 and the shock was placed in the XXX. Engines 2 and 3 were then retarded to military, then shortly thereafter engine #1 was retarded to military. Acceleration was still slow.

The right inlet returned to a fixed bypass of 440 sq. in. near 2.0 Mn, then the right was placed in STBY. The throat and bypass were manually adjusted to 2.1 and 950 sq. in. Shortly thereafter the RH SHOCK AFT caution light illuminated, and the light was extinguished by closing the bypass to 840 sq. in. near .42 SPR. The shock aft position did not affect the engines.

5.0 AUTOMATIC SHOCK CONTROL - LEFT INLET

The left inlet was rigged and AUTO was selected at 1.95 Mn. The acceleration was then started and automatic shock control on the left inlet was observed with the bypass controlling the shock at .63 SPR (top green) with 680 to 700 sq. in. The throat was reading 2.15 at 2.19 airplane Mn with zero deviation.

At 2.3 Mn, the bypass was controlling on the normal manifold at 580 sq. in., then LOW was selected. Excellent downstream shock control was observed at 920 sq. in. of bypass and the throat opened to 2.22 Mn. Normal was selected at a C/N 3852. The throat closed to 2.33 and bypass was reading 600 sq. in. controlling the shock at .63 SPR--airplane Mn was 2.33.

6.0 UNSTART

With the airplane stabilized out at 2.3 Mn, at 55,000 ft., left throat deviation was decreased until an unstart was observed at 2.38 throat Mn. Deviation was increased to zero. The bypass opened slowly and controlled the shock satisfactorily at the downstream shock position. The unstart light remained on. Then the throat was opened further with the deviation knob and the unstart light extinguished at + 2.6 deviation. The left throat indicated 2.17 Mn. No change in engine operation or performance was observed. At this point, the reset switch was pushed and the AICS reset light extinguished. The bypass closed slowly, positioning the shock toward the forward manifold. Deviation was reduced to zero. Inlet stabilized out at 2.28 Mn and 670 sq. in. bypass.

A right turn was started toward Edwards AFB and as the bank angle increased to 32 degrees, the left-hand throat deviation was increased to + 1.0 to give the left inlet more unstart margin. This deviation was removed as the airplane rolled out of the turn.

Another unstart was accomplished by decreasing the throat deviaton. As the unstart light illuminated, 2.37 throat Mn was observed. As the bypass door opened near 700 sq. in., the deviation was increased momentarily, then decreased back toward the original unstart position. At 800 sq. in., all of the deviation was taken out. Then the deviation was increased further to + 2 and the inlet started with the throat reading 2.1 Mn and the bypass reading 1000 sq. in.

LOW performance was then selected, and as the throat opened (an unexpected result) the deviation was decreased to zero. With the deviation at zero, the throat read out at 2.20 Mn and bypass indicated 1010 sq. in.

Still at 2.30 airplane Mn, the reset switch was then pushed and the AICS reset light extinguished; however, the throat did not change. Bypass maintained control of the shock at the downstream position.

The following downstream shock position tests were accomplished with increasing bypass door angles:

Throat Deviation	Throat Mn	Bypass-Sq.In.	Remarks
+1	2.17	1040	
+2	2.11	1120	
+3	2.07	1230	Mild Buffet
+3.6	2.02	1280	Light Buffet
0	2.31 - 2.34	-	

At this point NORMAL performance was selected and the bypass closed to 640 sq. in. and controlled the shock at .63 SPR (top of the green). The throat settled out at 2.32 at 2.31 airplane Mn.

7.0 STANDBY to AUTOMATIC - RH INLET

With the right bypass near 850 sq. in., AUTOMATIC was selected on the right inlet at 2.32 airplane Mn. The bypass door closed at high rate to 630 sq. in. and controlled the shock on the normal manifold. During this high rate bypass closure, the pilot remarked that #6 EGT pulsated but stabilized out. The right-hand throat was observed at 2.28 Mn, and shortly thereafter was observed at 2.34 Mn. The right-hand deviation knob was increased to +0.8, which placed the right throat approximately .01 lower than the airplane Mn. Then the right-hand standby electrical switch was held in the closed position for one second. No change in bypass area was observed (as was advertised). Shortly thereafter, at 2.33 Mn, the bypass was observed controlling the shock around 640 and 620 sq. in., left and right respectively. The throats were 2.30 and 2.26 (this indicated the right throat had drifted open .05 Mn).

A military power deceleration was then commenced. At 2.05 Mn, the bypasses were 900 and 740 sq. in., left and right, with the shocks in the top of the green. The left inlet went off of shock control at 2.0 Mn and stabilized out at 630 sq. in. At 1.75 Mn, the right inlet still appeared started with the shock in the green. The right bypass was closed from 750 to 630, which then unstarted the inlet.

8.0 INLET SUMMARY

Automatic starting of the inlets near 2.05 Mn was satisfactory with good bypass control and response. The shock stabilized at the normal manifold and very little overshoot was observed.

Shock control was excellent both at the normal manifold and at the downstream shock position (LOW performance). Control and response were good; however, a random continual long period (10 seconds) oscillation of ± 10 to 15 sq. in. of the bypass doors was observed at both positions. On the normal manifold the shock oscillated slightly ± .01 SPR - 1 second cycle). On LOW performance, shock position could not be observed as the shock position instrument was bottomed out and essentially did not move. Except for the random oscillation of the bypass, the operator had a feeling of operating in the blind when the shock was being controlled downstream. Control in transferring from Normal to Low or Low to Normal was excellent with very little overshoot; and transfer was slow, which was a desirable trait.

Unstarts at 2.3 Mn were as planned. The throat unstart line was approximately .07 Mn or $1\frac{1}{2}$ inches closed from the normal schedule and the throat restart line was approximately .13 Mn, or $2\frac{1}{2}$ inches open from schedule. Transfer to and from downstream shock position was orderly and with minimum overshoot. Manual operation of the throat during unstarts and restarts was as expected and easy.

Engine operation with a downstream shock and extreme bypass door open positions was normal and uneventful. Only light buffet was felt.

Exhaust gas temperature fluctuated on engine #6 during a high rate closing of the bypass doors. High rate opening of the doors was not encountered during this flight, but must be investigated carefully on a subsequent flight.

9.0 INLET CONTROL SWITCHES

The performance switch was not locked in any of its three positions. In order to prevent inadvertent actuation of HIGH performance, the switch should be locked out of HIGH--requiring two actions before HIGH can be selected.

10.0 FUEL MANAGEMENT

Automatic fuel sequence was utilized and the system was much improved over the two previous flights. This was essentially accomplished by filling tank #6 full and switching tank #1 on after tank #2 emptied. Further improvement could be realized if fuel was not used from tank #6 on the ground. Twenty-five thousand pounds were used from tank #6 before takeoff. Later in the flight this demanded a high flow from tank #4 after tank #6 emptied prematurely. This enabled tank #2 to feed with tank #4.

Periodically tank #8 had to be manually switched on to keep its level at 10,000 lbs. because of a faulty level control valve in the right tank.

11.0 CONCLUSIONS

1. Automatic inlet shock control was satisfactory at both the normal manifold and downstream shock positions.
2. Bypass door slow rate was excellent and did not affect the engines.
3. Bypass door high rate in the closing direction affected engine #6.
4. Downstream shock control (.55 instead of .50 downstream ratio) did not affect the engines even with large door areas.
5. Automatic fuel sequencing was much improved over the previous flight.
6. Takeoff should be accomplished with tank #6 full in order to reduce the feeding of fuel from tank #2 when tank #4 feeds.

V H Shepard

V. H. Shepard
Copilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. H. Shepard

FLIGHT NO. 1-20 COPILOT A. S. White

DATE OF TEST 12 November 1965 FLIGHT TIME 2:25

CHASE AIRCRAFT AND PILOTS

Chase 1	-	TB-58 #662	-	Lt. Col. Fulton/Maj. Benefield
Chase 3	-	T-38 #194	-	Capt. Hoag
Rescue	-	C-130 #131	-	Col. Fetty
Helicopter		H-21 #389	-	Capt. Vasquez

PURPOSE OF FLIGHT

1. Pilot checkout
2. AICS bypass door variation with throttle setting
3. Performance
4. Airstarts at 1.4 and 1.3 Mns, 35,000 ft.
5. Airspeed calibration (pacer)

1.0 TAXI

Taxi was normal. The airplane tended to accelerate very slowly using idle power on all six engines. Brakes were used very gingerly to prevent taxi speed from exceeding 20 mph and very little chatter was observed. It was difficult for the pilot to feel small decelerations upon brake application; and unless he paid special attention to the change in deceleration, the pilot had no control over the brake chatter. Excessive care had to be used in stopping the airplane or excessive brake chatter would occur below 5 mph. Consequently, distances in the neighborhood of 300 to 400 ft. were required to stop the airplane to prevent unacceptable brake chatter.

2.0 TAKEOFF AND CLIMB

Takeoff speed was computed to be 203 knots, and seven knots were added to the handbook number for the actual indicated takeoff speed of 210 knots. Acceleration was satisfactory, and at 190 KIAS the nose was placed on the horizon. Lift-off and acceleration were normal and no lateral overcontrol was experienced. After gear and flaps were retracted the airplane was accelerated to 400 knots, wingtips were lowered to one-half, and the climb was continued at .95 Mn to 37,000 ft. through several thin layers of clouds using maximum A/B power. While attempting to obtain level flight acceleration performance data to 1.4 Mn, the altitude had to be varied because of the cloud layer near 37,000 ft. The acceleration was very slow at 37,000 ft.

Clearance was received to descend to 35,000 ft. in order to improve the acceleration; however, the descent had to be stopped near 36,500 ft. and a climb made back to 37,000 ft. because of the clouds.

After the airplane reached 1.3 Mn, the wingtips were lowered to 65 degrees. Then the acceleration was rapid to 1.8 Mn, at which time the #4 generator failed.

Since the generator could not be brought back on the line, the airplane was turned around and flown back to the Edwards area at supersonic speed. All tests were aborted except the airspeed calibration.

3.0 AIRSPEED CALIBRATION - PACER

The following clean, wingtips one-half, airspeed pacer points were obtained utilizing F-104 #748:

RUN	AIRSPEED-KIAS VSI	AIRSPEED-KIAS STBY	ALTITUDE-FT VSI	ALTITUDE-FT STBY	PACER A/S (KIAS)	PACER ALT (FT)	REMARKS
1	-	403.5	27,130	-	383	25,700	.97 Mn
2	-	382.5	26,040	-	359	24,930	
3	333	339	26,750	26,820	320	25,860	
4	295	299	28,240	28,340	282	27,570	Light Buffet
Low approach configuration - gear and flaps down							
5	267.5	263	11,850	11,960	253.5	11,550	
6	238	228	10,830	10,940	218.5	10,610	
7	209	202	10,110	10,250	192.5	9,940	9.5α
8	187.5	182	9,340	9,460	173	9,280	Light Moderate Buffet

All of the above runs were well stabilized in airspeed and altitude. The above data indicates a large static pressure error and should be investigated thoroughly as No. 2 XB-70 error is much less.

4.0 AIRSPEED CALIBRATION - TOWER FLYBY

Two tower flyby runs were attempted; however, due to turbulence, the airspeed was not stabilized. On the first run the altitude was well stabilized at 2400 ft. and the airspeed varied from 261 to 258. On the second attempt the altitude was well stabilized during the first part of the run at 2360 ft. and the airspeed varied $\pm$ 4 knots around 220. This run was considered no good and further attempts were not accomplished.

5.0 LANDING

After one low approach resulting in a runway flyby of 10 to 15 ft., the pattern was set up for the final landing. The airplane flew very

well at 250 knots on the downwind and there was essentially no turbulence. No problems with sideslip were encountered; however, it was noticed that less sideslip developed if considerable rudder was used in turn entries. The approach was flown from 205 to 215 knots with no difficulty encountered in maintaining good airspeed control. Just short of the runway the power was reduced and the airplane was leveled off near 3 to 4 ft. with chase helping by calling out airplane wheel height. The landing appeared to be satisfactory and the writer could feel the touchdown. The airplane was stopped on the runway and data was obtained to correlate the tower flyby pressure altitude.

6.0 LATERAL DIRECTIONAL CHARACTERISTICS

This airplane appeared much easier to fly than No. 2 XB-70, in that sideslip excursions appeared less. Even though the sideslip excursions were near $\pm 1\frac{1}{2}$ degrees in the low-speed range and ± 1 degree in the high subsonic range, this pilot found that he did not have to use extreme care in maintaining sideslip. Whereas in No. 2 when the airplane tended to sideslip near two degrees, the pilot would feel a lateral unbalance and would unconsciously apply aileron which increased the sideslip further. This was not the case in No. 1 airplane. The reason for the small continual random oscillation in sideslip at all speeds--especially subsonic--was not discovered, for on several occasions the sideslip was wandering around with hands off the ailerons.

While accelerating near 1.05 to 1.1 Mn, step inputs of the sideslip needle of near two degrees were observed and near one-third rudder was required to center the sideslip. However, on one occasion while holding this rudder, with the sideslip needle centered, the ball was one-third deflected in the other direction.

Lateral trim had to be used only once during the flight and this trimming was difficult because of essentially no friction in the knob resulting in no feel. The sensitivity with tips up or one-half tips appeared excessive in the subsonic speed range. Frictional feel in the knob would probably improve the apparent high sensitivity.

7.0 CONCLUSIONS

1. Airspeed and altitude error are excessive and should be investigated, since No. 2 airplane does not exhibit this magnitude of error.
2. Lateral-directional characteristics of No. 1 airplane are superior to No. 2 airplane at all subsonic speeds.
3. Roll trim friction was essentially nil.
4. The production ADI ball (sideslip) is an inferior instrument because of stickiness, being hard to see, and general quality is not up to flight test standards. (A good inchinometer should be installed.)

5. Brake chatter still exists and borders on being unacceptable.

8.0 DISCREPANCIES

1. Pitch trim transient upon engaging augmentation at .85 Mn.
2. No. 5 tachometer stickey
3. No. 5 four-joule ignition inoperative
4. No. 2 primary pump went directly in pumping mode at EDV (35%)
5. Yaw meter has a step input near 1.15 Mn
6. Pitch augmentation disengaged near 1.1 Mn, re-engaged OK
7. No. 4 generator inoperative
8. Tank 6 did not turn tank 4 on. Had to use manual.
9. Flaps would not retract on first two attempts after landing.

Van H Shepard

Van H. Shepard
Pilot

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. H. Shepard

FLIGHT NO. 1-20 COPILOT A. S. White

DATE OF TEST 12 November 1965 FLIGHT TIME 2:25

1.0 PREFLIGHT AND TAXI

During the weather briefing prior to pilot's preflight, it was decided to change the route of flight due to poor weather conditions north of Edwards. The flight was delayed due to the change in flight plan.

After a normal pilot preflight, all six engines were started without difficulty. On the first attempt to start engine #5, it did not ignite and the airstart ignition was used successfully on the second attempt. Immediately after engine start, #4 generator was turned on and the ground power unit went to standby. When #3 generator was turned on, #4 came off the line and the airplane went back to ground power. No. 3 was turned off and the cycle repeated, and on this attempt the generators paralleled and both stayed on the line. The remainder of the systems checkout and the taxi were satisfactory.

2.0 TAKEOFF AND CLIMB

Brakes were released for takeoff at 0927. Rotation occurred at 190 and the airplane flew off the ground at 210 KIAS. Gear and flaps were raised immediately and the tips lowered to the one-half position at 300 knots. When the augmentation was engaged at 28,000 ft., .85 Mn, an abrupt nose-up trim change occurred. This pitch trim change has been occurring when the augmentation was engaged on previous flights; however, this was the most abrupt trim change to date.

Due to the flight planned route, it was necessary to depart SOA ALFA at 37,000 ft. A circle was made within SOA ALFA in order to comply with this requirement. Upon reaching 37,000 ft. a level flight acceleration was attempted. The rate of acceleration was extremely slow at this altitude.

During the acceleration the anti-collision light turned off and retracted automatically at approximately 1.1 Mn. At approximately 1.4 Mn the pitch augmentation disengaged and was re-engaged without a transient.

The airplane was then climbed to 45,000 ft. and 1.8 Mn.

3.0 MISSION TESTS

While setting up for the AICS tests at 1.8 Mn, the #4 generator dropped off the line. Several attempts were made to reset the generator, but they were unsuccessful. It was decided at this time to return to the local area near Edwards for reduced environment tests. A left 180-degree turn was made holding 1.8 Mn in order to give the pilot some experience with the airplane's handling qualities at this speed and then speed was reduced to 1.4 Mn. After re-entering SOA ALFA, a deceleration and descent was made to subsonic speeds for a pacer airspeed calibration. During the descent and deceleration the anti-collision light extended at 1.08 Mn.

Four pacer airspeed calibration points were accomplished in the clean configuration between 26,000 and 28,000 ft. and speeds between 300 and 400 knots. The airplane was then decelerated and the gear and flaps lowered. The yaw augmentation was turned OFF; however, pitch and roll augmentation were left ON. Four pacer airspeed calibration points were accomplished at approximately 10,000 ft. from 270 knots down to 182 knots. The 182-knot point was the minimum touchdown speed of the gross weight of the airplane at that time.

Subsequently, two tower flyby runs were made in the landing configuration at 260 knots and 220 knots; however, the data was not considered good due to turbulence.

4.0 APPROACH AND LANDING

One low approach to the runway was made for pilot proficiency reasons prior to the final approach and landing. The touchdown occurred at approximately 180 knots and the landing was excellent. The landing was made with pitch and roll augmentation ON, yaw augmentation OFF. All three chutes deployed and the airplane was stopped with light braking.

5.0 SUMMARY

Mr. Shepard handled the airplane in all phases of flight in an excellent manner and was subsequently signed off as having completed the initial qualification as pilot of the XB-70A.

A. S. White
Copilot and Aircraft Commander

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 PILOT Col. J. Cotton

FLIGHT NO. 1-21 COPILOT V. H. Shepard

DATE OF TEST 18 November 1965 FLIGHT TIME 2:02

CHASE AIRCRAFT AND PILOTS

Chase 1	-	TB-58 #662	-	Lt. Col. Fulton/A. White
Chase 2	-	F-104 #315	-	Maj. Sorlie/Boswell (NAA Photo)
Chase 3	-	F-104 #748	-	Capt. Roosa
Rescue	-	C-130 #132	-	Maj. Barrett/Capt. Kurowski
Helicopter		H-21 #389	-	Capt. Otto
WX Check		T-33 #663	-	Capt. Fredericks

PURPOSE OF FLIGHT

1. Level flight performance at .95 Mn, 35,000 ft. and 1.6 Mn, 41,000 ft.
2. Inlet Airflow Calibration
3. Engine Airstarts 1.4 and 1.3 Mn at 35,000 ft., .9 Mn at 25,000 ft.
4. Engine acceleration and deceleration tests at 1.4 and 1.3 Mn, 35,000 ft.

1.0 LEVEL FLIGHT PERFORMANCE, 35,000 FT.

The pilot stabilized the airplane at .95 Mn with the wingtips at one-half, nose ramp down, and flew for approximately four minutes in level flight while adjusting the power for the stabilized point. During the last minute the speed was fairly well stabilized from 327 to 330 KIAS at 35,600 ft. While stabilized, the B-58 read 320.5 KIAS at 34,550 ft. Since the data was obtained on an IFR flight plan, the XB-70 flew at a calibrated altitude of 35,000 ft. as determined by the B-58. During the stabilized run, engines 1, 2, 5, and 6 were near 85-degree throttle angle and engines 3 and 4 were near military power. The copilot's angle of attack was observed at $5\frac{1}{2}$ degrees.

The nose ramp was raised and maximum A/B selected on all engines. A level flight acceleration was accomplished to 1.4 Mn. Altitude control was good during this run.

2.0 BYPASS AIRFLOW CALIBRATION

After stabilizing at 1.8 Mn, 45,000 ft., the left bypass was opened to position the shock position needle at .75 pressure ratio. This shock position required 520 sq. in. The following data was obtained by retarding engine #1 throttle to idle in increments, then with #1

at idle, #3 throttle was retarded in increments to idle. All other engines remained at 100 per cent in A/B. While engines were being retarded, the shock was maintained at a .75 pressure ratio by opening the left bypass. Data was obtained at a constant shock position of .75 pressure ratio on all runs.

No. 1	No. 3	Left Bypass Sq. In.	Remarks
90	100	770	1.76 Mn, 45,800 ft.
80	100	--	
79 (Idle)	100	1030	
Idle	90	1320	1.7 Mn
Idle	80	1780	1.68 Mn
Idle	78 (Idle)	2000	

After stabilizing at 1.6 Mn, 41,000 ft., the left bypass was opened to position the shock at .75 pressure ratio. This required 670 sq. in. of left bypass. The following data was obtained by repeating the above engine tests:

No. 1	No. 3	Left Bypass Sq. In.	Remarks
90	100	880	
80	100	1080	Rub Board Buffet
77 (Idle)	100	1090	1.54 Mn
Idle	90	1360	1.5, 41,000 ft.
Idle	80.5	1690	1.45 Mn
Idle	77.5 (Idle)	1830	

The above tests had to be accomplished at a constant altitude due to an IFR clearance; therefore, the Mach number could not be held.

3.0 MISSION ABORTED - UTILITY #2 HYDRAULIC SYSTEM PROBLEMS

Sometime during the above runs the No. 5 utility hydrauic pump failed, and shortly thereafter the No. 2 system level decreased continuously from 150 to 45 per cent. The remaining airstarts and airspeed calibrations were not accomplished as the airplane was returned home in order to lower the landing gear before utility #2 system failed completely.

While returning home at subsonic speed, the following well-stabilized speed power point was obtained by the copilot. The pilot's data read .98 Mn, 35,930 ft. and 334 KIAS (VSI), 343 KIAS (Standby). The copilot's angle of attack read $4\frac{1}{2}$ degrees.

With the wingtips up, gear and flaps down, an F-104 obtained a pace point prior to an ILS run. The point was obtained in a descent; however, the airspeed was fairly well stabilized in light turbulence.

The XB-70 read 239 KIAS and 5450 ft. VSI. Standby airspeed read 245 KIAS. The pacer read 233 KIAS at 5340 ft.

4.0 LANDING

After the ILS was accomplished by the copilot, the pilot entered a left downwind leg in preparation for the landing. Below 300 ft. on the final approach, both pilots were bounced around in the cockpit due to turbulence; however, no difficulty was encountered and a good landing was accomplished by the pilot.

5.0 DISCREPANCIES

1. Airplane pulls right taxiing, steering on or off.
2. No. 5 utility pump inoperative.
3. Tank 2 did not turn tanks 1 and 7 on at 200-pound level.
4. Sump low caution light does not turn on master caution light.
5. Utility #2 quantity went to low of 12 per cent inflight.
6. No side tone on UHF 2.
7. Magnetic heading 217° on runway of 223°.
8. No. 3 engine primary pump pressure 3350 psi.

V H Shepard

V. H. Shepard
Copilot and Aircraft Commander

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. H. Shepard

FLIGHT NO. 1-24 COPILOT Lt. Col. F. Fulton

DATE OF TEST 7 December 1965 FLIGHT TIME 2:26

CHASE AIRCRAFT AND PILOTS

Chase 1	F-104 #314	-	Maj. Sorlie/White
Chase 2	F-104 #763	-	Capt. Hoag
Chase 3	T-38 #599	-	Maj. Parson/Capt. Gentry
Rescue	C-130 #130	-	Col. Andonian/Col. Jacobs
Helicopter	H-21 #361	-	Capt. Flannagan

PURPOSE OF FLIGHT

1. Inlet performance at 2.0 Mn, 50,000 ft.
2. Inlet airflow calibration at 2.4 Mn, 60,000 ft.
3. Level flight performance at .91 Mn, 35,000 ft.; .8, .75 and .7 Mns., 15,000 ft.; .6 Mn, 10,000 ft.

1.0 ENGINE START

All engines started satisfactorily, except #3 and #5. Normal ignition on #5 did not start the engine, and airstart ignition was used. Three attempts were unsuccessful to start #3 engine; and finally, after the ground crew turned the shaft, the engine started successfully.

2.0 TAKEOFF AND CLIMB

A maximum A/B takeoff was accomplished, and the airplane was rotated at 190 KIAS. With the nose one to two degrees above the horizon, the airplane flew off the ground normally at 213 KIAS. Acceleration was good with this nose-high attitude. Gear and flaps were retracted immediately and the tips were lowered to one-half as soon as the flaps were up.

Using maximum A/B, the airplane was trimmed out, hands off, at 325 knots; then accelerated to a stabilized speed of 420 knots, where four or five pounds of forward force were required. All FACS were ON for this run and a slight nose-up pitching moment was observed when FACS was turned ON. The airplane was leveled off at 50,000 ft. and the speed was stabilized at 2.0 Mn. No difficulty was encountered in holding a stable Mach number, but one had to work in order to hold the altitude. The copilot placed the left throat in MANUAL and obtained

stabilized data at various throat positions from 2.1 throat Mach number to full open throat. Good stabilized Mach number was held throughout the throat inlet test.

3.0 MISSION TESTS

3.1 INLET AIRFLOW CALIBRATION

Automatic throat was then selected and both inlets started. The airplane was accelerated and climbed to 60,000 ft., 2.4 Mn. The engines were then unlocked and #1 throttle was placed in mil. power to begin the airflow test. This was accomplished by opening the left bypass as the throttle was retarded to maintain a constant shock position. Data was obtained with #1 engine at 95 per cent rpm and IDLE. Data was then obtained with engine #3 at 100 and 95 per cent rpm while the copilot maintained a constant shock position. At this time the #6 engine LOW OIL PRESS light illuminated and the engine was shut down immediately.

A deceleration was then commenced in order to try to reach 22 per cent rpm on #6 engine before five minutes. Deceleration was slow. All engines were retarded to the 40-degree throttle angle. The airplane was decelerated to 360 knots where this airspeed was held; however, after five minutes, the Mn had reduced to only 1.6 at 56,000 ft. Engine #6 windmill rpm was 67 per cent. The windmill brake was then actuated. After approximately 45 seconds, the #6 engine started unwinding moderately and reached zero rpm, indicating the brake had operated satisfactorily. The airplane was descended to 41,000 ft. on an IFR flight plan, and all five engines were placed in max. A/B at about .98 Mn.

At this weight, speed could not be held as the heavy buffet was encountered near .87 Mn. A lower altitude was requested, and again level flight could not be held at 39,000 ft., the new assigned altitude. While holding 39,000 ft., the Mach number decreased from .92 to .86 Mn. Finally, near .92 Mn at 35,000 ft., altitude and speed were held.

3.2 LEVEL FLIGHT PERFORMANCE - FIVE ENGINES

Data was obtained of the following stabilized speed-power points with the gear and flaps up, nose ramp down, and wingtips at one-half:

Run	Alt-Ft.	Airspeed-KIAS STBY	Airspeed-KIAS VSI	Mn	Remarks
1	35,340	319	313	.915	$\alpha = 5.1^\circ$ 85,500 lb.fuel remaining
2	15,460	412	405	-	$\alpha = 3.2^\circ$
3	10,840	330	327	-	$\alpha = 4.2$
4	10,360	228	220		50 ft/min climb to hold speed Light moderate buffet

The tips were then raised and the following data was observed:

Run	Alt.Ft.	Airspeed-KIAS STBY	Airspeed-KIAS VSI	Remarks
5	10,350	229	222	Buffet decreased with tips up

All points were well stabilized in level flight, except Run 4 where a 50 ft/min climb had to be maintained in order to hold speed. It was found that the vertical tape (VSI) instruments were disappointing in getting the level flight performance data. Trend information was difficult and the veedor root readouts had excessive hysteresis and electrical oscillation. The standard round pneumatic instrument was far superior. Once the round (STBY) instruments were found to be superior, no difficulty was encountered in obtaining excellent stabilized data. Excellent throttle characteristics make the job easier, also.

3.3 INLET PERFORMANCE, .8 MN, 15,000 FT.

With the bypass closed, data was obtained of various throat positions from full open to 2.0 throat Mach number. Airflow was allowed to stabilize for ten seconds at each throat position.

4.0 APPROACH AND LANDING

The approach and landing was flown with all augmentation on. No significant difference in stability or control was apparent; however, a direct comparison was not accomplished with augmentation off. Rudder pedal feedback was not present, with yaw dampers, in smooth air.

Augmentation was disengaged prior to lowering the nosewheel to the runway. Nosewheel steering was not engaged until the drag chute was jettisoned. Difficulty was encountered in finding the engagement switch, and eyes had to be taken off the runway at a critical time. In fact, the turnoff was almost missed. This could be even more critical at higher speeds in a crosswind. It is recommended that this switch be moved to the control wheel or the pilot have the copilot perform this duty.

5.0 CONCLUSIONS

1. Longitudinal static, stick free, stability from 325 to 420 KIAS with wingtips at one-half was slightly positive to neutral.
2. Engine windmill brake actuated satisfactorily and reduced the rpm to zero near 1.5 Mn.

3. With 100,000 pounds of fuel remaining, using five engines, level subsonic flight cannot be maintained at 39,000 ft.
4. Standard round pneumatic instruments were superior to vertical tape instruments during level flight performance data gathering. The VSI's should be subdivided in increments less than 10 knots and 50 ft. Trend information was not available from the Veedor-Root readouts and was not readable at the one-half knot and 5 ft. midpoints.
5. Nosewheel engage switch should be operated by the copilot.

6.0 DISCREPANCIES

1. Total temp. inoperative.
2. Normal ignition would not start #5 (airstart OK).
3. #2 primary status light will not turn on MASTER CAUTION.
4. Copilot pitch augmentation disengagement intermittent.
5. #6 engine oil pressure caution light illuminated at 2.4 Mn. The windmill brake was actuated.
6. #2 UHF had a weak receiver and a noisy bakcground.

V H Shepard

V. H. Shepard
Aircraft Commander

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. H. Shepard

FLIGHT NO. 1-24 COPILOT Lt. Col. F. Fulton

DATE OF TEST 7 December 1965 FLIGHT TIME 2:26

CHASE AIRCRAFT AND PILOTS

Chase 1	-	F-104 #314	-	Maj. Sorlie/White
Chase 2	-	F-104 #763	-	Capt. Hoag
Chase 3	-	T-38 #599	-	Maj. Parson/Capt. Gentry
Rescue	-	C-130 #130	-	Col. Andonian/Col. Jacobs
Helicopter		H-21 #361	-	Capt. Flannagan

PURPOSE OF FLIGHT

1. Inlet performance at 2.0 Mn, 50,000 ft.
2. Inlet airflow calibration at 2.4 Mn, 60,000 ft.
3. Level flight performance at .91 Mn, 35,000 ft.; .8, .75 and .7 Mns., 15,000 ft.; .6 Mn, 10,000 ft.

1.0 ENGINE START

All engines started satisfactorily, except #3 and #5. Normal ignition on #5 did not start the engine, and airstart ignition was used. Three attempts were unsuccessful to start #3 engine; and finally, after the ground crew turned the shaft, the engine started successfully.

2.0 TAKEOFF AND CLIMB

A maximum A/B takeoff was accomplished, and the airplane was rotated at 190 KIAS. With the nose one to two degrees above the horizon, the airplane flew off the ground normally at 213 KIAS. Acceleration was good with this nose-high attitude. Gear and flaps were retracted immediately and the tips were lowered to one-half as soon as the flaps were up.

Using maximum A/B, the airplane was trimmed out, hands off, at 325 knots; then accelerated to a stabilized speed of 420 knots, where four or five pounds of forward force were required. All FACS were ON for this run and a slight nose-up pitching moment was observed when FACS was turned ON. The airplane was leveled off at 50,000 ft. and the speed was stabilized at 2.0 Mn. No difficulty was encountered in holding a stable Mach number, but one had to work in order to hold the altitude. The copilot placed the left throat in MANUAL and obtained

stabilized data at various throat positions from 2.1 throat Mach number to full open throat. Good stabilized Mach number was held throughout the throat inlet test.

3.0 MISSION TESTS

3.1 INLET AIRFLOW CALIBRATION

Automatic throat was then selected and both inlets started. The airplane was accelerated and climbed to 60,000 ft., 2.4 Mn. The engines were then unlocked and #1 throttle was placed in mil. power to begin the airflow test. This was accomplished by opening the left bypass as the throttle was retarded to maintain a constant shock position. Data was obtained with #1 engine at 95 per cent rpm and IDLE. Data was then obtained with engine #3 at 100 and 95 per cent rpm while the copilot maintained a constant shock position. At this time the #6 engine LOW OIL PRESS light illuminated and the engine was shut down immediately.

A deceleration was then commenced in order to try to reach 22 per cent rpm on #6 engine before five minutes. Deceleration was slow. All engines were retarded to the 40-degree throttle angle. The airplane was decelerated to 360 knots where this airspeed was held; however, after five minutes, the Mn had reduced to only 1.6 at 56,000 ft. Engine #6 windmill rpm was 67 per cent. The windmill brake was then actuated. After approximately 45 seconds, the #6 engine started unwinding moderately and reached zero rpm, indicating the brake had operated satisfactorily. The airplane was descended to 41,000 ft. on an IFR flight plan, and all five engines were placed in max. A/B at about .98 Mn.

At this weight, speed could not be held as the heavy buffet was encountered near .87 Mn. A lower altitude was requested, and again level flight could not be held at 39,000 ft., the new assigned altitude. While holding 39,000 ft., the Mach number decreased from .92 to .86 Mn. Finally, near .92 Mn at 35,000 ft., altitude and speed were held.

3.2 LEVEL FLIGHT PERFORMANCE - FIVE ENGINES

Data was obtained of the following stabilized speed-power points with the gear and flaps up, nose ramp down, and wingtips at one-half:

Run	Alt-Ft.	Airspeed-KIAS STBY	Airspeed-KIAS VSI	Mn	Remarks
1	35,340	319	313	.915	$\alpha = 5.1^\circ$ 85,500 lb.fuel remaining
2	15,460	412	405	-	$\alpha = 3.2^\circ$
3	10,840	330	327	-	$\alpha = 4.2$
4	10,360	228	220		50 ft/min climb to hold speed Light moderate buffet

The tips were then raised and the following data was observed:

Run	Alt.Ft.	Airspeed-KIAS STBY	Airspeed-KIAS VSI	Remarks
5	10,350	229	222	Buffet decreased with tips up

All points were well stabilized in level flight, except Run 4 where a 50 ft/min climb had to be maintained in order to hold speed. It was found that the vertical tape (VSI) instruments were disappointing in getting the level flight performance data. Trend information was difficult and the veedor root readouts had excessive hysteresis and electrical oscillation. The standard round pneumatic instrument was far superior. Once the round (STBY) instruments were found to be superior, no difficulty was encountered in obtaining excellent stabilized data. Excellent throttle characteristics make the job easier, also.

3.3 INLET PERFORMANCE, .8 MN, 15,000 FT.

With the bypass closed, data was obtained of various throat positions from full open to 2.0 throat Mach number. Airflow was allowed to stabilize for ten seconds at each throat position.

4.0 APPROACH AND LANDING

The approach and landing was flown with all augmentation on. No significant difference in stability or control was apparent; however, a direct comparison was not accomplished with augmentation off. Rudder pedal feedback was not present, with yaw dampers, in smooth air.

Augmentation was disengaged prior to lowering the nosewheel to the runway. Nosewheel steering was not engaged until the drag chute was jettisoned. Difficulty was encountered in finding the engagement switch, and eyes had to be taken off the runway at a critical time. In fact, the turnoff was almost missed. This could be even more critical at higher speeds in a crosswind. It is recommended that this switch be moved to the control wheel or the pilot have the copilot perform this duty.

5.0 CONCLUSIONS

1. Longitudinal static, stick free, stability from 325 to 420 KIAS with wingtips at one-half was slightly positive to neutral.
2. Engine windmill brake actuated satisfactorily and reduced the rpm to zero near 1.5 Mn.

3. With 100,000 pounds of fuel remaining, using five engines, level subsonic flight cannot be maintained at 39,000 ft.
4. Standard round pneumatic instruments were superior to vertical tape instruments during level flight performance data gathering. The VSI's should be subdivided in increments less than 10 knots and 50 ft. Trend information was not available from the Veedor-Root readouts and was not readable at the one-half knot and 5 ft. midpoints.
5. Nosewheel engage switch should be operated by the copilot.

6.0 DISCREPANCIES

1. Total temp. inoperative.
2. Normal ignition would not start #5 (airstart OK).
3. #2 primary status light will not turn on MASTER CAUTION.
4. Copilot pitch augmentation disengagement intermittent.
5. #6 engine oil pressure caution light illuminated at 2.4 Mn. The windmill brake was actuated.
6. #2 UHF had a weak receiver and a noisy background.

V H Shepard

V. H. Shepard
Aircraft Commander

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT Lt. Col. F. Fulton

FLIGHT NO. 1-25 COPILOT V. H. Shepard

DATE OF TEST 10 December 1965 FLIGHT TIME 2:18

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #316 - Maj. Sorlie/Col. Cotton
Chase 2 - T-38 #600 - Lt. Col. Wood/Col. Cotton
Rescue - HC-130 #855 - Maj. Schiele
Helicopter H-21 #361 - Capt. Thomas

PURPOSE OF FLIGHT

1. Inlet performance at 1.2 and 1.6 Mns. with various throat heights
2. Single- and multi-engine airstarts at 1.8 Mn, 50,000 ft., and .9 Mn to 25,000 ft.
3. Level flight performance at 1.2 Mn, 35,000 ft.; .95 and .8 Mns. at 25,000 ft.; .7 and .75 Mns, at 15,000 ft.

1.0 INLET PERFORMANCE

1.2 MN, 35,000 FT.

With the left bypass closed and the left throat in manual, 10 seconds of stabilized data was obtained at the following throat positions:

Throat Mn	Shock Pressure Ratio
1.68 (open)	.8+
1.81	.8+
2.0	.75+
1.9	
1.75	

With the left bypass open to 400 sq. in., data was obtained at the following throat positions:

1.69 (open)	
1.825	
2.01	.42
1.91	.75+
1.755	.8+

All data was obtained at a constant Mach number of 1.2. It was interesting to note that the secondary shock did not form with the closed bypass area, but did form with the 400 sq. in. area as the throat was closed near 1.93 throat Mach number. The secondary shock disappeared while opening the throat near the same throat Mach number.

1.6 MN, 41,000 FT.

With the airplane stabilized at 1.6 Mn, left inlet data was obtained at the following throat positions with a 400 sq. in. bypass area. Ten seconds of stabilized data was obtained at each throat position:

Throat Mn	Shock Pressure Ratio	Remarks
1.69 (open)	.8+	
1.82		
2.025	.67	Bypass 410
1.91	.72	
1.76	.75+	Light turbulence
1.69 (open)	.8+	

2.0 AIRSTARTS 1.8 MN, 50,000 FT.

With the throat in AUTO-MANUAL and the left bypass set at 700 sq. in., rpm unlocked, engines 1, 2, and 3 were shut down and airstarted individually. Windmill rpm was observed at 72 per cent for all starts and the light-offs were satisfactory for each engine, requiring 15 to 25 seconds. Mach number was held fairly constant; except on the #3 engine start, the airplane decelerated to approximately 1.78 Mn at 49,000 ft. Then #1 and #2 engines were shut down simultaneously where stabilized windmill rpm's of 72.5 and 72 per cent were observed respectively. In a descent near 48,000 ft., 1.78 Mn, EGT's less than 100°C, both throttles were moved to IDLE simultaneously and #1 started first within 20 seconds and #2 followed shortly thereafter (26 seconds from throttle movement). No change in #3 engine was observed during the shutdowns or the airstarts.

At .9 Mn, 35,000 ft., #1 engine was shut down from an IDLE rpm of 66 per cent. Stabilized windmill rpm of 34 per cent was observed. The airstart occurred within 32 seconds of moving the throttle from OFF to IDLE. This start was accomplished with the bypass closed.

3.0 LEVEL FLIGHT PERFORMANCE

Three level flight performance runs were accomplished at 1.2 Mn, 32,000 ft., at three different bypass settings. The following data was observed:

Run	Bypass	Airspeed-KIAS VSI	STBY	Mn	Altitude-Ft.
1	400	435	433	1.205	34,800
2	200	439	435.5	1.21	34,700
3	040 (closed)	437	434.5	1.205	34,550

The above data was obtained with gear, flaps, and nose ramp up and wingtips at one-half. The data in Run 3 was obtained in a stabilized slight descent.

While descending to the next speed power point at 25,000 ft., a loud acoustical panel vibration began at 400 knots, 28,500 ft. The cabin recorder was turned on to record this foghorn-type noise. The nose ramp was raised and the noise ceased.

Level flight performance data was then obtained at .95 Mn, near 25,000 ft., at three different bypass areas: 0, 200, and 400 sq. in. Two minutes of stabilized data were obtained for each area. The nose ramp was down and wingtips one-half. Light turbulence was encountered on all of these runs.

The following stabilized data was obtained near 25,000 and 15,000 ft:

Bypass Sq.In.	Airspeed-KIAS VSI	STBY	Mn	Alt-Ft.	Remarks
0	339	336.5	.805	24,910	
200	335.5				
400	335	333.5	.801	25,170	
0	375		.748	15,000	Light buffet
0	352	348	.697	15,200	Pitch Oscillation
0	356	351.5	.705		Repeat Run

The nose ramp was positioned up and the following stabilized point was obtained:

0	356	351	.702	15,240

4.0 CONCLUSIONS

1. Loud acoustical noise encountered near 400 KIAS at low altitudes appears to disappear when nose ramp was raised.
2. Airstarts singularly and two engines simultaneously were satisfactory at 1.8 Mn, 50,000 ft.
3. Approach and landing were satisfactory with augmentation on.

5.0 DISCREPANCIES

1. UHF #2 inoperative.

V. H. Shepard
Copilot and Aircraft Commander

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT A. S. White

FLIGHT NO. 2-15 COPILOT V. H. Shepard

DATE OF TEST 11 December 1965 FLIGHT TIME 2:03

1.0 PREFLIGHT

During the AICS checkout, it was found that the standby bypass switch would not open the left bypass doors even though the switch was held five to fifteen seconds repeatedly. Left-hand shock aft light remained out. Right-hand bypass operated properly. Ground advised to hold the switch longer. The door opened after holding the switch for approximately five seconds. Left-hand shock aft light came on when the counter increased. The check was completed and rigged for takeoff.

2.0 TAKEOFF

The brakes were released with 258,500 lbs. of fuel showing on the fuel remaining totalizer. Acceleration check was normal and the airplane lifted off and accelerated satisfactorily.

3.0 CLIMB

Automatic AICS was selected on both inlets near .7 IMN after the RESET button was pushed. No transients were observed. Near 1.2 Mn, both throats were observed scheduling normally--both reading 1.75 at 1.26 Mn. At 1.45 Mn, the right bypass commenced to open and stopped at 410 sq. in. The acceleration was stopped at 1.55 Mn because the left bypass would not open automatically. The bypass was then opened by "beeping" the standby switch with the inlet in AUTO mode. The left area was increased to 440 sq. in. and the acceleration continued.

The following throat positions were observed while accelerating with the wings level:

Mn	Throat Mn L	Throat Mn R
1.6	1.835	1.855
1.9	1.94	1.935
2.0	1.995	1.965

Both inlets automatically went on shock control at 2.05 Mn with bypass stabilizing out at 900 and 970 sq. in. left and right respectively.

4.0 AUTOMATIC INLET

The following inlet data was observed during the acceleration-climb while on automatic shock control in both inlets:

Mn	Throat L	Throat R	Bypass L	Bypass R	Shock Pos. L	Shock Pos. R	Inlet Press. Ratio L	Inlet Press. Ratio R	Remarks
2.2	2.16	2.11			.68	.68-.71			Left Shock Osc.
2.3	2.29	2.23							
2.4	2.39	2.32	770	710	.65	.71			
2.5	2.51	2.445	660	620	.68	.69	1.54	1.51	
2.6	2.64	2.55							
2.7	2.72	2.68	540	460	.65	.68	1.84	1.79	Level flight
2.77	2.79	2.77	460	420	.69	.69	1.98	1.93	
511K/67,400'	2.81	2.775	480	420			1.98	1.92	
513K/67,900'	2.85	2.82	450	400	.69	.69	2.06	1.99	
499K/70,000'	2.88	2.82	450	410	.68	.68	2.10	2.02	Mild Rumbling Aft

5.0 AUTOMATIC RESTART CYCLE

While accelerating near 2.72 Mn in a right turn, a mild noise was experienced with an increase in buffet. The AICS RESET light illuminated, the MASTER CAUTION light was already on because of low intermittent hydraulic pressure on utility pump #4. Other caution lights were not observed to illuminate. Immediately a quick look at the throats and bypasses revealed that the left inlet had gone through a restart cycle, as the left bypass was reading 1180 sq. in. and throat had opened to 2.39 Mn. Right throat was reading 2.66 Mn. The left shock was bottomed out. Data was turned on and shortly thereafter the RESET button was pushed. The left inlet returned to schedule slowly. No other transients were encountered after this incident. From the writer's experience with unstarts at 2.4 Mn, the inlet did not unstart.

6.0 FUEL MANAGEMENT

Considerable difficulty was again encountered in trying to find out what was wrong with the automatic system on this flight. However, it wasn't a good test, as one pump was inoperative in tank #2, and it appeared that tank #4 may have been turned off prematurely, allowing tank #7 to feed ahead of tank #5 when tank #2 emptied. During the early part of the flight, all pumps had to be turned off as strip 1A was rising, indicating fuel leaking rapidly in tank #1. More than 39,000 lbs. was found in tank #1; its level had been 35,800 since takeoff.

This writer has a tendency to turn pumps off early, and it is believed that this causes most of his problems. It is again highly recommended

that low fuel pressure warning lights be installed next to the tank pump switches in order to tell the copilot when to turn off the pumps.

7.0 CONCLUSIONS

1. Inlet automatic shock control was satisfactory; however, the shock position was somewhat nervous having a random movement generally between .67 and .71 shock pressure ratio.
2. Right throat appears to lag the schedule below 2.6 Mn and above 2.8 Mn.
3. The transient restart cycle caused no problems on this flight, but this shock was traveling at a high rate in a direction that may cause serious problems on the next reoccurrence.
4. Fuel tank numbers next to the tank pump switches are hard to read.

8.0 RECOMMENDATIONS

1. Until the reason for a transient restart is found, the airplane should not exceed 2.8 Mn.
2. That the tank numbers next to the fuel tank pump switches be made larger and painted in such a way as to be easily readable.

VH Shepard

V. H. Shepard
Copilot

File 8 MGA
TFD-65-869

INTERNAL LETTER

North American Aviation, Inc.

Date · 14 December 1965

TO · Roy Ferren
Address · Dept. 186, Bldg. 2
Los Angeles

FROM · A. S. White
Address · Dept. 186, Bldg. 2
Los Angeles

Phone · 3548

Subject · XB-70A Flight Report (U)

Enclosed is the pilot's flight report for flight No. 2-15 of the XB-70A.

A. S. White
Chief Test Pilot

NORTH AMERICAN AVIATION, INC. / LOS ANGELES DIVISION

Serial No. 55

PILOT'S FLIGHT REPORT (U)

AIR VEHICLE XB-70A #2 (207) PILOT A. S. White

FLIGHT NO. 2-15 COPILOT V. H. Shepard

DATE OF TEST 11 December 1965 FLIGHT TIME 2:03

CHASE AIRCRAFT AND PILOTS

Chase 1	-	F-104	#316	- Capt. Engle/Col. Cotton
Chase 2	-	F-104	#763	- Capt. Gentry
Chase 3	-	F-104	#748	- Capt. Livingston
Chase 4	-	F-104	#315	- Capt. Engle/Col. Cotton
Rescue	-	C-130	#131	- Col. Fulton/ Capt. Kurowski
Helicopter		H-21	#389	- Capt. Flannagan

PURPOSE OF FLIGHT

1. Fifteen minute heat soak at 2.8 Mn.
2. Performance at 2.8 Mn.
3. Heat soak at 2.9 Mn.

1.0 PREFLIGHT AND TAXI

The preflight and engine start phase were normal. Engines #1 and #2 were started with the airstart ignition with no difficulty.

The airplane was ready to taxi at approximately 0826; however, it was overweight for taxi at this time. After burning out fuel so that the gross weight of the airplane was 542,000 lbs., the taxi was started at 0828. No difficulty was encountered in the taxi phase at this gross weight, except for the usual brake chatter from the left brakes.

After lining up on the runway, the following headings were noted: MAG-43°, Derated MAG-43°, Great Circle-37°, Realigned Great Circle-43°, MAG-43°.

TAKEOFF AND CLIMB

The acceleration for takeoff was good, rotation started at 185 KIAS, and the airplane flew off the ground at 205 using approximately 8000 ft. of runway. The total fuel remaining at brake release was 259,000 lbs. Just after takeoff the gear and flaps were raised, and almost immediately thereafter the wingtips were lowered to the one-half position. At approximately .47 Mn the #1 throttle was reduced to military power until the airplane had accelerated to Mach 1.

The reason for this power reduction was that a fixed orifice had been installed in place of the right-hand bypass cooling valve in bay #1.

During the climb to 32,000 ft. the chase aircraft reported that the #5 bay engine cooling doors were open up to .83 Mn. Prior to these doors closing, the #5 tailpipe was reported a glowing red over more of the nozzle area than the other engines.

During the climb it was noted that the yaw indicator was indicating 2½ degrees of right yaw and was inoperative.

Just after lowering the tips to the one-half position, the augmentation was engaged. Channel 2 of the yaw augmentation did not engage. The engage switch was held for approximately 30 seconds. The yaw augmentation power switch was then recycled and Channel 2 yaw augmentation did engage on the second attempt.

After leveling off at 32,000 ft., #1 engine power was advanced to max. A/B and the airplane accelerated to 575 KIAS for the continuation of the climb. During the acceleration at 32,000 ft., the throats started to schedule at 1.26 Mn. The pilot could feel a small directional transient in the airplane at this time. The wingtips were lowered to the full down position at 1.4 Mn, and at 1.45 Mn the RH bypass started opening. At 1.55 Mn, the LH bypass doors had not yet opened. Power was reduced and the Mach number held below 1.6 Mn while the standby bypass door switches were actuated to get the LH bypass doors open to approximately 500 sq. in. Power was then advanced and the acceleration and climb continued. Just after passing Mach 2, both throats started on the automatic system. At this time it was noted that the yaw indicator was now working properly.

During the acceleration and climb between 2.2 and 2.4 Mn, the copilot noted that fuel was feeding into tank #1. All of the fuel tanks were turned off and tank #1 turned on until the fuel was reduced to 36,000 lbs. in that tank. During the next few minutes of the climb and acceleration, the copilot had some difficulty with tank #5 and tank #7 in the AUTO sequence. This will be described in detail in the copilot's report.

3.0 MISSION TESTS

The acceleration and climb were continued to 67,500 ft. and indicated 2.78 Mn just prior to making a right turn north of Salt Lake City.

Just after starting the turn, the LH duct went into a restart cycle for no apparent reason. The UNSTART light and the MASTER CAUTION light did not come on, but the AICS RESET light did come on, and the throats and the bypass doors did open. When the RESET button

was pressed, the duct went back to normal performance, and max A/B was selected to regain the speed lost during the restart cycle.

During this portion of the climb, the Mach meter was erratic--jumping as much as .06 Mn at times.

Just after completing the turn, a one-minute stabilized performance run was made to 2.785 Mn at 67,500 ft. The airplane was almost ideally stable during this performance run. The run was discontinued when the Mach meter jumped from 2.785 to 2.83 Mn. At this time the throttle angle was approximately 93 degrees, the needle and ball were centered, the sideslip indicator was indicating one-third of a degree of right yaw, and the aileron trim was 4½ to 5 degrees of left aileron. The standby airspeed indicator indicated 515 KIAS; and before the jump, the tape airspeed indicator was indicating 502. After the jump, the tape airspeed indicator indicated 510. The total temperature at this time was 518 degrees.

As the turn was entered near Needles, California, max. A/B was selected to hold speed in the turn. Prior to this advance in power, the total temperature was 519 degrees, the tape airspeed indicator was 507, and the standby was 511 at 68,000 ft. During the turn, the Mach meter jumped to 2.93 Mn and the tape airspeed was 521 knots. A climb was made to 70,000 ft. at this time and the max. total temperature indicated was 556 degrees. When leveling at 70,000 ft. a short performance run was made at 500 KIAS on the standby instrument and indicated 2.935 Mn. The throats were indicating 2.88 Mn on the left and 2.81 Mn on the right. The throat trim power had not been turned on. The copilot was instructed by ground station to turn the power on and trim the throats; but since the throat schedule was on the safe side and since the airplane was fairly stable, the pilot elected not to turn the throat trim power on. The airplane passed over Edwards AFB at 2.93 Mn at 70,000 ft. Shortly thereafter, a right turn was started and deceleration was begun.

The maximum Mach number observed was 2.94 indicated; the maximum altitude, 70,600 ft.; the maximum total temperature, 556 degrees; and the maximum airspeed was 578 knots, which occurred during the climb.

4.0 DESCENT AND LANDING

The deceleration and descent to subsonic speed were normal. Just after going subsonic, #4 engine indicated 60 to 65 per cent on the vibration meter. The engine was reduced to idle and the vibration came back to normal level for the remainder of the descent. Later in the flight, engine #4 was checked at all power settings up to military power and did not show the high vibration again.

After raising the wingtips and lowering the gear and flaps, a constant speed, constant angle-of-attack approach was made at approximately 500 fpm rate of descent. This approach was made at 200 knots and the angle-of-attack indicator showed 8 degrees. The power was not changed as the airplane flew into the ground effect. Over approximately 10,000 ft. of runway, the speed fell off approximately 10 knots while the angle of attack remained the same. It was estimated that the airplane was flying with the gear approximately 20 ft. above the runway.

Prior to the full stop landing, the tire condition was checked by the chase and found to be satisfactory. One touch and go landing was made at this time. The touchdown occurred at 175 KIAS and military was applied at 145 KIAS while rolling on the runway. A small pitch trim change occurred, but was easily manageable and the airplane accelerated rapidly to climb speed.

The final landing was satisfactory, and the pilot felt that he could have stopped for a turnoff at the center taxiway by using heavy braking. The airplane was stopped on Runway 22 (heading 223°). The MAG heading indicated 217 degrees; the derated MAG heading, 219 degrees; and the great circle indicated 223 degrees. After realigning, great circle indicated 218 degrees; and after switching back to MAG, it indicated 218 degrees.

5.0 SUMMARY

The automatic inlet system performed better on this flight than it has on the previous two flights, but still needs considerable work before it is satisfactory. It is the pilot's opinion that this automatic AICS should give good duct performance without nuisance restart cycles before we attempt the 30 minutes of sustained Mach 3 flight, because a great deal of performance is lost and added fuel used when the inlet duct goes through the unscheduled restart cycle. There is also the danger of an unstart and possible buzz at Mach 3. On this flight, in addition to the restart cycle, the pilots were constantly bothered by a RH #2 buzz light coming on intermittently and by a utility status indicator on engine #4 lighting. The MASTER CAUTION light was on intermittently throughout the flight. The mission could be performed in spite of the nuisance caution lights, but the sustained Mach 3 run would probably be interrupted by the unscheduled restart cycle.

6.0 DISCREPANCIES

1. Sideslip indicator inoperative during first part of flight. After it started working, it was erratic at times.
2. LH bypass doors would not open in AUTO at 1.4 Mn.
3. Engine cooling doors did not close on Engine #5 until .83 Mn.

4. RH BUZZ No. 2 on at odd intervals during flight.
5. UT PUMP STATUS (#4) on erratically throughout the flight.
6. Engine #4 high vibe on at approximately 85% rpm after being at idle during letdown.
7. Fuel feeding into tank #1 at approximate time of feeding of 5A segment.
8. Tank 7 feeding ahead of AUTO sequence.
9. LH anticollision light did not retract after turning switch OFF.
10. The C/B on all three phases of environmental liquid control were blown after flight.
11. LH duct went into restart cycle at 2.8 Mn, 67,500 ft., for no good reason.
12. Yaw #2 damper did not come on with other dampers. Aug. power switch recycled and then damper came on.

A. S. White
Aircraft Commander

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. H. Shepard

FLIGHT NO. 1-26 COPILOT Lt. Col. F. Fulton

DATE OF TEST 14 December 1965 FLIGHT TIME 2:10

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #316 - Capt. Knight/A. White
Chase 3 - T-38 #598 - Col. Rushworth/A. White
Helicopter H-21 #854 - Capt. Flannagan

PURPOSE OF FLIGHT

1. Level flight performance at .4 Mn, 10,000 ft., and .6 Mn, 18,000 ft.
2. Stability and control at .6 Mn, 10,000 ft., and .8 Mn, 10,000 ft.
3. Airspeed calibration - pacer and tower flyby
4. Single- and multi-engine throttle bursts, .8 Mn at 15,000 ft.

1.0 ENGINE START AND TAXI

All engines started satisfactorily, except that reduced hydraulic pressure had to be used in order to get #5 engine to rotate. Since engines #4 and #6 were running, the reduced pressure was obtained by cycling the control system. Also, #3 engine would not rotate upon actuation of the ground start switch; and after the ground crew rotated the engine shaft two different times, the engine responded to the start switch.

Taxi was normal, except that nosewheel steering was overly sensitive in the taxi mode and was somewhat improved in the takeoff and landing mode, but still too sensitive around center.

2.0 COMPASS CHECK

While lined up, prior to takeoff, on Runway 4 (44°), the following readings were observed:

MAG - 45°
Derated MAG - 45°
Great Circle - 35°
Great Circle - 45° (after Realign)
MAG - 45°

3.0 MISSION TESTS

3.1 LEVEL FLIGHT PERFORMANCE

The airplane was climbed through an overcast and 18,000 ft. was the minimum altitude to remain on top. Therefore, the .4 Mn, 10,000 ft. gear down speed power was eliminated. Level flight performance data was obtained at .615 Mn with the gear, flaps, and wingtips up, and the nose ramp down. The point was well stabilized and the following data was observed: 277 KIAS (Standby), 278 KIAS and 18,580 ft. (VSI).

3.2 STABILITY AND CONTROL, .6 MN, 18,000 FT.

In the above level flight performance configuration with FACS on, two pullup longitudinal dynamic maneuvers were accomplished. Damping was essentially deadbeat. With the FACS still on, a full right rudder constant heading sideslip and a directional dynamic release from one-half rudder were accomplished. The force gradient and sideslip angle appeared linear with pedal deflection. Full rudder resulted in three and one-half degrees of right yaw. The dihedral effect was moderate, requiring 15 to 20 pounds of left aileron to maintain a constant heading. No lightening of the force gradient was observed. The directional dynamic maneuver had essentially deadbeat damping.

With the FACS off, another longitudinal dynamic pullup was accomplished, where the oscillation had reduced to one-tenth amplitude in one cycle. Full left and right rudder constant heading sideslips were then accomplished with the same characteristics described above. Then the directional dynamic maneuver was accomplished from a one-half rudder release where one cycle was required to reduce the oscillation to one-tenth amplitude. No periodic residual oscillations were observed. No oscillations of either the rudder or aileron controls were observed after release. A windup turn to the left was attempted at C/N 2708, but the speed fell off to .58 Mn and the point was no good. The airplane was retrimmed at 19,500 ft., .61 Mn, where light moderate airframe buffet was present. The first part of the data after C/N 2803 was a trim shot, and a windup turn to the left was repeated to 1.45G. Speed was stabilized in this turn and the data was considered satisfactory. The gradient was moderately heavy and linear with "G". Control was not sensitive and no difficulty was encountered in "flying" precise "G".

3.3 STABILITY AND CONTROL, .8 MN

With the gear and flaps up, wingtips one-half, and nose ramp down, a trim shot was obtained at 14,000 ft. at 410 KIAS. Data was then obtained of a full right rudder constant heading sideslip.

with FACS on. The gradient was linear out to two and one-half degrees, then flattened out considerably, resulting in four and one-half to five degrees of sideslip at full rudder. The rudder displacement was then reduced to near three-quarters rudder for the stabilized point. There was essentially no dihedral effect at this speed.

Again, with FACS on, data was obtained of a directional dynamic maneuver by releasing from one-half rudder and the damping was deadbeat. With the data off and descending as the clouds kept getting lower, the airplane was trimmed at 432 KIAS (STBY) and 435 KIAS (VSI) at .81 Mn near 12,000 ft. Three-quarters left and then three-quarters right constant heading sideslips were accomplished having the same characteristics as observed above. A directional dynamic maneuver was then accomplished from a one-half rudder release where one and one-half cycles were required for the oscillation to reach one-tenth amplitude. During the latter part of this maneuver, the Mach number decreased to .78 because of leveling off to stay out of the clouds.

3.4 AIRSPEED CALIBRATION - TOWER FLYBY

Due to the thick overcast, the pacer aircraft was not launched; and the ground reported the weather was getting worse, and advised the pilot to begin a descent. The descent was accomplished by the copilot utilizing radar vectors and the ILS. The letdown was routine through several layers of clouds, and the ground could be seen periodically once the airplane descended below 6,000 ft. With the wingtips up, gear and flaps and nose ramp down, four tower flybys were accomplished from west to east. The runs were opposite the normal direction because of very low clouds north of the Base.

The following data was observed:

RUN	AIRSPEED - KIAS STBY	AIRSPEED - KIAS VSI	ALTITUDE FEET
1	269	269	2780
2	252	255	2680
3	221	227	2620
4	200	207	2630

All runs were well stabilized, especially in altitude from the runway mid point to the east end. Since the runs were made opposite to the normal direction, final adjustments and stabilization had to be accomplished over the first part of the runway, which are normally accomplished over the lakebed when traveling west. The event marker and counter number were obtained at the center taxi intersection. All runs were flown down the centerline of the main runway in essentially no turbulence.

4.0 SUBSONIC MANEUVERING

The airplane was flown for an extended period below 1000 ft. terrain clearance with the gear and flaps down, wingtips up. No difficulty was encountered with the augmentation on; except upon entering abrupt turns, such as missing clouds at the last moment, wherein "normal" aileron and rudder would result in excessive yaw. This airplane was not like most jet airplanes where normal aileron and relatively small or no amount of rudder would produce a banking turn without excessive amounts of adverse yaw.

With augmentation off in light moderate turbulence, the airplane would "wallow" in a Dutch roll, requiring excessive attention in not using the ailerons in order to maintain acceptable control. This was a conflict with this pilot in that it was not natural to concentrate on not using ailerons or "babying" the ailerons when flying close to the ground at low speeds.

One must rate this airplane as unsatisfactory with augmentation on when maneuvering at low altitude. Furthermore, in light turbulence, with yaw augmentation on, rudder pedal feedback was present with the gear down and was unsatisfactory. However, to this pilot, it was the lesser of the two evils. The landing was made with all augmentation on; and in very light turbulence, the feedback was negligible.

5.0 APPROACH AND LANDING

After one practice low approach, a normal landing was accomplished where the chutes were deployed near 180 knots. Braking was normal. After stopping on Runway 4, the following compass readings were observed:

MAG - 47.5°
Derated MAG - 44°
Great Circle - 45°
Great Circle - 44.5° (after Realign)
MAG - 44.5°

After turning off the runway, while coming to a full stop, front brakes "only" were used and brake chatter was excessive near five knots. Then rear brakes "only" were used and the airplane stopped with no chatter; however, the ground observed that the rear brakes locked up and the airplane slid while coming to a stop. Because of this, the remaining taxiing was accomplished using front brakes "only." Data was obtained of military power runs; and with all six engines in idle, three complete control cycles were obtained at slow, moderate, and fast rates for NASA.

6.0 CONCLUSIONS

1. Longitudinal and directional dynamic damping was satisfactory at .6 and .8 Mn with augmentation off.

2. Static directional stability was positive; however, a reduction in slope near two-thirds rudder at .8 Mn was unsatisfactory. The slope did not reverse.
3. Longitudinal accelerated stability at .6 Mn was positive. The gradient was moderate and satisfactory.
4. Excessive yaw due to aileron deflection should be investigated during aileron rolls and ways to reduce the yaw, such as more forward CG's and different canard trim positions be investigated.
5. Airplane handling qualities were better with augmentation on at low speeds with wingtips up than with augmentation off.

7.0 DISCREPANCIES

1. No. 1 engine holds at 930°C ± 5 degrees at Mil power.
2. Nosewheel steering pulls right on engagement.
3. Holding brake released four times without pressing brakes.
4. Master caution not energized by #1 primary status light.

V H Shepard

V. H. Shepard
Aircraft Commander

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. Shepard

FLIGHT NO. 1-28 COPILOT Col. J. Cotton

DATE OF TEST 22 December 1965 FLIGHT TIME 2:35

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #315 - Capt. Engle/Lt. Col. Fulton
Chase 2 - F-104 #748 - Col. Rushworth (Pacer)
Chase 3 - F-104 #316 - Capt. Hoag/Lt. Col. Fulton
Helicopter H-21 #361 - Capt. Vasquez

PURPOSE OF FLIGHT

1. Level flight performance at 235 KIAS, 10,000 ft.
2. Stability and control at .6 Mn, 10,000 ft.
3. Airspeed calibration - .97 Mn through 1.4 Mn
4. Airstarts at .9 Mn, 25,000 ft.
5. Single- and multi-engine throttle bursts at .8 Mn, 15,000 ft.

1.0 ENGINE START AND TAXI

Eight minutes were required to start all engines satisfactorily. The EGT peak observed in the first 10 seconds after light-off ranged from 455 to 500°C, and the peak observed from 10 seconds after light-off to idle ranged from 510 to 550°C.

While taxiing out, it was observed and confirmed by the copilot that the ADI's were indicating three to four degrees left wing down. This occurred on three different stretches of taxiway and the runway. When the standby gyro was switched to the copilot's ADI, the gyro returned to almost straight up--less than one degree of vertical. Then the fast erect button was pushed and no change in the copilot's ADI or the pilot's ADI was observed.

2.0 COMPASS CHECK

After lineup on Runway 4, the following compass headings were observed on the HSI:

MAG - 48
Derated MAG - 48
Great Circle - 32 (variation 0)
Great Circle - 48 (after Realign)
MAG - 48

The airplane was lined up very carefully by using the center flat windshield panel to look through.

3.0 MISSION TESTS

3.1 LEVEL FLIGHT PERFORMANCE, 10,000 FT.

After takeoff the airplane was leveled off at 10,000 ft., gear, flaps, and nose ramp down, and wingtips up. Power was adjusted to hold near 235 knots and data was obtained for three minutes. However, the point was no good because of excessive turbulence near the mountains. The airplane was turned around and restabilized in light moderate buffet at 238 to 239.5 KIAS*, 10,300 ft. The angle of attack was observed at 10.8 degrees.

The same speed-power point was then obtained with gear and flaps up at 242 KIAS. Near the end of this point, however, a slight climb was required to hold the airspeed. This point was obtained with 173,000 lbs. of fuel remaining.

Near the end of the flight, the above two points were repeated. The following data was observed:

	Airspeed*	Altitude	Fuel Remaining
Gear and Flaps Up:	232 KIAS	13,560 ft.	38,500 lbs.
Gear and Flaps Down:	242 KIAS	13,760 ft.	28,000 lbs.

3.2 STABILITY AND CONTROL, .6 MN, 10,000 FT.

The airplane was trimmed up, hands off, at .595 Mn with the wingtips up and the nose ramp down. A pullup and release from approximately 1.4G was accomplished and the damping was essentially dead beat. Then a full right rudder sideslip was accomplished where four degrees of indicated yaw was observed. This corrected to 3 1/4 degrees of yaw, as the yaw meter read 3/4 degrees right with the ball in the center. The gradient was moderately positive with no lightening and the dihedral was positive, requiring 15 pounds of left aileron to hold a constant heading. Then a release from approximately one-half rudder was accomplished where only a slight overshoot was observed in the resulting oscillation. The airplane rolled mildly to the left upon control release.

With FACS off at the same flight condition, another pullup and release was accomplished and the oscillation damped to one-tenth amplitude in 3/4 of a cycle. A slow full left rudder sideslip, then a slow full right rudder sideslip were accomplished. Full

*All speeds observed on the round instrumentation airspeed meter.

rudder again resulted in 3 1/4 degrees of sideslip and the dihedral was positive. A directional dynamic maneuver was then accomplished by releasing all controls from a one-half rudder constant heading sideslip. The airplane was retrimmed and a windup turn to the left was accomplished to 1.4G.

3.3 AIRSPEED CALIBRATION

Using an F-104 pacer, the following airspeed calibration points were obtained with the wingtips at one-half and the nose ramp down:

Run		Airspeed STBY - KIAS	Altitude VSI - FT	Mn	C/N
1	XB-70	355.5	32,060	.975	No Data
	Pacer #748	345.0	30,800	.915	
2	XB-70	399.5	32,920	1.08	4056
	Pacer	390.5	31,820	1.04	
3	XB-70	431.5	32,500		4156
	Pacer	429.0	31,550		
4	XB-70	450	32,000	1.205	4398
	Pacer	456	31,100	1.16	
5	XB-70	526	32,970		4619
	Pacer	528	-		
6	XB-70	523.5	32,920	1.4	-
	Pacer	526	32,050	1.35	
7	XB-70	372.5	30,200		-
	Pacer	361.5	29,850		

All points were well stabilized in airspeed, except Run 5 which was repeated. The data was inadvertently left off on Run 1 and it was believed that the pacer was flying too close on Run 1. This point was repeated on Run 7.

3.4 AIRSTARTS, .9 MN AT 25,000 FT.

The #1 engine was shut down from an idle speed of 63.5 per cent with the nozzle reading 74 per cent. The engine was airstarted successfully 25 seconds after the throttle was placed in idle.

3.5 THROTTLE BURST, .8 MN AT 15,000 FT.

Data was obtained of a one-second throttle burst from max. A/B to idle and a one-second burst from idle to max. A/B on #3 engine.

The acceleration time was nine seconds. Then engines #1, #2, and #3 were retarded from maximum A/B to idle, using a slow throttle movement requiring approximately 10 seconds. After stabilizing at idle, the engines were advanced slowly to maximum A/B, and no unusual characteristics were observed other than the #2 nozzle indicator was sluggish. (EGT on #2 was normal when compared to engines #1 and #3.) The left engines were then retarded from maximum A/B to Idle in one second, and after stabilizing at idle, they were advanced from Idle to maximum A/B in less than one second. No unusual characteristics were observed.

While advancing all six engines towards military power, it was observed that the #5 nozzle did not continue to close once the rpm reached 93 per cent. Because of this, #5 engine EGT was only 700 degrees with the throttle at military power. This engine was then returned to 80 per cent rpm and a descent was begun to complete the level flight performance data at 10,000 ft.

4.0 MISCELLANEOUS

After the gear was lowered, difficulty was encountered in extending the flaps. On three attempts, the indicator changed to "barber pole" and the flap pressure light illuminated. The flaps did not extend until the third attempt.

5.0 CONCLUSIONS

1. The AGPS (Auxiliary Gyro Platform System) heading information was still inaccurate in all modes.
2. Longitudinal and directional dynamic stability were satisfactory at .6 Mn, 10,000 ft., with the wingtips up.
3. Directional static stability was satisfactory at .6 Mn, 10,000 ft., wingtips up. The gradient was linear and positive and the dihedral was positive.
4. Three engines per inlet throttle burst was satisfactory from maximum afterburner to IDLE and IDLE to maximum afterburner at .8 Mn, 15,000 ft.

6.0 DISCREPANCIES

1. AGPS roll information taxiing out 3 - 4° left wing down; on same spot after landing roll was accurate.
2. No. 2 nozzle indicator sluggish.
3. No. 5 nozzle will not close below 60 per cent (occurs at 92-93%).
4. Flaps would not extend on first two attempts - 250 KIAS.

V. H. Shepard
Pilot

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT Lt. Col. F. Fulton

FLIGHT NO. 1-29 COPILOT V. H. Shepard

DATE OF TEST 3 January 1966 FLIGHT TIME 2:41

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #315 - Major Evenson
Chase 2 - F-104 #315 - Major Evenson
Helicopter H-21 #389 - Captain Thomas

PURPOSE OF FLIGHT

1. Level flight performance - .6 Mn, 10,000 ft., .7 Mn, 15,000 ft.
2. Throttle modulation - .8 Mn, 15,000 ft., .6 Mn, 25,000 ft.
3. Stability and control - .8 Mn, 10,000 ft. and 25,000 ft.
4. Airspeed calibration (tower flyby)
5. Airstarts - .9 Mn, 25,000 ft.
6. Inlet performance -.8 Mn, 25,000 ft.
7. Brake chatter test.

1.0 TAXI

Taxiing was normal, except turning radius to the left was excessive and unacceptable. On the 90° turn in front of Base Operations, the radius was so large that one of the right rear tires ran over a taxi light located approximately eight feet into the blacktop off the concrete. Turns to the right were normal and satisfactory. The ground crew found no tire damage after running over the light and the crew cleared the airplane for flight.

Data were obtained of low speed braking action while coming to a stop on the runway prior to takeoff. The chatter below five knots was still excessive and unsatisfactory.

2.0 LEVEL FLIGHT PERFORMANCE

Four speed power points, gear and flaps up, nose ramp down, were obtained in level flight. All points appeared stabilized and satisfactory. The following data were observed:

Run	Airspeed KIAS STBY	VSI	Alt. - Ft.	C/N	Fuel Remaining-lbs.	Remarks
1	325	330	10170	2847-2975	211,000	Wing tip up
2	344.5	349	15000	-10295	72,500	Wing tip up
3	344.5	349	15000	10371-10437	71,000	Wing tip ½
4	328.5	332	9900	10774-10899	65,000	Wing tip up

It was interesting to note that there was no change in speed or power with wing tips up or down one-half during runs two and three.

3.0 STABILITY AND CONTROL, .8 Mn AT 10,000 AND 25,000 FT.

Static and dynamic directional and accelerated and dynamic longitudinal stability tests were accomplished with the wing tips up at 10,000 and 1/2 at 25,000 ft. Technique was good; however, on both longitudinal dynamic pull-ups, it appeared that the airplane entered stall buffet. This buffet increased the period and gave one the impression of returning sluggishly to 1G.

The pilot remarked that the airplane flew well with all augmentation off at 450 KIAS (.8 Mn) 10,000 feet.

Data was obtained at .8 Mn, 10,000 ft. of the nose ramp trim change. No trim change was reported by the pilot. Shortly after actuating the switch, near 1/4 of the up travel, a noise commenced which increased to loud rumbling and shaking of the two longerons. The noise sounded like the rumbling of a large pane of glass. This noise decreased near the 3/4 up travel and faded away to nothing as the windshield stopped.

4.0 INLET PERFORMANCE, .8 Mn AT 25,000 FT.

With the left bypass set at 400 and 800 sq. in., data were obtained of the following stabilized left throat positions: open, 1.83, 1.93, 1.78 throat Mach numbers. with the 800 sq. in. bypass, it was observed that the shock "bottomed out" at .45 pressure ratio as the throat was closing near 1.9 throat Mn. The lowest shock position observed with the 400 sq. in. area was .675 PR at 1.93 throat Mn. With the left throat closed to 2.0 Mn, data were obtained of the following stabilized left bypass areas: closed, 300, 500, 800, 600, 400 sq. inches. During the test, it was observed that the shock "bottomed out" near .45 pressure ratio as the area was increased more than 600 sq. in.

5.0 THROTTLE MODULATION

Slow and one-second throttle bursts were accomplished from MAX A/B to IDLE and IDLE to MAX A/B at .6 Mn, 25,000 ft. These throttle movements included engine #3 singularly and engines #1, #2, and #3 simultaneously. Engines responded excellently. Airspeed was held by adjusting engines #4, #5 and #6.

At .8 Mn, 15,000 ft., a slow and one-second throttle bursts were accomplished from MIN A/B to MAX A/B and MAX A/B to MIN A/B. Slow and one-second bursts were also accomplished from IDLE to MIL power and MIL power to IDLE. These throttle movements included engine #3 singularly and engines #1, #2, and #3 simultaneously. Again, no problems were encountered.

6.0 AIRSPEED CALIBRATION (TOWER FLYBY)

The following data was observed during tower flybys down the runway from west to east. The wingtips were positioned at one-half and the nose ramp was down:

Airspeed - KIAS STBY	VSI	Altitude - Ft. VSI	Counter Number at Mid Taxiway
296.5	299.5	2360	5186
314	319.5	2340	4755
334.5	340.5	2420	4344
354.5	362	2420	5552
374	380	2400	6316

The last two runs were questionable because of the turbulence, and the test was terminated early because of the turbulence.

7.0 AIRSTART, .9 MN AT 25,000 FT.

No. 1 engine was shut down from an IDLE rpm of 68 per cent. After the EGT had cooled to below 100°C, the throttle was placed in IDLE with the airstart switch ON. The engine did not start within one minute, and the throttle was returned to OFF for fifteen seconds. The throttle, again, was moved to IDLE from a windmill speed of 34 per cent rpm and light-off occurred after 16 seconds. Data was turned off at a counter number of 6856.

8.0 HEAVY BRAKE TEST

During the landing rollout with the brakes in NORMAL-AUTOMATIC, data was obtained of moderate to heavy braking near 110 KIAS. Deceleration was good and no chatter or skidding were felt.

9.0 CONCLUSIONS

1. Low speed brake chatter below five knots still exists.
2. Near .7 Mn, 15,000 ft. the drag of the airplane does not change with wing tips up or positioned at one-half down;
3. Windshield shakes excessively while the nose ramp was moved from down to up at .8 Mn, 450 KIAS, 10,000 ft.

10.0 FLIGHT DISCREPANCIES

1. Accelerometer reads 1.4 under 1.0 "g" conditions.
2. ADI jitters $\pm 2°$ in roll at both stations.
3. Flaps failed to extend on first attempt.
4. No. 4 Utility Pump status light amber.
5. Left steering authority low during taxi out.
6. No. 1 engine made normal start after alternate throttle had been jogged.

VH Shepard

V. H. Shepard
Copilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. H. Shepard

FLIGHT NO. 1-30 COPILOT Lt. Col. F. Fulton

DATE OF TEST 6 January 1966 FLIGHT TIME 3:40

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #314 - Capt. Hoag
Chase 2 - F-104 #314 - Capt. Roosa
Support - B-52 #008 - Col. Cotton/Maj. Doryland
Helicopter H-21 #361 - Capt. Flannagan

PURPOSE OF FLIGHT

1. Subsonic cruise performance
2. Cruise environmental test
3. Ram purge at .92 Mn

1.0 ENGINE START

All engines started satisfactorily, except #1 and #3. Normal ignition would not start #1 and airstart ignition had to be utilized. No. 3 engine would not rotate until the shaft was turned by the ground crew.

2.0 TAKEOFF

The gear handle was placed in the UP position immediately after becoming airborne. Shortly thereafter, near 230 KIAS, the flaps were retracted. It was noticed that the flap-up trim change was reduced considerably by retracting flaps early and allowing the increasing speed to somewhat compensate for the nose-down trim change.

3.0 CLIMB AND CRUISE

A maximum afterburner takeoff and climb to 25,500 ft. was accomplished, then power was adjusted to maintain approximately .92 IMN. Indicated altitude was flown 500 ft. above Air Traffic Control required calibrated pressure altitude of 25,000 ft. This minus correction $H_{pcal} = H_{pic} + (-\Delta H_p)$ was determined by accomplishing a cursory look at the F-104 hand-written pacer data obtained on Flight 1-28.

An F-104 chase verified our calibrated altitude near 25,000 ft. Power required was less than military power - near 745°C EGT with 200,000 lbs. of fuel remaining. All rpm's were riding on the governor - 100 per cent. As the weight decreased, power was reduced uniformly across the board to maintain Mach number. Step climbs using military

power were performed in accordance with prepared range data. Three of these climbs to 28,500, 31,500, and 33,500 ft. were accomplished. The following flight log data was observed:

Position	Dist. Flown (N.Mi.)	Time (PST)	Fuel Remain. (Lbs.X10^{-3})	Altitude (Ft.)	Mn	KIAS	Remarks
Edwards	0	1014	235.5				Brake release
Hector	70	1024	197.5	25,500	.93		
Needles	168	1034.5	187.2				
Prescott	267	1045.5	176.0				
Winslow	353	1055.5	166.0				
Albuquerque	549	1118	141.5	25,500	.928	387.5	
Las Vegas	639	1128	132.5	25,500			
Pueblo	801	1147.5	114	28,500			Fuel flow 45,000 lbs/hr*
Denver	896	1158.5	103.5				
Rock Springs	1116	1225.5	82.0	28,500		366	490K G.S.
N.E. of SLC	1202	1237	70.0				Climb to 31,500 ft.
Salt Lake City	1257	1242.5	68.0				
Provo	1292	1247	64.5	31,500		341.5	Fuel flow 42,870 lbs/hr*
Milford	1417	1301.5	55.0			338	517 G.S.
S. of Milford	1475	1308					Climb to 33,500 ft.
Boulder	1583	1320.5	40.0				
Hector	1689	1332	32.0	33,500			Fuel flow 38,700 lbs/hr*
Edwards	1759	1340	29.0	33,500			

*Obtained by timing sump tank, only, with all pumps off.

4.0 MISSION TESTS

4.1 LEVEL FLIGHT PERFORMANCE

The following data was observed during stabilized speed power points:

KIAS	Altitude	Fuel Remaining	Angle of Attack	Counter No.	Remarks
387.5	25,620	150,500	4.8	3500	
366.0	28,500	86,000	4.3	7590-7798	14°F Total Temp.
341.5	31,540	59,000	4.5	9574-9790	
325	33,480	34,500	4.4	11670-11853	

4.2 CABIN AIR FLOW AND FLOOD FLOW

Just prior to leveling off near 25,000 ft., the crew air shutoff handle was placed in the two-thirds up position (one-third air flow available to cockpit). One hour after takeoff the handle was moved to the one-third up position (two-thirds air flow available to cockpit). Two hours after takeoff, the handle was positioned full down (maximum airflow to the cockpit) and this position was held until counter No. 10632 - almost three hours after takeoff. It was noticed that as the airflow was increased, the cabin temperature setting had to be increased in order to maintain a comfortable temperature. After three hours of flying, the writer's feet tended to cool off, but were not uncomfortable. (Much better than a T-39 flight after three hours.)

With the crew air shutoff handle full up (cockpit air flow shut off), cabin altitude stabilized at 8600 ft., EE temperature 40°F, and the airplane stabilized at 33,500 ft., the ram scoop was extended at counter No. 11000. Cabin altitude increased rapidly to 30,500 ft. and stabilized with no overshoots. EE temperature started down, and after six minutes had decreased to 32°F. Ground advised to close the scoop even though ten minutes of scoop operation had not been completed. The scoop was closed at counter No. 11430 with EE temperature at 31° and <u>not</u> stabilized. The scoop closed satisfactorily; and as the cabin descended through 25,000 ft., the switch was released. Shortly thereafter the cabin stabilized near 9,000 ft.

5.0 COMPASS CHECKS

Before takeoff, the platform was slewed to the runway heading - 44°. The magnetic compass read its normal 47 - 48°. Twenty-six minutes after takeoff in level stabilized flight, the magnetic compass read 84° while great circle read 65°. One hour and 56 minutes after takeoff, both magnetic and great circle read 285°. This was strange; but considering the difficulty in remaining on a radial and never really determining the wind direction, it was believed the great circle was correct and the magnetic heading was varying during flight. Over Edwards, three hours and 26 minutes after takeoff, the magnetic compass read 270° while great circle read 277°. Lined up on the runway after landing, the great circle read 44° (runway heading) and magnetic read 48°. This further indicates the platform did not drift and was correct and magnetic was erratic during this flight. This compass should be air-swung along the section lines west of Lancaster.

6.0 MISCELLANEOUS

The following amounts of consumable stores and temperature levels were observed during the flight:

Time	Water (Lbs.)	Ammonia (Lbs.)	Oxygen (Liters)	EE Temp. (°F)	Total Temp. (°F)
0902 (Eng.Start)	1840	515	18.3	-	-
1225	1400	470	16.2	42	15 (28,500 ft.)
1330	1200	470	15.8	40	
1354 (After Ldg.)	1100	440	15.5		

7.0 CONCLUSIONS

1. Flap trim change was reduced considerably when retracted at 230 KIAS and allowing airplane to accelerate during retraction.
2. Cockpit temperature remained comfortable throughout the flight
3. Magnetic heading varies as much as 20 degrees during flight.
4. Longitudinal static speed stability was neutral during cruise requiring no more than normal attention to hold altitude, because of the light gradient.

8.0 MALFUNCTIONS

1. Brake control caution light illuminates when testing brake systems 1 and 2.
2. Drag chute slow to deploy.

V H Shepard

V. H Shepard
Pilot

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT Lt. Col. F. Fulton

FLIGHT NO. 1-31 COPILOT V. H. Shepard

DATE OF TEST 11 January 1966 FLIGHT TIME 1:35

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #314 - Major Sorlie
Chase 2 - F-104 #315 - Major Evenson/Colonel Cotton
Helicopter H-31 #361 - Captain Thomas

PURPOSE OF FLIGHT

1. Level flight performance at 1.6 and 1.7 Mn at 41,000 ft., and .8 Mn at 25,000 ft.
2. Power modulations at .4 Mn, 10,000 ft.; 1.8 Mn and 1.6 Mn at 45,000 ft.
3. Engine airstart at .9 Mn, 25,000 ft.

1.0 LEVEL FLIGHT PERFORMANCE

The following stabilized level flight performance runs were accomplished with the gear and flaps up:

Run	A/S	Alt.-Ft.	Mn	Wingtips	C/N	Nose Ramp	Remarks
1	339	25,230	.81	1/2	863-985	Down	Light Moderate Buffet
2	335	25,010	--	Up	1210-1342	Down	Light Turbulence
3	- -	- -	1.7	Down	-3022	Up	Near Minimum A/B Point Bypass 400 Sq.In. Slight descending Point
4	- -	- -	1.7	Down	3061-3145	Up	Bypass 500 Sq.In.
5	- -	- -	1.67	Down	3242-3365	Up	Light Turbulence Bypass 300 Sq. In.

Run	A/S	Alt.-Ft.	Mn	Wingtips	C/N	Nose Ramp	Remarks
6	-	-	1.58	Down	3683-3782	Up	No good, turbulence Bypass 300 sq.in.
6a	Repeat	-	1.58	Down	3825-	Up	Bypass 300 sq.in.
7	-	-	-	Down	3945-4013	Up	Slight climbing point Bypass 400 sq.in.
8	-	-	-	Down	4035-4100	Up	Bypass 500 sq.in.

2.0 POWER MODULATION

At 1.8 Mn, 45,000 ft., engines #1, #2 and #3 were cycled slowly from maximum A/B to idle to maximum A/B. Then these three engines were rapidly decelerated from maximum A/B to idle with a one-second throttle movement, then allowed to stabilize and accelerated in one-second throttle movement from idle to maximum A/B. The above test was repeated at 1.6 Mn, 45,000 ft. For all tests, the left-hand bypass was positioned at 1100 sq. in. with rpm lockup released. Fairly good Mach number was held in level flight by adjusting power in the A/B range on the right three engines. Engine accelerations and decelerations were satisfactory and the only out of the ordinary occurrence was that #3 engine EGT cycled three times on each afterburner light before settling down.

At .4 Mn, 10,000 ft., the #3 engine was cycled from maximum A/B to idle to maximum A/B by using a one-second throttle movement. The engine was allowed to stabilize at idle and no difficulties were encountered, except #3 engine EGT again cycled three times during the A/B light. Then engines #1, #2 and #3 were decelerated from maximum A/B to idle at a slow rate; and after stabilizing at idle, the pilot momentarily moved the throttles rapidly toward military power and remembering that this was to be a slow acceleration, he returned them back to idle. After the engines stabilized, the engines were accelerated at a slow rate to maximum A/B. The engines were then returned to less than military power, and at this time the vibration light came on and #2 engine was vibrating from 40 to 55 per cent. The writer pulled the #2 throttle back slightly and re-advanced it. The vibration returned to a low level. The three-engine fast cycle and the six-engine normal cycle runs were not accomplished because of low fuel state--22,000 lbs. in the sump.

3.0 AIRSTART, .9 MN, 25,000 FT.

The #1 engine was shut down from an idle speed of 63 per cent. After the EGT decreased below 100°C at a windmill rpm of 35 per cent, the throttle was moved to idle with the airstart on. The start occurred in 20 to 25 seconds.

4.0 WINDSHIELD OPERATION

The windshield ramp was raised at 1.7 Mn, 41,000 ft., 550 KIAS, in order to prepare the airplane for the correct level flight performance configuration. The windshield operated successfully and no change in noise was felt or heard.

At .8 Mn, 10,000 ft., 450 knots, the windshield was raised and a rumbling noise started after the windshield had reached approximately one-third travel. This rumbling became heavy during the mid travel. As the windshield reached full up, the rumbling disappeared. The loud, sharp rumbling, and shaking of the longerons as seen and heard on a previous flight were not present during this actuation. The windshield was then placed in the down position and moderate rumbling during the mid travel was heard, increasing to a high level during the last quarter of travel. The chase pilot reported that the steel windshield fairing visibly fluttered during windshield operation. This last loud rumbling was of the same magnitude as that experienced on a previous flight and must be considered unsatisfactory. It is recommended that the windshield not be operated at this speed and altitude.

5.0 LANDING

The approach was satisfactory and the speed was reduced to approximately 185 knots just prior to the runway, which was very close to the computed best flare speed of 184 (tape) KIAS. The airplane was slightly high at this point, which resulted in more time before the touchdown. One-hundred seventy-three knots was observed on the copilot's tape at touchdown. This would be near 164 knots on the instrumentation airspeed instrument, which is the lowest touchdown speed observed by this writer. No difficulties were encountered and the landing was satisfactory.

6.0 DISCREPANCIES

1. AICS cool switched to #2 system during flight. Was reset and operated normally for the remainder of the flight.
2. #6 nozzle will not close down enough at military power to get over 720°EGT.

VH Shepard

V. H. Shepard
Copilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT V. H. Shepard

FLIGHT NO. 2-19 COPILOT Col. J. Cotton

DATE OF TEST 7 February 1966 FLIGHT TIME 2:11

CHASE AIRCRAFT AND PILOTS

Chase 1 - T-38 #600 - Maj. Sorlie/Lt. Col. Fulton
Chase 2 - F-104 #313 - Capt. Gentry/Capt. Curtis
Rescue - C-130 #132 - Maj. Smith/Col. Andonian
Helicopter H-21 #389 - Capt. Flannagan/Maj. Cuthill

PURPOSE OF FLIGHT

1. Level flight performance .8 and .95 Mn, 25,000 ft; 1.4 and 1.2 Mn, 41,000 ft.
2. Longitudinal dynamic and accelerated stability .8 and .95 Mn, 25,000 ft.; 1.4 and 1.2 Mn, 41,000 ft.

1.0 BEFORE TAXI

Seven minutes were required to start all six engines, and no difficulties were encountered. Approximately 25 minutes after the last engine was started, the ground crew reported excessive blue smoke coming from engine #1. For 35 minutes this smoke was investigated and nothing wrong could be found. Both oil and hydraulic fuel levels were checked, and the engine area for leaks, with no results. The helicopter reported the smoke to be shifting from one side of the airplane to the other. That is, they would see excessive whitish blue smoke coming from engines #5 and #6, and later would report the smoke coming from the left side of the airplane from engines #1 and #2. The engines were accelerated to 85 per cent RPM individually, but the excessive smoke would not cease. The ground reported the smoke to be excessive and abnormal. They advised to begin taxiing and the final decision would be made prior to brake release.

2.0 TAXI

Taxiing was begun on the hour (1200 noon) and 16 minutes later, the airplane was lined up on the runway. During the taxiing the brakes were investigated, and the low-speed chatter resulted in excessive airplane shaking. This was present regardless of how the brakes were applied. The majority of this chatter came from the rear brakes, especially the left side. Excessive distance was required to stop the airplane from 15 mph prior to taking the runway to prevent brutal shaking of the airplane.

3.0 TAKEOFF

All speeds and distances were computed for 530,000 lbs. at 50°F. This resulted in calibrated rotation and liftoff speeds of 185 and 205 knots. (The actual temperature and weight, 45°F and 522,000 lbs., would have resulted in the liftoff speed one knot lower--204 KCAS.) Rotation was begun at 185 KIAS, as read from the round dial. Rotation was fast and the airplane was over-rotated approximately three degrees. The copilot observed the lift-off at 200 KIAS, which corrected to 199 KICAS*.

Immediately after becoming airborne, the writer transferred from the round dial to the tape where near 205 KIAS (202 KICAS) was observed. The nose was high and airspeed was watched closely and it appeared to decrease. The nose was lowered immediately to approximately 13 degrees, and the airplane appeared not to accelerate. The airplane tended to pitch up and was trimmed "nose down." The nose was lowered further to approximately 12 degrees, and the airplane started to accelerate, with the tape airspeed reading near 202 KIAS.

4.0 LEVEL FLIGHT PERFORMANCE

During the climb to 25,000 ft., the chase plane reported #4 A/B hotter than the other A/B's, and #4 engine cooling doors were still open. At .9 Mn, all cooling doors on #4 engine were still open and the A/B section was getting redder. The ground advised to reduce the power on #4 to military; and just prior to retarding the throttle, the chase said the aft door closed. The copilot reported #2 and #3 utility hydraulic pump status caution lights illuminated.

Data was obtained of the following speed power points:

Run	KIAS	Alt-Ft	C/N	Wing-tips	Remarks
1	410	24,620	1220-	1/2	
2	335	25,980	2364-2655	1/2	Light moderate buffet
3	336.5	25,760	2655-2780	Up	Buffet level slightly increased over Run #2
4	454	40,380	4740-5086	Full	1.39 Mn. Power was changed at 4805 C/N, 100,000 lbs.fuel
5	454	40,680	5086-5295	1/2	Power was reduced at 5115 C/N Angle of attack - 3.0°
6	383	-	5975-6200	Full	Point no good due to descent
7	378	41,300	6686-6878	Full	1.19 Mn. Power changed at 6735 C/N. Angle of attack - 3.3°
8	396	41,250	6985-7070		1.24 Mn

*KICAS - knots instrument corrected (only) airspeed

All the 25,000 ft. runs were well stabilized in level flight. The 1.4 Mn, 41,000 ft. runs were not as well stabilized, but were satisfactory. Continual hunting around level flight existed throughout all 41,000 ft. runs because of apparent sticky rate of climb needle and difficulty in determining altitude trend from the tape or the Veedor Root read-out. The 1.4 Mn runs were obtained on a neutral to slightly positive power required curve, whereas the 1.2 Mn runs were definitely on a negative slope requiring more time to stabilize. The 1.2 Mn points, however, were considered acceptable.

It was again found that vertical tape (VSI) instruments were disappointing in almost every instance to get level flight performance data at 40,000 ft. Further investigation of the CADS computer revealed a possible 40 ft. threshold before altitude or the rate of altitude needle would move. This is unsatisfactory instrumentation for the purpose of obtaining excellent stabilized level flight performance data. Until better type rate of climb and altitude instruments are installed, it is recommended that excessive time not be spent in obtaining level flight data, but accept small rates of climb or descent for the performance data.

5.0 LONGITUDINAL DYNAMIC AND ACCELERATED STABILITY

5.1 .95 MN, 31,000 FT.

Data was obtained with the wingtips at one-half at 31,000 ft. rather than 25,000 ft. due to clouds. In light 1'g' buffet, longitudinal dynamic data was obtained in a pullup which was repeated because of stall buffet encountered on the first maneuver. Moderate buffet was encountered on both pullups resulting in sluggish return of the 'g'. Data was obtained in a windup turn to the left where 1.45 'g' was observed on the tape. (Acceleration data to 1.6 'g' was planned; however, the instrumentation normal acceleration instrument was not installed in the cockpit and the writer preferred not to trust the tape instrument over 1.5 'g'.)

5.2 .8 MN, 25,000 FT.

Longitudinal dynamic and accelerated data were obtained with the wingtips up and one-half positions. With the tips up, buffet increased from light moderate at 1 'g' to moderate at 1.4 'g' in the wind-up turn. The wind-up turn was repeated at C/N 3025-3050 because of unsatisfactory speed control on the first turn. Some lightening of the gradient was observed at 1.4 'g' with the tips up. With the tips at half, the buffet increased from light moderate to moderate heavy at 1.4 'g'. The longitudinal dynamic data was obtained with pitch augmentation off; the resulting pitch oscillation disappeared after two cycles.

5.3 1.4 MN, 41,000 FT.

Longitudinal dynamic and accelerated data were obtained at one-half and full down wingtips. The data was satisfactory and no unusual characteristics were observed. The pitch oscillations, resulting from the pullup, damped satisfactorily within two cycles.

5.4 1.2 MN, 41,000 FT.

Longitudinal dynamic pullup was accomplished with full tips, then the airplane was retrimmed at C/N 5515 where longitudinal accelerated data was obtained in a windup turn to the right. Light buffet commenced at 1.5 'g' in this turn with approximately 80,000 lbs. of fuel remaining. Again, longitudinal dynamic and accelerated data were obtained at one-half tips where the data was satisfactory. No buffet was encountered at 1.5 'g', 1.25 Mn, with approximately 35,000 lbs. of fuel remaining.

6.0 LEVEL FLIGHT ACCELERATION

With the airplane trimmed out at .8 Mn, 25,000 ft., maximum afterburner was selected on all engines--two at a time. The airplane was allowed to climb approximately 500 ft. from .8 to .95 Mn in order to offset the position error. At .97 Mn the forward force was in excess of 100 lbs. and nose-down trim was applied. Data was turned off at 1.01 Mn with the stick well forward; 11 degrees as read by the copilot. The gradient was very steep above .94 Mn, and the airplane climbed excessively.

7.0 LANDING

The landing was accomplished with 50-degree crosswind from the right at 10 knots, gusting to 18 knots. The crab was noticeable on the final approach; and as the airplane approached the ground, the right wing was lowered, resulting in almost no crab at landing. The landing was accomplished right wing down, and the airplane skipped from right to left wheel very easily. It was the writer's best landing, and it was the only landing where control of the rate of descent within two feet of the runway was attempted. No difficulty was encountered in feeling for the runway, even though the simulator indicated that the airplane would rotate and bang the main wheels on the runway.

The chute was called for with the nose in the air, but the copilot requested that the nose be lowered. The nose was lowered and the chute was deployed with the nose off the runway. No yawing was observed and shortly after the nose was lowered to the runway, the steering was engaged with feet off the rudders. With the rudders free and the drag chute extended, drifting on the runway was not appreciable, indicating the crosswind was low at this time.

8.0 CONCLUSIONS

1. Excellent level flight performance data was difficult to obtain at 40,000 ft. because the rate of climb and altitude instrumentation were not responding to small changes.
2. Power required curve appeared to have a slightly positive slope at 1.4 Mn and a slightly negative slope at 1.17 Mn.
3. Longitudinal dynamic stability was satisfactory at .8 Mn, 25,000 ft., and 1.2 and 1.4 Mn at 41,000 ft., damping to less than one-half amplitude in one cycle.
4. Longitudinal accelerated stability was satisfactory at .95 Mn, 31,000 ft.; .8 Mn, 25,000 ft.; 1.2 and 1.4 Mn, 41,000 ft., exhibiting positive but moderately steep gradients.

9.0 DISCREPANCIES

1. Roll augmentation disengaged when returning the wheel from a full left aileron input.
2. "C" band beacon inoperative.
3. Utility #2, #3, and #4 status caution lights on continuously above 30-degree throttle angle.
4. Pilot and copilot rate of climb needles not zeroed, and the pilot's needle sticks.
5. Thump in airplane when tank #2 fuel pump turned off.
6. No. 4 engine cooling doors late to close.
7. Low-speed braking shakes the airplane excessively, especially rear and left brakes.

V. H. Shepard
Pilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. Shepard

FLIGHT NO. 1-34 COPILOT Lt. Col. F. Fulton

DATE OF TEST 26 February 1966 FLIGHT TIME 2:22

CHASE AIRCRAFT AND PILOTS

Chase 1 - T-38 #601 - Capt. Gentry
Chase 2 - F-104 #314 - Maj. Evenson/Col. Cotton
Chase 3 - T-38 #601 - Capt. Gentry
Helicopter H-21 #854 - Capt. Vasquez

PURPOSE OF FLIGHT

1. Photograph wing, canard, and vertical stabilizer tufts.
2. Longitudinal and directional dynamic and directional static stability at .8 Mn, 15,000 ft.

1.0 ENGINE START AND TAXI

The engines were started satisfactorily and all tests were completed using ground cooling air. After the door was closed, the ammonia auxiliary cooling system was turned on. Shortly thereafter, the ammonia system had to be turned off because of excessive fumes in the cockpit, and ground cooling was reconnected. With the engines still running, the presence of ammonia was verified on two separate occasions. The engines were shutdown and the ammonia system and the make-up air valve were checked. The engines were restarted, and no fumes were detected in the cockpit when the ammonia system was turned on. The wind had shifted from the east to the west prior to the last check. The east wind may have blown the overboard ammonia toward the cabin regulators.

Data were obtained of a normal left turn (915-950 C/N) east of the tower while proceeding towards Runway 22. During the latter part of the turn, full rudder was required. Data of a right turn and a complete stop on the runway were obtained with end counter number reading 1770. The right turn was normal, but seemed more responsive than the previous left turn.

The brakes on this airplane were acceptable, if one took extreme care in depressing the pedals and used minimum brake to stop the airplane. Brake chatter was not present, but the airplane did quiver mildly.

2.0 AIRFLOW TUFT STUDY

The airplane was stabilized out near 10,300 ft., .43 Mn, 230 KIAS, with the gear and flaps up and wingtips at one-half, and photographs were obtained of the tufts by a photographic chase airplane. The XB-70 demonstrated moderate airframe buffet, and the chase reported light turbulence during this run.

The airplane was then accelerated and climbed to .6 Mn, 11,500 ft., where less turbulence was observed. Then further photographs of the tufts were obtained by the chase photographer. The chase reported no turbulence during these runs, and the XB-70 exhibited light airframe buffet.

The airplane was then climbed to 20,000 ft. and stabilized at .6 Mn for further photographs of the tufts. The chase reported no turbulence at this altitude, and the XB-70 exhibited light-moderate airframe buffet with 157,000 lbs. of fuel remaining. Near the end of this run at .6 Mn, with 143,000 lbs. of fuel remaining, the buffet had decreased to light. At this time the INSTR COOL MALF light illuminated and the RESET button was pushed. Shortly therafter the COOL MALF light came on, causing the instrumentation to shut off. The last two photo runs were obtained with the instrumentation off and the following data were observed:

Position 3, 2-inch lens - .6 Mn - 276 KIAS - 19,850 ft.
Position 3, 4-inch lens - .605 Mn - 278 KIAS - 19,820 ft. - 7.9°α

The airplane was accelerated to .9 Mn at 20,000 ft.; and with the instrumentation off, the following data were observed as the photographer called out an identifying mark:

Position	Lens-In.	KIAS	Mn	Altitude-Ft.	Angle of Attack-Deg.
1	1	428	.91	20,000	3.5
1	1	428	.905	20,020	3.5
1	2	424	.90	20,000	3.5
1	2	422	.896	20,000	3.5
1	4	424	.903	20,000	3.6
1	4	424	.90	19,980	3.6
2	1	423	.903	20,080	3.6
2	1	423	.903	20,070	---
2	2	425	.902	20,000	3.5
2	2	422	.899	20,040	---
2	4	428	.91	19,940	3.4
2 (repeat)	4	423	.898	19,890	3.4
2	4	422	.899	19,940	3.4
3	2	423	.901	19,990	---
3	2	423	.90	19,995	3.4
3	4	425	.903	19,950	3.4
3	4	424.5	.902	19,940	3.4

During these runs near .9 Mn, the chase reported no turbulence and the XB-70 exhibited very light airframe buffet.

3.0 LONGITUDINAL DYNAMIC AND DIRECTIONAL STABILITY, .8 MN, 15,000 FT.

With the wingtips at one-half and the augmentation ON, a pullup and release from 1.5 G was accomplished at C/N 3666. The G returned rapidly and a 10 - 20 per cent overshoot was observed with no residual oscillations. After this one run was obtained, the COOL MALF light came ON, and the instrumentation was turned off to allow cooling before the next run.

With the instrumentation and augmentation ON, a slow right sideslip was accomplished to three degrees, requiring slightly more than three-quarters rudder. While reading 3 degrees on #1 yaw needle, #2 yaw system was selected at C/N 3735 and 2.7 degrees of left yaw were observed in the right sideslip. Dynamic directional stability was obtained from a two-degree release. Damping was satisfactory.

With augmentation OFF, a pullup and release from 1.4 G was obtained on the instrumentation; however, the digital tape light was extinguished, but the dial read 30 per cent. The resulting longitudinal oscillation damped to less than one-half amplitude in less than one-half cycle.

4.0 CAPSULE FLYING

With the airplane trimmed up and FACS ON, the copilot flew the airplane from inside the capsule at .8 Mn, 15,000 ft. Also, a descent to 10,000 ft. at 400 knots was accomplished. He reported all flying had to be accomplished by instruments only, as he could not see outside the airplane. He reported roll to be insensitive, but liked it that way.

5.0 HYDRAULIC REPLENISHING SYSTEM

With P_1 utility system reading 6.2 gallons, the replenishing system was turned on; and after one minute, one gallon of fluid was transferred to system P_1. Then with U_1 reading 13.1 gallons, 1.6 gallons were transferred in one minute to the U_1 system. With P_2 reading 5.6 gallons, the system was turned on for one minute, at which time the system read 6.7 gallons--a transfer of 1.1 gallons per minute. Each of the above three systems was replenished using the primary bus. With U_2 reading 12.1 gallons, 0.9 gallons was transferred to this system in 45 seconds using the essential bus. All systems operated satisfactorily.

6.0 COMPASS CHECK

The following compass readings were obtained while lined up with Runway 22 (actual heading - 223°):

Prior to Takeoff	After Landing
Magnetic 217	215
Great Circle 213	218
Great Circle 217 (after REALIGN)	217
Magnetic 217	216
Derated Mag. 217	216

7.0 BRAKE TEST

Using the brake control test box, two stops from 8 and 15 knots taxi speeds were accomplished by placing the control knob at 10--then switching the master switch on. Braking was normal and very smooth. Then a stop was accomplished from 17 knots using control setting 15. The braking was excellent and moderate and the airplane stopped in quick fashion; however, the ground crew advised that some skidding was observed on this stop.

From 15 knots, a stop was accomplished by starting a deceleration using setting 10, then increasing the setting to 15 for the remainder of the stop. The braking was excellent and very smooth; however, the ground crew again reported skidding. Several other stops using control setting below 10 were accomplished for data purposes. All of these stops were excellent, and it was found that slight deceleration still existed even with the control setting placed at zero. Complete brakes could be released only by turning the master switch off.

8.0 CONCLUSIONS

1. From the chase comments on the tufts, the canard appeared to be stalled out at .43 and .6 Mns.
2. All flow on canard and wings was smooth at .9 Mn.
3. Vertical stabilizer flow was smooth at all Mach numbers.
4. Longitudinal dynamic stability was excellent at .8 Mn, 15,000 ft., with augmentation off.
5. Braking characteristics were excellent using the test brake control box. Deceleration was very smooth with all chatter, grabbing, and quivering completely absent from all stops.

9.0 DISCREPANCIES

1. #6 and #3 turbine flange engine vibrations inoperative.
2. #4 primary hydraulic pump cycles ± 500 or 600 psi.
3. Instrumentation ran on #2 for approximately 30 minutes; then COOL MALF light ON. Instrumentation OK below 10,000 ft.
4. Water-ammonia light late to go out and came on near end of flight at 90%.

V. H. Shepard

V. H. Shepard
Pilot

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT Lt. Col. F. Fulton

FLIGHT NO. 1-35 COPILOT V. H. Shepard

DATE OF TEST 3 March 1966 FLIGHT TIME 2:42

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #316 - Capt. Gentry
Chase 2 - F-104 #314 - Capt. Gentry
Chase 3 - F-104 #316 - Maj. Sorlie/Col. Cotton
Helicopter H-21 #854 - Maj. Baldwin

PURPOSE OF FLIGHT

1. Photographic Airflow Tuft Study
2. Low-speed Cooper Ratings

1.0 TAKEOFF

A takeoff weight of 520,000 lbs. at 35°F, using MAX A/B, resulted in a handbook acceleration time of 17 seconds from 70 to 150 KCAS. The actual time observed was 19.5 seconds. Considering that the actual brake release occurred closer to 510,000 lbs., this time was excessive and indicates that better acceleration data should be made available to the pilots to prevent an embarrassing abort.

2.0 GENERAL COMMENTS

The majority of the scheduled tests were not accomplished because the FLAP PRESS caution light would not extinguish with the flaps up. Photographs were obtained of the tufts on the wing, vertical, and canard. Tuft patterns of the canard were obtained--flaps up and down.

2.1 POWER MODULATIONS - .4 MN, 10,000 FT.

Rapid power modulations of engines #1, #2, and #3 from IDLE to MAX A/B to IDLE were accomplished with no difficulties. All engines were cycled normally through this range with no difficulties.

2.2 TRIP TO ELECTRONICS BAY IN PRESSURE SUIT

A trip was accomplished back to the EE bay in order to cycle several flap control circuit breakers. The main problem encountered in traversing back to the EE bay was disconnecting all the

taped-up leads to the pressure suit. Communication from the EE bay was satisfactory, once the pilot turned up the writer's master interphone volume. However, the writer was not able to talk to anyone while cycling and identifying circuit breakers due to the fact that the stationary mike switch was located in the mid-top part of the EE bay, whereas the circuit breakers are located in the bottom aft part of the EE bay. It was found to be very time-consuming in going from a prone or on-the-knees position to a stand-up position in order to use the mike switch because of no traction between the floor and the pressure suit. This caused the pilot to always slip towards the ammonia heat exchanger grating.

2.3 LONGITUDINAL COOPER RATINGS

The airplane was rated by climbing 2,000 ft. from a stabilized level flight condition to another stabilized level flight condition, then descending to the original altitude. The airplane was given a longitudinal Cooper Rating of 2, both with and without augmentation on. The climbs and descents were accomplished at a constant 250 KIAS.

2.4 LATERAL-DIRECTIONAL COOPER RATINGS

The airplane was rated by turning from one stabilized heading to another stabilized heading using a 30-degree bank angle. Rudder was used to coordinate the turn, and the airplane was given a rating a 4--with or without augmentation on.

Using aileron-only turns, the lateral-directional rating was increased from 4 to 4½--with or without augmentation on. This poorer rating was given because of the initial excessive adverse yaw (2-3 degrees) due to aileron.

2.5 POWER TRIM CHANGE

With the airplane trimmed up in level flight, at an approach speed of 215 knots, a throttle angle of 35 degrees was observed. Military Power was then selected and a mild five to seven pounds of forward force were required to stabilize the airspeed. After stabilizing, MIN A/B was selected where near 10 to 12 pounds of forward force were required. Then maximum A/B was selected, and approximately 20 pounds of push force were required to stabilize at the original trim speed of 215 KIAS.

3.0 RECOMMENDATIONS

1. That the mike switch in the electronics bay be placed on the communications card so that the user may talk at any time.
2. That more accurate takeoff acceleration data be made available before summertime.

4.0 DISCREPANCIES

1. #1 primary hydraulic pump status light flickers inflight.
2. Landing gear slow to retract, and right main door slow to close.
3. Flap pressure light would not go out with flaps up.
4. Flaps would not retract near end of flight.
5. Both VSI angle-of-attack tapes inoperative.
6. Both (P & CP) ADI balls not leveled.
7. Tire overheat circuit breaker popped in flight (6L 8A).
8. #2 engine would not start on 4-joule ignition.
9. Yaw indicators don't agree with each other nor with the balls.

V. H. Shepard

V. H. Shepard
Copilot

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT Lt. Col. F. Fulton

FLIGHT NO. 1-36 COPILOT V. H. Shepard

DATE OF TEST 4 March 1966 FLIGHT TIME 2:27

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #316 - Capt. Hoag/Maj. Cuthill
Chase 2 - F-104 #315 - Maj. Sorlie/Col. Cotton
Chase 3 - F-104 #817 - Capt. Roosa
Helicopter H-21 #389 - Capt. Otto/Maj. Ludwig

PURPOSE OF FLIGHT

1. Level flight performance
2. Inlet bypass - capsule test
3. Longitudinal dynamic and accelerated stability
4. Directional dynamic and static stability
5. Airstart at .9 Mn, 25,000 ft.

1.0 GENERAL COMMENTS

1.1 LEVEL FLIGHT PERFORMANCE

Two engines in A/B (74-degree throttle angle) and four engines at Military were required to maintain .98 Mn at 25,000 ft. shortly after takeoff. Also, power required for level flight at this condition did not appear to change with windshield up or down.

1.2 POWER MODULATION

No difficulties were encountered in cycling #3 engine fast or slow from MIN to MAX to MIN afterburner at 1.8 Mn, 55,000 ft. Also, no difficulties were encountered in cycling three (left) engines rapidly from IDLE to MAX A/B to IDLE at .8 Mn, 15,000 ft.

1.3 BYPASS - CAPSULE DESCENT BUILDUP TEST - 1.4 MN, 41,000 FT.

With the three left engines at flight idle (75 per cent rpm), the left bypass was driven wide open (2200 sq. in.) rapidly with the electric standby switch. Stabilized data were obtained for ten seconds, then this test was repeated with the engines stabilized at 85 per cent and 40-degree throttle angle. No engine problems were encountered during the rapid bypass movements.

1.4 AIRSTART - .9 MN, 25,000 ft.

An airstart was accomplished on engine #1 from a windmill rpm of 37 per cent. The engine started 13 seconds after the throttle was advanced to IDLE.

2.0 CONCLUSIONS

1. Airstart was satisfactory at .9 Mn, 25,000 ft.
2. Rapid opening of the bypass with the three engines in the respective inlet at IDLE, 85 per cent and 40-degree throttle angle resulted in no engine problems at 1.4 Mn, 41,000 ft.

3.0 DISCREPANCIES

1. EGT on #3 went to 780 degrees with engine at IDLE--appeared to be gage problem.
2. Both attitude indicators had large transients on several occasions.
3. #1 engine primary hydraulic pressure caused warning light to flicker.
4. Primary pitch trim disengaged for some unknown reason.
5. #1 ADS overpressure door blew open inflight.
6. #5 ADS overpressure door has skin pealed back.
7. #5 engine runs at 101.2 rpm at Military Power.
8. Left gear door slow to close after takeoff.
9. U_2 gage shows 3550 psi inflight.

V. H. Shepard

V. H. Shepard
Copilot

R-66-3-2 Edwards AFB Copy 8

PILOT COMMENTS

XB-70A FLIGHT 1-36 4 MARCH 1966

INTRODUCTION: The flight was scheduled for 1100 hours and became airborne at 1055. Flight objectives were subsonic and supersonic performance, engine tests, AICS tests, stability and control tests, and sonic boom tests. Maximum speed and altitude scheduled were 2.0 Mach and 55,000 feet. All scheduled tests and an additional series of 1.2 Mach AICS tests were completed. The maximum speed and altitude attained were 2.02 Mach and 56,000 feet. Flight duration was two hours and 27 minutes.

PREFLIGHT AND TAXI: All engine starts were normal except #3 which had erratic EGT indications on the first start and was shutdown when the EGT went above 750 degrees. The problem was analyzed to be a faulty EGT and the second start of that engine was normal. Using the normal toe brakes carefully and gradual brake applications allowed the airplane to be slowed down and stopped without encountering any brake chatter.

TAKEOFF AND CLIMB: Total fuel remaining three minutes prior to brake release was 259,000 pounds. FACS was engaged prior to takeoff and remained engaged for the takeoff. Using max A/B, the airplane accelerated rapidly and was lifted off at approximately 212 knots as scheduled. After retracting gear and flaps and setting the wing tips to 25 degrees, a normal climb was made to 25,000 feet.

LEVEL FLIGHT PERFORMANCE:

A speed power run with nose ramp up and wing tips at 25 degrees was flown at .93 Mach, 25,000 feet, with engines 1, 2, 5 and 6 set at military power and engines 3 and 4 in afterburner at 74 degrees throttle angle. The angle of attack was 3 degrees and the airplane seemed to be up against a steep drag rise as it was very easy to hold speed and altitude.

The airplane was climbed and accelerated using max A/B to reach 2.0 Mach at 55,000 feet. The supersonic jump came at 1.04 indicated Mach and caused an altitude increase of 650 feet. The acceleration appeared to be fairly rapid. The speed and altitude were 1.77 Mach at 40,000 feet passing Edwards where sonic boom data was recorded.

The first supersonic speed power run was at 2.01 Mach, 54,800 feet, with the inlets unstarted. The indicated speeds were 485 knots on the tape and 476.5 knots on the round dial. The inlets were started without any change in airframe noise or buffet. The speed decreased slightly when the inlets were started and a throttle advance was required to obtain the stabilized speed power run at 1.995 Mach.

ENGINE TESTS:

Power was reduced and the airplane was decelerated to 1.8 Mach while holding 55,000 feet. After establishing 1.8 Mach, 55,000 feet, the #3 engine was cycled slowly and then rapidly from max A/B to min A/B to max A/B. Engine indications were normal except for min A/B instability which went away when the throttle was advanced to 65 degrees throttle angle.

AICS TESTS:

The airplane was slowed to 1.4 Mach at approximately 41,000 feet. AICS pressure data was obtained with RPM released and the left bypass doors set at 1100 and then at full open (approximately 2220) with engines 1, 2 and 3 set at idle (73-75%), idle +10% RPM (85%), and then at 40 degrees throttle angle. All engine indications were normal. There was a strong nose up trim change as the bypass doors went to full open.

The flight was going slightly ahead of schedule, therefore, as the airplane was slowed down, Data Control advised to do a series of sideslips at 1.2 Mach, 35,000 feet. Sideslips were done in each direction with bypasses set at 800 and then with bypasses set at 400. All indications were normal.

STABILITY AND CONTROL AT .95 MACH, 25,000 FEET, WING TIPS 25 DEGREES:

A FACS on pull-up and release damped out rapidly. A FACS on sideslip to 3 degrees had positive stability and required less than full rudder. Five degrees of bank was needed to stabilize. The release from 2 degrees of sideslip damped out in less than one cycle.

With FACS off, the airplane was trimmed at .95 Mach and speed was increased to an indicated .99 Mach which required approximately 20 pounds of push force to stabilize. After slowing to .845 Mach, elevator force needed to stabilize was 15 pounds of pull.

With FACS still off and stabilized at .95 Mach, a pull-up and release damped in approximately one cycle. Sideslips to 3 degrees required less than full rudder and only a small amount of opposite aileron. The release from 2 degrees sideslip damped to ½ amplitude in one cycle. A wind-up turn at 1.4 "g" had a positive gradient with higher than desired elevator forces.

SUBSONIC LEVEL FLIGHT PERFORMANCE:

Speed power runs at 25,000 feet were obtained under the following conditions:

Mach	Tape IAS	Wing Tips	Nose Ramp	Pitch Aug	Comments
.93	420	25°	Up	On	
.90	386	25°	Down	On	
.90	386	Up	Down	Off	
.80	334	Up	Down	Off	Round Dial IAS=332
.80	334	25°	Down	On	Round Dial IAS=331.5

When the wing tips were moved from 25 degrees to up there was a very noticeable deterioration in flying qualities. It was very easy to induce small self generated neutrally damped lateral oscillations with the ailerons. By prudent aileron manipulations, these could be eliminated.

AIRSTART: The #1 engine was shutdown at .90 Mach, 25,000 feet. Idle RPM prior to cut off was 63% and windmill RPM was 37%. Light off occurred 13 seconds after the throttle was set in idle and the EGT was low. All engine indications appeared normal during the airstart.

ENGINE TESTS AT 15,000 FEET: The airplane was established at .80 Mach with engines 1, 2 and 3 at max A/B. The throttles were retarded rapidly from max A/B to idle and after stabilizing, they were advanced rapidly to max A/B. Engine response was normal except that high vibration was encountered on #6 engine when it was advanced rapidly to maintain the desired speed. This was apparently 520 cps vibration and stopped when the engine was set at 85% RPM for a few seconds. All six engines were then set at max A/B and cycled to idle and back to max A/B at a normal rate. Engine response was satisfactory, however, it was impossible to hold speed at .80 Mach and the speed increased to .90 Mach with all engines at max A/B and then decreased to .75 Mach with all engines at idle power.

STABILITY AND CONTROL AT .80 MACH, 10,000 FEET, WING TIPS 25 DEGREES: With FACS on approximately half right rudder produced 2.6 degrees of sideslip and required 10 degrees of left bank to stabilize. A release from 1.5 degrees of sideslip damped rapidly and then tended to roll off to the right slightly. With FACS off, a sideslip of 3.2 degrees required approximately 10 degrees of bank to maintain a constant heading. The release damped out satisfactorily.

APPROACH AND LANDING: The airplane was returned to the pattern and landed with approximately 23,000 pounds of fuel remaining. Touchdown speed was approximately 170 knots on the vertical airspeed indicator. All three chutes came out but one of them failed to inflate. The airplane had slowed to 70 knots with 5,000 feet of runway remaining without using the brakes.

SYSTEMS:

1. The flight control system functioned normally except for a primary pitch trim disengagement which occurred without any apparent reason and without any warning. This occurred during .8 Mach flight at 15,000 feet and the disengagement was not noted until the primary pitch trim wheel had been rolled nose down several times in attempting to trim the airplane. The standby pitch trim was cycled from armed to off to armed and the pitch augmentation was cycled off to on without regaining primary pitch trim. These switches were recycled several additional times and suddenly the airplane appeared to have a nose down run away pitch trim. The primary pitch trim wheel was rolled in the nose up direction as 35 to 40 pounds of pull force was held on the control column to prevent further airplane nose down tendency. Movement of the wheel finally began to take effect and the forces were trimmed out. It appears that actually the primary pitch trim had re-engaged. The early attempts to trim the nose down with the pitch trim wheel had left the primary pitch trim system offset from null and when it engaged the system immediately began to "run away" to reach the trim position set by the trim wheel. This is a very unsatisfactory and potentially dangerous design feature. If it should occur during very high Mach flight, I feel that there is a good chance of exceeding the design speed. The pitch trim should be redesigned to always engage in a null position.

2. All other systems had generally satisfactory operation.

MISCELLANEOUS ITEMS OF INTEREST:

1. Noise and vibration in the cockpit had a marked increase between .85 and .88 Mach as it has on previous flights and the chase airplane reported that the tufts attached to the canopy area showed very turbulent air flow in that speed regime.

2. The sun shades attached above the windshield are effective in eliminating glare from the sun, however, the nontransparent material is unacceptable since it always eliminates some of the visibility. When stowed, the upper windows are blocked out and when lowered the windshield is blocked. The XB-70 visibility is already too marginal to accept a sun shade that always reduces some of the visibility.

CONCLUSIONS:

1. The flight was very successful with all scheduled and one extra test being completed.

2. At high subsonic speeds, 25,000 feet, there was a marked decrease in lateral handling qualities when the wing tips were moved from 25 degrees to up.

3. The design feature of the primary pitch trim that allows it to engage in other than a null condition is very unsatisfactory.

4. The nontransparent sun shades are unacceptable.

MAINTENANCE DISCREPANCIES:

1. EGT on #3 engine went to 780 degrees with engine at idle - appeared to be gauge problem.

2. Both attitude indicators had large transients on several occasions.

3. The #1 engine primary hydraulic pressure caused warning light to flicker.

4. Primary pitch trim disengaged for an unexplained reason.

5. The #1 ADS overpressure door came open in flight.

6. The #5 ADS overpressure door had skin peeled back.

7. The #5 engine went to 101.2% RPM at military power after flight.

8. Left gear door slow to close after takeoff.

9. O_2 pressure gauge shows 3550 PSI.

RECOMMENDATIONS:

1. Correct the maintenance discrepancies noted.

2. Redesign the pitch trim system to cause engagement to be in a null position.

3. Install transparent sun shades.

Fitzhugh L. Fulton

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Pilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. H. Shepard

FLIGHT NO. 1-37 COPILOT Col. J. Cotton

DATE OF TEST 7 March 1966 FLIGHT TIME 2:19

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #316 - Capt. Hoag/Lt. Col. Fulton
Chase 2 - F-104 #316 - Capt. Hoag/Lt. Col. Fulton
Helicopter H-21 #389 - Capt. Flannagan

PURPOSE OF FLIGHT

1. Level flight performance at .9 Mn, 25,000 ft.
2. Afterburner ignition at 2.15, 1.8, 1.6, and 1.4 Mn, 55,000 ft.; .8 and .4 Mn, 15,000 ft.
3. Power modulations at 2.15 Mn, 55,000 ft.; 1.4 Mn, 41,000 ft.; .95 Mn, 25,000 ft.
4. Airstarts at .9 Mn, 25,000 ft.
5. Longitudinal accelerated stability at 1.6 and 1.4 Mn, 55,000 ft.

1.0 TAKEOFF

A new takeoff technique was used on this flight (per NASA-FRC) wherein an attempt was made to increase the angle of attack during the takeoff, but leave the nosewheel on the runway and start the rotation earlier. Shortly after brake release, 20 to 30 pounds of aft stick were applied and held to 173 KIAS. It appeared that this increased the angle of attack near 70-80 knots from -4.5 to near -3.5 degrees. The nose felt light approaching 170 KIAS, but the nosewheel remained on the runway. The rotation was started at 173 KIAS, and as the airplane reached 10 degrees pitch angle (using the nose 11-degree reference), the airplane flew off very smoothly near the predicted takeoff speed of 203 KIAS. The rotation was slower than the normal rapid rate required previously to get the airplane airborne within the 20-knot spread from rotation to lift-off.

Using this slower rotation, the airplane appeared to do exactly what the writer wanted it to do. This technique was preferred over the old "yank fast, and let's see what happens." It is recommended that several takeoffs be accomplished in this fashion to determine the effects on distance. Augmentation was engaged 200 ft. in the air, and the device was a welcome one in the light turbulence. During the initial climb, the gradient appeared lighter and less trim was required; and best of all, the airplane flew almost hands-off, lateral-directional wise, while accelerating to 425 KIAS.

2.0 LEVEL FLIGHT PERFORMANCE - .9 MN, 25,000 FT.

Data were obtained of a good stabilized level point with gear, flaps, and wingtips up and nose ramp down. EGT was near 850°C on all engines. Then a point was attempted at the same speed with the wingtips at one-half; however, the point had to be discontinued because ATRC would not allow the flight to continue at 25,000 ft. This point was considered unsatisfactory because of insufficient time to stabilize.

3.0 AFTERBURNER LIGHT-OFFS

Data were obtained of the #3 engine afterburner lights by moving the throttle from MIL to MAX A/B and from MIL to MIN A/B at 2.15, 1.8, 1.6, and 1.4 Mn at 55,000 ft., and .4 and .8 Mn at 15,000 ft. All light-offs were satisfactory (except at .4 Mn) when advancing the lever to MAX A/B; but when advancing the lever to minimum A/B, instability occurred. This instability resulted in EGT and rpm oscillations, which were stopped by moving the throttle forward slightly. Afterburner light-offs were satisfactory at .8 Mn, 15,000 ft., both from MIL power to MIN and MAX afterburner. Three-engine afterburner light-offs at .4 Mn, 15,000 ft., were not satisfactory because #3 engine would not light off. No. 1 and No. 2 engine light-offs were satisfactory.

4.0 POWER MODULATIONS

The three left engines were cycled slowly and rapidly from IDLE to MAX afterburner to IDLE at 2.15 Mn, 55,000 ft.; 1.4 Mn, 41,000 ft.; and .95 Mn, 25,000 ft. No difficulty was encountered, except that the .95 Mn rapid cycle from MAX A/B to IDLE resulted in an inadvertent shutdown of engines #2 and #3. This run was repeated later after the engines were airstarted at 15,000 ft., 450 KIAS. Also, single-engine rapid cycles of engine #3 were obtained at 1.4 Mn, 41,000 ft., and .95 Mn, 25,000 ft., with no difficulties encountered.

5.0 AIRSTARTS

No. 1 engine was airstarted satisfactorily at .90 Mn, 25,000 ft., within ten seconds from the time the airstart ignition was turned on. No. 2 and No. 3 engines would not start at .9 Mn, 25,000 ft. nor 20,000 ft. No. 2 engine started successfully on the first attempt at 15,000 ft., 450 KIAS. No. 3 engine started successfully on the second attempt at 15,000 ft., 450 KIAS.

6.0 LONGITUDINAL ACCELERATED STABILITY - 1.6 and 1.4 MN, 55,000 FT.

Accelerated stability was obtained by accomplishing windup turns to 1.45G at constant Mach numbers. The gradient was moderate at 1.6 Mn and moderately heavy at 1.4 Mn. No shallowing of the gradients or buffet was encountered at either Mach number.

7.0 LANDING GEAR EMERGENCY

The landing gear handle was placed in the down position near 260 KIAS, and immediately a large jolt was felt in the airplane. Shortly thereafter, Chase reported fluid streaming from the right gear well. At this time all three utility system #1 pumps turned amber and the pressure decreased rapidly to zero. Chase reported all gear normal, except that the right-hand bogie did not unfold, but had rotated behind the strut and remained vertical.

Utility #2 system was normal, then the electrical emergency switch was placed in the down position with no results. No. 2 manual emergency system was then used, but the bogie did not unfold; however, the #2 utility system status lights turned amber and the pressure went to zero. Fluid levels remained near five gallons, but hydraulic head pressure was decreasing. The manual emergency handle was then returned to NORMAL. Chase then reported the left bogie to be drifting to the vertical position. It was then decided to land on the northern lakebed--having no utility pressure meant no brakes, no nosewheel steering, and no chute!

After the utility pressure failed, the throats were watched carefully, and even while flying the latter part of the final approach at 180-185 KIAS, no throat movement was detected.

Some difficulty was experienced on final approach in maintaining approach speed. Speed decreased to 180 KIAS on two occasions; and as Military Power was applied to control the speed, full down elevator (on the stop) was required to maintain attitude. The CG was aft because of fuel being trapped in Tank 8 and because the sump level was near 10,000 pounds on final approach. It was believed, however, that the CG was well within limits and the situation should be thoroughly investigated. It is believed that the extreme forward column position lead to the poor airspeed control.

The landing was accomplished quite smoothly at 172 KIAS, and an attempt to "play" with the right gear was accomplished to see what comments the Chase had. Shortly after touchdown, the airplane appeared to lean excessively to the right. Chase called out to rack the airplane to the right, which was confusing, to say the least, since considerable left aileron was already applied to hold the right side up. The racking was accomplished twice, but resulted in no unloading of the left gear, which was tippy-toe; i.e., solidly resting on the front two wheels only of the bogie that had drifted and remained vertical. (The state of the left gear was not known to the crew; only that the airplane was listing heavily to the right, giving us the impression that the right gear was folding underneath the fuselage with the left gear being normal.)

The nose was flown to the lakebed and the touchdown occurred near 100 KIAS. Engines #2, #4, and #5 were shutdown. The airplane wanted to turn right, and full left rudder would not maintain directional control; therefore, #6 engine was utilized to maintain directional control. On at least four or five occasions, MAX A/B was used on #6 engine to stop a rather sharply increasing turn to the right. Fair directional control was available from #6 in A/B; however, the airplane would accelerate about the time the turn was stopped and the engine had to be retarded.

The chute was not used because of the moderate right crosswind (260-280°/16+22). (It probably would not have deployed because of no utility pressure.) Finally near 25 knots, the airplane was allowed to turn excessively without using the #6 engine so as to finally stop, for the lakebed appeared questionable ahead. This was an agonizing moment, as one feared the nosewheel might "dig in" in this forever-decreasing radius turn; and out of sheer fright, Military Power on #6 engine was applied just prior to stopping, hoping to alleviate the situation somewhat. The throttle was retarded as the airplane came to a moderate stop after having turned approximately 100 degrees from the lakebed Runway 18R centerline. Later on, the tracks in the lakebed revealed a lateral displacement to the right of .55 miles from the centerline and 2.7 miles were required to stop the airplane.

This landing could not have been accomplished on any runway in this country; and thank God for Rogers Dry Lake, on which twenty years ago--almost to the week--I made by first lakebed landing.

8.0 CONCLUSIONS

1. Thirty-knot spread between rotation and lift-off allows for more feel and precise control during the takeoff phase than does 20 knots.
2. Afterburner lightoffs at 55,000 ft. from 2.15 to 1.4 Mn were excellent if the throttle was not left in minimum afterburner position for the lightoff.
3. Three-engine throttle bursts simultaneously from IDLE to A/B to IDLE were satisfactory at 2.15 Mn, 55,000 ft.; 1.4 Mn, 41,000 ft.; and .95 Mn, 25,000 ft.
4. Airstart on #1 engine at .9 Mn, 25,000 ft. was excellent lighting-off within ten seconds. #2 and #3 engines would not light at this test condition.
5. Longitudinal accelerated stability gradient (Fs/g) was much steeper at 1.4 Mn, 55,000 ft. when compared with 1.6 Mn, at 55,000 ft.
6. The drifting bogie landing gear condition ends up in a tippy-toe folded, vertical bogie and presents a precarious situation if bogies do not end up symmetrical after touchdown.
7. Directional control could not be maintained below 40 to 60 knots with unsymmetrical bogies during landing roll.
8. Nose down longitudinal control was inadequate with an aft CG condition at best flare speeds.

9.0 RECOMMENDATIONS

1. That a study be made to determine if a spring or slipstream spoiler can be incorporated to prevent the bogies from drifting to the vertical position.
2. More nose down longitudinal control be made available for low speed, aft CG conditions.

10.0 DISCREPANCIES

1. Background noise on guard, both UHF sets.
2. Elevons not even laterally with TTO light ON.
3. Both main gear doors slow to close on retraction.
4. Digital would not switch to "B" recorder automatically.
5. No. 3 A/B would not lightoff.
6. TACAN bearing breaks lock frequently, distance O.K.
7. RH gear extended too abruptly and jolted A/C when gear handle moved to down.
8. On touchdown, RH bogie moved from vertical to normal horizontal, but LH bogie had drifted near vertical before landing and remained vertical on touchdown and throughout the landing roll.
9. Pressure lost on both utility #1 and #2.
10. #1 primary hydraulic status light blinks continuously.

V H Shepard

V. H. Shepard
Pilot

JUCRER PRINTS

IL, "Flight 1-37 Landing (Lakebed)" 10 March 1966

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INTERNAL LETTER
North American Aviation, Inc.

Date · 10 March 1966

TO · H. Z. Hopkins, Jr.
Address · D/186 EAFB

FROM · R. G. Yeamans
Address · D/186 EAFB

Phone · 7331

Subject · Flight 1-37 Landing (Lakebed)

The following diagram and notes cover an inspection made of the lakebed following an emergency landing on runway 18 (right hand side) on Flt. 1-37, 7 March 1966. Dimensions in miles unless otherwise noted.

14. 100° from original landing direction at stop

13. 2.7 Mi total landing roll

12. Start of another sharp right turn

11. Start of a sharp right turn

10. Offset to stop from original landing path .55 Mi.

9. Drift to left 25'

8. Start of left drift

7. Nose wheel on continuously

6. Nose wheel first touchdown for .1 mi. then off for a .1 mi.

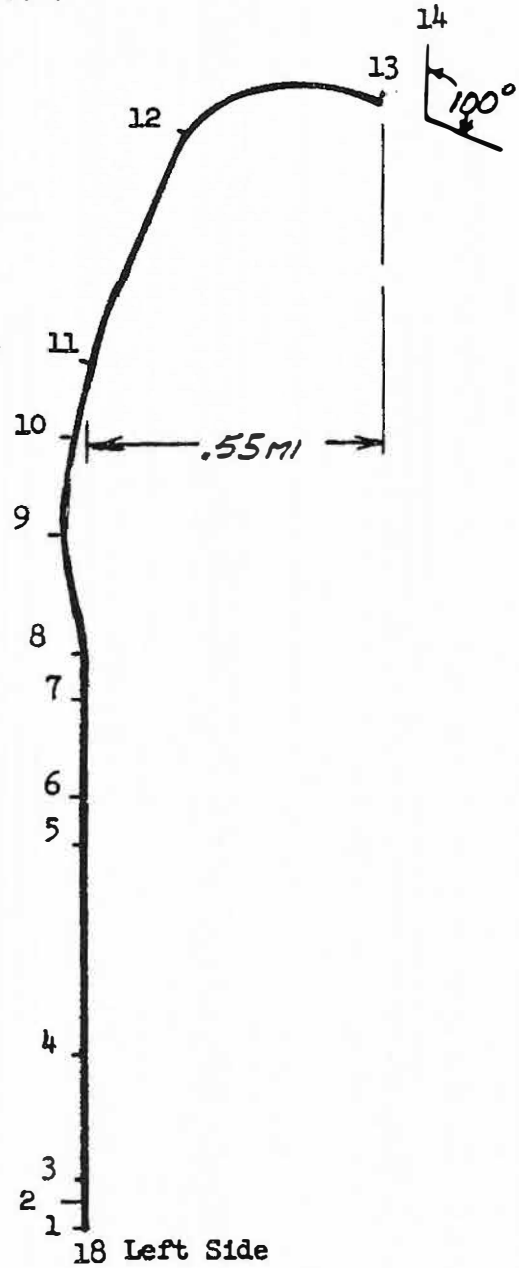
5. Softest area. Track 1 1/4" deep. 3/8" dia. rod penetrates 1/2". Ball 3"

4. RH touches for 25' followed by lift off 50' followed by remaining on ground

3. RH initial roll 121' followed by lift off

2. RH gear first touchdown, 158' after LH gear

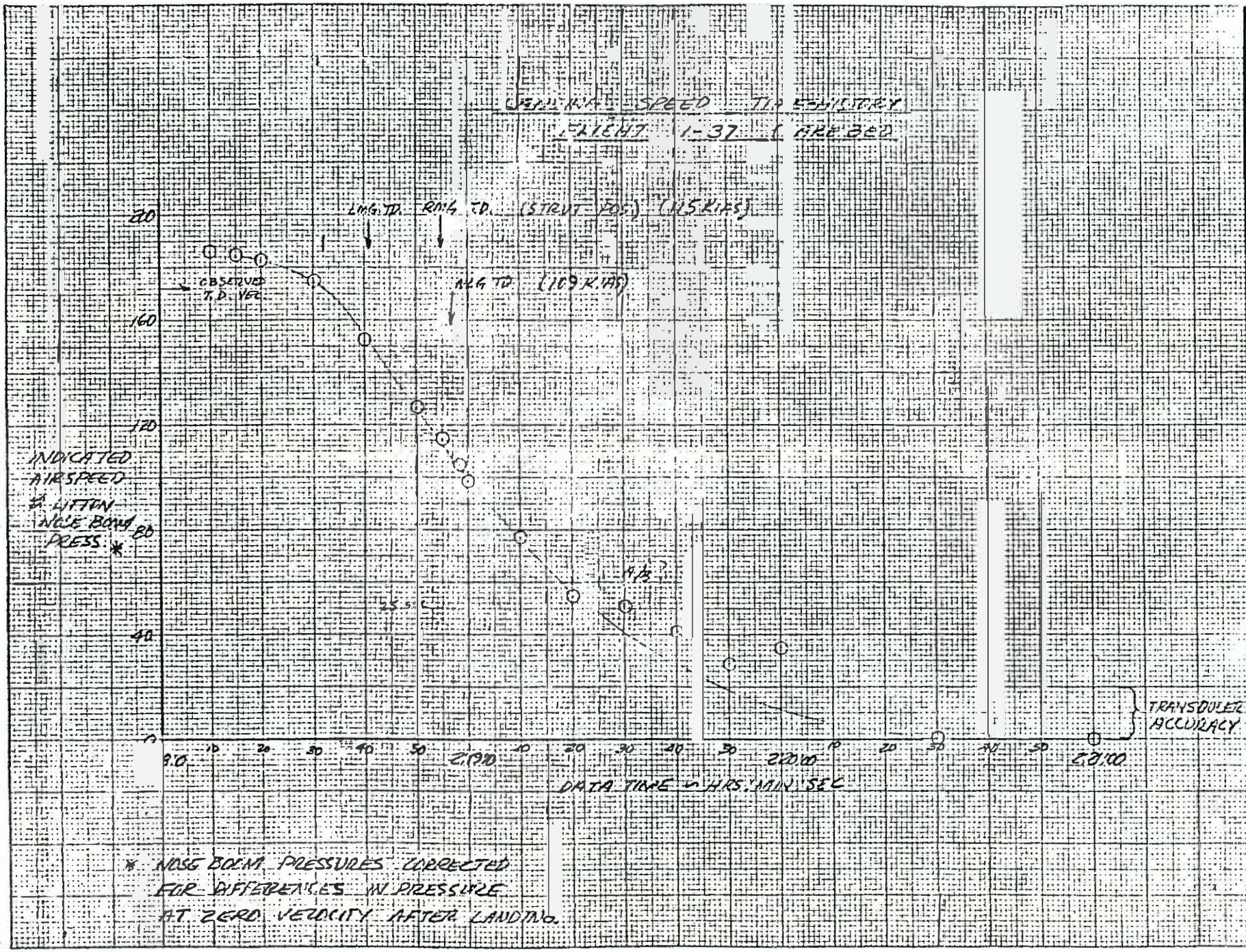
1. LH gear touchdown & remains on ground. Track 1/2" deep. BEAUTIFUL LANDING. CONGRATULATIONS!



R. G. Yeamans
Sr. Flight Safety Engineer

Form 131-R Rev. 2-65

MOD. STRUCT. GEAR POS
" CABS. A/S.



FORM 1031-6

PREPARED BY: REL

CHECKED BY:

DATE: 3-14-66

NORTH AMERICAN AVIATION, INC.

PAGE NO. OF

REPORT NO.

MODEL NO.

FT Nº 18396

TEST NO. FLT 1-37 MODEL NO. XB-70A DATE 3-7-6

TITLE A/V #1

WITNESSES

DATA BY PART NO.

OBJECT SHEPARD - COCKTOW (PRESS SUITS)

1300 OAT 70° Pro 27.552
1301 ENG START
No. 4 EGT 550° PK
570° SP.
No. 6 550° FP 565° SP
No. 5 525° FP 550° SP
No. 3 565° FP 615° SP
No. 1 540° FP 600° SP
1307 No. 2 560° FP 585° SP
1312 C/N 12 FULL THROWS
C/N 126 DATA OFF
1312 PRIM LITE ON-OFF
C/N 462 FLAPS DN
C/N 582 FLAPS UP
DATA OFF
P1 182 V1 170
P2 190 V2 190
INL. PWR 85 % RPM
STEADY LITE OK
1330 ANX COOL - ON
DOOR CLOSED
FAN - ON (2)
1339 BEGIN TAXI
1352 DATA FLAPS DN
1357 DATA OFF
1355 T1 34.3
T2 27.
[illegible] 26.
4 [illegible]
6L [illegible]
6R 18.5
7 L 10.0
7 R 10.6
8 L 13.3
8 R 13.1

1355 TOT. 253.6
1358 HDING 223
1400 ALL TKS AUTO
CONT SET [illegible]
HD 216 PWR UP [illegible]
REFR ON
1402 2 & 5 1 & 6 3 & 4
1402:30 B/R MAX AB
1403 OFF AT 204 K
GEAR UP BOTH DOORS
SLOW
1404 DATA OFF FLAPS [illegible]
1406 W/S [illegible]
1407 CABIN [illegible]
ANX COOL [illegible]
ALL [illegible]
1408 MIL PWR
1415 DATA ON
1416 C/N 965 TOT [illegible]
1418 1½ MIN PCKF [illegible]
TIPS DN [illegible]
1420 C/N 1164 DATA [illegible]
1422 1½ MIN PCKF [illegible]
D/OFF [illegible]
1423 [illegible]
A/V ALT [illegible]
1424 D/ON 141[illegible] MIN
D/OFF
1427 CAB [illegible]
D/ON [illegible]
1428 1.38 Mn [illegible]
1428 1.4 Mn [illegible]
1429 [illegible]
1429 TOT 176.0

FT Nº 18396

TEST NO. _____ MODEL NO. _____ DATE _____

TITLE _____

WITNESSES _____

DATA BY _____ PART NO. _____

OBJECT _____

1431 WHEELS AFT AUTO
EGT'S 914
1433 Mn 2 CK LIST
910 L 910 R
2.0 + Mn EGT 1 BACK
1434 T4 21K # Mn 2.15
1435 L & R 750 2.10 Mn
SHOCK NED .6-.7
1436 WOULD LIKE SHOCK POSI
MARK AS CIO A/V 2
START ET TURN
1438 START A/B LITES
LH BYPASS GREEN
2.12 Mn
920 L 925 R
1439 D/ON 2300
#3 ENG 51° T4
2340 MIL-MAX
Mn 2.14 GOOD
LITE OFF
MIN A/B 2357
MIN A/B INDIAG.
1440 MIN A/B - MILL
2383 Mn 2.15
1441 2424 INC. THRUT
DIFF TO TELL IF
A/B LITE
1442 T4 OFF
1443 1,2,3 BACK
HAND TO MAINT XXX
1444 2180 III BYPASS
Mn 2 SHOCK .6
1445 ATTITUDE OFF 10°
RDY FOR FAST CYCLE
STOPPED ENG. 83% OIL SLOW

1446 HYD OK
1447 L 880
1,2,3 MAX-IDLE 2843
2865 C/N 1,2,3 82%
UP ON THRUT
K 560 D/OFF 2900
2.09 Mn 52.000'
1449 DECEL FROM 55K'
FOR CARD 3 RUN 2
Mn BELOW 2.0
1451 P1 PUMP BLINKING ALL
THE TIME
1452 Mn 1.76 MAX A/B
DESCENDING, T2 OFF
1454 1.79 Mn 52.5 K'
Mn 1.8 A/B LITE
BYPASS 700 LH
#3 TO MIL BP 70
D/ON 3262 1.79
53.5 K' D/3275
MIL @ 3295 @ 1.74 Mn
T3 MIN A/B 3305 C/N
TO MIL 3311 .75 Mn
@ 53.5 K' D/3 32
D/OFF 3346
1458 Mn 1.7 CK LIST OK
DECEL Mn 1.6
CAB - REC RDY
LH 700 III
1459 #3 TO MIL D/3353
TO 100C° MAX
TO MIL
TO MIN A/B 3560
A/B TO MIL 3565
WIND UP TURN 400 III

FT № 18396

TEST NO. _____ MODEL NO. _____ DATE _____

TITLE _____

WITNESSES _____

DATA BY _____ PART NO. _____

OBJECT _____

1501 3590 LITE
D/OFF 490 BP
1502 TOT 102.0 FUEL
ANGLE OF ATT 4°
1503 C/N 3724 1.55 Mn
54.4K' D/OFF
1503 D/ON 1.6 @ 3790
TURN YEI 98.0 FUEL
1504 Mn 1.45 BP 390 400
1505 D/OFF DECEL 1.4
1506 T7 GIFE
1507 BP 400
D/ON 4000
#3 TO MIL 4007
TO MAX AB 4017
EGT 950°
TO MIL 4029
C/N 4040
TO MIL 4061
1.39 Mn
D/OFF
1508 WIND UP TURN
4079 LITE
BP 400 4100
1509 D/LONG CAP KEEP OFF
1510 4175 C/N OUT OF A/B
D/OFF 4186
1511 TIPS 1.3 Mn
4237 C/N BP 400
LNZ 98
LITE ALL A/B'S
1512 RDY CHKD 4, RUN 2
1513 BP 400 LT. TURB.

1514 4392 #3 MAX A/B
4405 IDLE
1.4 41,700' 74%
4435 FWD 990° MAX
4453 STEADY D/OFF
1515 BP TO 700 L
1,2,3 SLOW CYCLE
4515 1,2,3 IDLE
4540 MAX AB
4551 BACK
1516 FAST CYCLE DOWN
A/B 4576 Mn 1.35
FT FULL PWR
1517 40K' 76.0 FUEL
1518 50% DATA
1519 BP 400 OUT OF A/B
1520 1.33 Mn MAX AB
1,2,3 CYCLE 700
MAX A/B IDLE FAS
D/ON 4830 42.4K
73% 1170° EGT
4873 TO MAX A/B
#2 TO 1000°
1522 ALL ENG 40° T4
1523 W/S RAMP DN Mn 1.2
DECEL 0.95 Mn, 25K'
1526 Mn 1.0
1527 HID 5K
1528 25K'
1529 T/M OFF
#3 TO MAX D/ON 5371
FAST CYCLE IDLE
C/N 5363 IDLE 5361
5395 FWD TO MAX 960°
D/OFF 5411

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TEST NO. _____ MODEL NO. _____ DATE _____

TITLE _____

WITNESSES _____

DATA BY _____ PART NO. _____

OBJECT _____

1531 1,2,3 TO MAX A/B
5440 TO IDLE
5464 TO MAX A/B
1532 5479 IN MAX A/B
95 MN 5494
1,2,3 AT IDLE 5500
1 @ 100 %
2 & 3 SHUT OFF
1533 TRY AIRSTART
S/DN INADVERT.
#3 TO IDLE
AIR START ON 15 SEC
1535 NO LITE 40° T &
THROT OFF AIRST.
OFF
5700 D/OFF
1536 #2 ENG. IDLE
AIR START ON 5740
FUEL OUT OF #2
1537 THR OFF NO LITE
DESC. TO 20K'
1538 D/OFF
1539 #6 INTO A/B
1540 #3 AIRST ON IDLE
D/ON 5956 FOG
#6 OUT OF A/B
1541 NO LITE A/S OFF
AIR ST. ON IDLE
1542 THRT OFF A/S OFF
NO LITE 15K
1543 DECEL TO 0.8 MN
1545 #2 & 3 A/S ON IDLE
450 KTS D/ON 6280
FOG OUT OF BOTH
#2 LITE EGT 15[illegible]

1546 #3 A/S OFF 15 SEC
#3 A/S ON IDLE
1547 6385 C/N #3 STARTED
A/S OFF
FUEL TOT 44.0
1549 RESET #3 GEN OK
1550 S/D ENG 1
6575 C/N
THR OFF 6591 C/N
TO IDLE NOW STAB.
1551 A/S ON 33.5
LITE 10 SEC. A/S OFF
D/OFF
1552 D/ON
1,2,3 6730 A/B
IDLE NOW
1553 6750 C/N TO MAX A/B
6770 D/OFF
THR 20° &
TOT 36.0 FUEL
1555 WIND 270 [illegible]
T/M ON AGAIN
1556 15K' ALT
6992 D/ON
#3 MIL TO A/B 7000
BACK TO MIL
TO MIN AB 7020
TO MIL NOW 7070
1558 1,2,3 MIL 7060
TO MAX A/B 7070
BACK TO 51° T4 7085
1,2,3 MIN A/B 7095
TO MIL NOW 50° T4
D/OFF 7107
23.6 JUMP FUEL

FT № 18397

TEST NO. _____ MODEL NO. _____ DATE _____

TITLE _____

WITNESSES _____

DATA BY _____, PART NO. _____

OBJECT _____

1559 30.5 TOT FUEL
1600 T&ON RT SIDE SL?
TT ON
02 TT OFF
TIPS UP 0.4 @ ISA
1601 L/ON 7325
HE MIL = MAX A/B
C/N 7347 TO MIL
TO MIN A/B
BACK TO MIL
7367 MIN A/B
BACK TO MIL
SUMP LOW LITE ON
7285 1ST A/B
HE NO A/B LITE
ALL IN MIL
1603 NHB / H2O LITE ON
@ 2K'
1609 GEAR UP
GAR IN A/V
RT. GAME OUT GUKL
RT NOT UNTOUCHED
U1 PRESS ZERO
ELEC
DK PRESS OK
ELEC CHECK DN
NOSE GR DN
RT NO CHANGE
RT GEAR NOT
UNTOUCH
EMERG NOTE
U2 @14 SS
U2 ISS D/ON
7910

1612 LAND ON LK BED
NO UTIL PRESS
1614 AUX COOL - ON
1616 BATTERY INV LITE ON
THEN OFF
1617 L&R NOT GREEN
FLAPS DN
161 D/ON BAT SW ON
CAMERA ON
10' ABOVE DECK
T/D 112
S/D 245
S/D 1 USING 6
1 - 4 ST 2ND
USING 6
WHEEL VER
K DN
7000 # INC
1 - R 787
1624 S/D # 6
1624 RW UT HANDLE
L&R IND UNSAFE
FLAP DN NO DRAG
SHD HAND U2 ON
EMERG ELEC ON
INVERT ON
15.0 TGTA - FUEL
ALL 6 STATUS
DEATION

P1 4.1	U1 4.5
P2 4.1	U2 4.5
P1 9.6	U1 128
P2 188	U2 30

FT Nº 18397

TEST NO. _____ MODEL NO. _____ DATE _____

TITLE _____

WITNESSES _____

DATA BY _____ PART NO. _____

OBJECT _____

1627	UTL GOING UP ON #1
	400-1100
1632	SHUT DOWN ENG #3
	RADIOS OFF
1635	GETTING PILOTS
	OUT
	DATA CONT OUT

COPILOT REPORT

XB-70A No. 62-001 7 March 1966

Flight 1-37

INTRODUCTION

Pilot - Mr. Van Shepard
Copilot - Col. Joseph Cotton
Max Altitude - 57,000 feet
Max Mach - 2.22
Max KIAS - 585

Takeoff Time - 1402
Total Flight Time - 2+19
Supersonic Time - 1+02
Time Over Mach 2.0 - 0+16

The flight objectives included heavy weight subsonic performance, afterburner lights at eight speeds from .40 to 2.15 Mach, subsonic and supersonic power modulation, airstart of No. 1 engine at .9 Mach and 25,000 feet, and tower fly-bys for airspeed calibration.

The takeoff was delayed due to a structural inspection of the inlet. The weather was good at Edwards but an undercast prevailed over the entire northern portion of the flight track. It was hazy below 35,000 feet. Light turbulence was encountered 100 miles north of Needles at 55,000 feet and light to moderate turbulence prevailed at 41,000 feet around Hector. Edwards was boomed at 38,000 feet, 1.4 Mach with a fuel total of 76,000 lbs. All tests were completed but the tower fly-bys. Engine performance during the afterburner lights and power modulation tests was excellent. Two engines were shutdown inadvertently when the throttles were moved through idle to cutoff during the power modulation tests. The throttle guard appears marginal if not inadequate. The emergency landing was a surprise climax to an otherwise very successful flight.

PREFLIGHT, ENGINE START AND TAXI

Engine start, in 7 minutes, was normal. The wind at time of taxi was 220° at 12 knots. Fuel totalizer at start of taxi was 257,500 lbs with 35,500 lbs in tank No. 1. While taxiing Van made two stops using the new manual hand brake control. Both stops were very smooth, totally absent of the usual chatter and associated cockpit vibrations. The background noise on the guard channel receiver prevents monitoring it in the BOTH receiver position. Predicted takeoff performance for 65°F at 520,000 lbs was: acceleration from 70 to 150 KIAS in 19 seconds, start slow rotation at 173 KIAS, and takeoff at 203 KIAS in 8,900 feet.

TAKEOFF AND CLIMB

The takeoff was on runway 22. The wind was 210° to 240° at 10 to 15 knots. The temperature was 70°F. At lineup the heading was 223° and

prior to takeoff had drifted to 216°. The fuel total 7 minutes prior to brake release was 253,600 lbs. Brake release and initial roll were smooth. I timed the acceleration from 72 to 153 KIAS, on the pilot's standby airspeed, at 19.8 seconds. Shep started a slow rotation at 173 and we were in the air at 204 KIAS. He commented that he liked this rotation procedure --- it was very comfortable, not at all abrupt or rushed. Fitz, in chase, commented that the main gear doors were a bit slow in closing. The FACS was turned on in the initial climb. The recently added second yaw vane (on the nose of the airplane) was observed within .2° of the No. 1 vane on the boom.

TESTS PERFORMED

Two heavy weight subsonic performance runs were completed:

Run	Counter Start End	KIAS Start End	MACH Start End	Altitude	Angle of Attack	Fuel Totalizer	Configuration
1	965	383	.885	24,500'	4.1°	208.	Tips up
	1065	387	----	-------	----	----	Pitch AUG off
2	1164	384	.89	24,600'	4.1°	----	Tips half
	1258	387	.893	-------	----	----	Pitch AUG on

NOTE:- Little, if any, power change was made after lowering the tips for the second point.

A level acceleration was made at 32,000 feet. The nose ramp was raised at 1.38 Mach and the wing tips lowered to full at 1.4 Mach. Climb to 55,000 feet and 2.15 Mach was made to Battle Mountain.

AFTERBURNER LIGHTS

During the afterburner lights on engine No. 3, at 2.15 Mach and 55,000 feet, it was not possible to maintain the left inlet shock needle in the lower green due to the extreme needle instability. Good control was possible to mid-green but below that position the needle was wild and oscillated constantly in the lower half of the indicator or bottomed out. The afterburner lights were normal --- which also means they included the nuisance instability in the minimum afterburner range.

At 1.78 Mach, 53,000 feet and 1.62 Mach, 55,700 feet successful afterburner lights were completed on engine No. 3 with a 700 square inch bypass area. During the light-offs the EGT peaked at 980°C to 1000°C and dropped back normally.

At 1.4 Mach, 54,500 feet and 400 square inches bypass No. 3 engine afterburner lights were successfully completed without experiencing the

minimum burner instability. The maximum EGT observed during the light off was 1040°C with a step reduction to 950°C, and back to normal.

While completing afterburner lights at .8 and .4 Mach, at 15,000 feet, the No. 3 engine afterburner failed to ignite.

WINDUP TURNS

Turbulence delayed the windup turn and cost us .05 Mach at 54,000 feet. The right 50° bank, with 400 square inches bypass, at constant power, in a descent at 1.6 Mach, 98,000 lbs of fuel, resulted in 1.45 indicated G.

At 1.38 Mach a 55° right bank constant power, descending turn to 50,000 feet was completed with 400 square inches bypass to 1.48 G.

POWER MODULATIONS

At 2.15 Mach, 56,800 feet power changes were made on engines No. 1, 2, and 3 simultaneously. It was not possible to maintain the left inlet shock needle in the crosshatched area (XXXX) during the power changes. With only a slow power reduction the shock needle shot up into the red (.8 SPR) and even with the bypass full open (2200 square inches) the aft most needle position possible was in the green at .6 SPR. The engine rpm was stopped at 83%, before the idle throttle position was hit. The throttles were slowly advanced at Mach 2. Prior to the fast cycle I positioned the left inlet shock in the XXXX area with an 880 square inch bypass and lead the throttle chop and burst with bypass wheel movement. With the throttles on the idle stop the rpms were 82%, the bypass wide open at 2170 square inches and the shock needle was in the green near .6 SPR. The rapid power advance was made at 2.09 Mach and 52,000 feet.

With 400 square inches bypass area a fast cycle of No. 3 engine was completed at 1.4 Mach and 41,700 feet. On the throttle burst the EGT went to 950, on to 990, reduced to 950 and back to the normal 900°C.

At 700 square inches bypass slow and fast cycles of engines No. 1, 2, and 3 were completed from 1.35 to 1.41 Mach between 40,000 and 42,500 feet. The maximum yaw excursion observed was 1°. Engine behavior was normal.

At .95 Mach, 25,000 feet, a fast cycle of No. 3 engine from idle to MAX afterburner was normal.

INADVERTENT SHUTDOWN OF ENGINES NO. 2 AND 3

At .95 Mach, near 25,000 feet, a normal cycle of engines No. 1, 2, and 3 was completed from MAX afterburner, to idle and back to MAX afterburner.

When I made a fast chop of throttles 1, 2, and 3 at .95 Mach and 25,600 feet engines No. 2 and 3 died. I must have raised the throttles slightly during the chop and went through idle to cut off with the two throttles. Although engine 1 throttle was at or near the same position I caught it in time or it actually hung up momentarily at 100%. Later I put it in afterburner and it responded normally thereafter. After relighting engines No. 2 and 3 we completed a fast cycle of the left three engines from MAX afterburner to idle to MAX afterburner at .95 Mach and 25,000 feet. Engine operation was normal.

ENGINE AIRSTARTS

In an attempt to restart engines No. 2 and 3, after the inadvertent shutdown, engine No. 3 would not light at .9 Mach and 25,000 feet. The new start technique was used which calls for a throttle angle of 40°. No. 2 engine would not light at the same altitude and speed using the normal procedure.

We descended to 20,000 feet and .9 Mach and was unable to light No. 3 engine using the normal procedure.

Engines No. 2 and 3 lit off using the normal procedure at 450 KIAS and 15,000 feet.

We climbed back to 25,000 feet and at 385 KIAS, .895 Mach and shutdown No. 1 engine. This engine had a modified fuel nozzle. I opened the throttle to idle and let the rpm stabilize at 33.5%. Ten seconds after turning the airstart ignition on, the engine lit off.

EMERGENCY LANDING

The letdown from 15,000 feet over Boron was initiated with the sump low light on and a fuel totalizer of 30,000 lbs. The tower reported the wind from 260° to 280° at 16 to 22 knots. From a position south of the base we turned downwind for a landing on runway 22. The recommended best flare speed was 186 KIAS.

The gear handle was placed down at approximately 265 KIAS. A very heavy jolt was felt in the airplane --- I suspected nose gear trouble. Fitz, in the chase, reported the right main gear extended unusually fast. The nose and right main gear indicator lights were both green. Fitz reported the right strut was extended properly, the bogie had unrotated but was not unfolded and fluid was coming from the right wheel well. At this time the fluid levels, head and system pressures were normal. Within a few seconds the Utility No. 1 head pressure started to drop but the fluid level remained at 5.5 gallons. Soon thereafter the system pressure dropped to zero and the Nos. 1, 2 and 3 utility pump status lights came on orange.

After some hesitation I placed the electrical emergency gear switch down. Fitz reported the nose gear door opened but the right main gear did not move --- it remained folded, in the vertical or tiptoe position.

The sump level was 17,000 lbs as we continued northeast to land on the north lakebed runway 18. With the electrical emergency gear switch still down I selected Utility System No. 2 with the manual selector handle. There was no change in the position of the right main gear bogie but the U_2 head pressure dropped to 155 psi. The fluid level remained at 5.5 gallons but the Nos. 4, 5, and 6 pump status lights came on. I returned the manual handle to the detent position, then to neutral. We expected throat panel closure but there were no indications of it.

We expected the tiptoe right bogie would cause the airplane to pull left on landing and would somewhat be cancelled out by the 20 knot, 90° right crosswind. We expected no brakes, steering or drag chute.

The approach was set up for the dry north lakebed runway 18 right. The FACS was turned off and the flaps lowered. The landing weight was 285,000 lbs with a fuel totalizer of 22,000 lbs and 13,000 lbs in the sump. I turned the battery-inverter switch on, eventually the inverter light came on and I turned the switch off. I saw 180 KIAS and called Shep's attention to the speed. He applied power to military and twice hit the full nose down elevator stop on the control column. We crossed the road and power lines about 150 feet and soon thereafter I turned on the battery-inverter switch and landing gear cameras. Without hydraulic power the left bogie also unfolded and wind blast held it in the tiptoe position. We were not aware of this new and unexpected development at the time of touchdown.

Shep made an excellent landing at 172 KIAS. I made no attempt to deploy the drag chute. Engines Nos. 2, 4, and 5 were cut during the initial roll. The right bogie flattened out (unfolded) properly on contact but the left one remained in the vertical tiptoe unfolded position. Fitz advised rocking to the right but all efforts were in vain. The airplane started turning right and obviously No. 1 engine was not needed so I shut it down. By jabbing No. 6 in and out of afterburner Shep kept the heading change partially under control. Full left rudder and left wheel down aileron were also used. Braking appeared to be ineffective. I turned the brake arm and engine shutdown switch on. The speed held at 55 KIAS for several seconds with 3 and 4 at idle and No. 6 engine in afterburner. After turning about 90° and slowing below 50 knots No. 6 engine was idled and we came to a slow and comfortable stop.

The fuel total was 15,000 lbs with 9,700 lbs in the sump. The red light was on in the landing gear handle and only the nose gear light was green. All 6 utility pump status lights were illuminated. The U_1 and U_2 pressures were at or near zero. The head pressures and fluid levels were

as follows:

	U_1	U_2	P_1	P_2
Fluid Level	4.8	4.8	4.7	4.8
Head Pressure	128	30	96	188

We questioned the fluid levels but their gages tested properly. After sitting a few minutes the U_1 system pressure increased and fluctuated between 500 and 900 psi. There was some concern that the left bogie position might change if the engines were cut but eventually everyone cleared from under the plane and the engines were shut down.

I was most surprised when I got out and saw the actual strut and bogie position. From the earlier position of the right bogie it was difficult to understand why the left wing was high and we turned right. Until I saw the actual bogie and strut positions I was convinced the left bogie was normal and the right strut had partially collapsed.

The upper attachment fitting on the right main gear retract actuator had failed and allowed the gear to fall into position with only airload damping. Hydraulic lines were dislodged and broken which permitted fluid loss from both utility systems. Previous failures in this area, during ground operation of the gear, had caused deletion of the H-11 fitting in favor of a heavier redesign of 4340 steel. All fittings (3) but this one had been changed.

FLIGHT SQUAWKS

1. Background noise on guard, both UHF sets.

2. Elevons not even laterally with TTO light on.

3. Both main gear doors slow to close on retraction.

4. Digital would not switch to "B" recorder automatically.

5. No. 3 afterburner would not light off.

6. TACAN bearing breaks lock frequently, distance O.K.

7. Right gear extended too abruptly and jolted the aircraft when the gear handle was moved to down.

8. On touchdown the right bogie moved from vertical to normal horizontal but left bogie had drifted near vertical before landing and remained vertical on touchdown and throughout the landing roll.

9. Pressure lost on both Utility No. 1 and No. 2.

10. No. 1 primary hydraulic status light blinks continuously.

11. Emergency battery was used during flight.

SYSTEMS SUMMARY

Landing Gear:

The right main gear upper attachment fitting for the retract actuator failed, caused the eventual loss of both hydraulic systems and the unsafe gear condition. This was the last of four H-11 steel fittings in the two airplanes. Previous failures should have dictated replacement of this fitting and prevented this landing incident.

Hydraulic:

Both utility systems were lost as a result of the gear failure. The new fluid level gages are a definite improvement. The P_1 status light blinked continuously with normal system pressure indicated.

Brakes:

Two very smooth stops were completed using the manual brake control. Elimination of the chatter is a great improvement.

Engines:

No. 2 and 3 engines were shutdown when the throttles were inadvertently cut off during power modulation tests. The new nozzle on No. 1 engine improved the airstart performance.

Electrical:

The emergency battery-inverter performed properly when activated in flight.

Instrumentation:

The digital recorder control malfunctioned.

Communications:

The background noise on the guard channel receivers is very unsatisfactory. Suspected cause is telemetry.

Flight Instruments:

The heading drifted 7° in magnetic after line up on runway 22. The attitude indicator was slow showing wings level after roll out of a turn.

TACAN:

It held distance lock on very well but very frequently broke lock on bearings.

Flight Controls:

The right elevon was lower than the left with the trim for takeoff light on.

The following systems operated satisfactorily:

Nose Wheel Steering	Air Induction Control
Flaps	Oxygen
Wing Fold	Windshield Ramp
IFF	Fire Detector
Environmental	Fuel

The ILS and drag chutes were not used.

CONCLUSIONS

1. Earlier replacement of the right main gear retract actuator fitting would probably have prevented the landing incident.

2. Full nose down elevator was required on the landing approach when power was applied to increase speed from 180 KIAS.

3. Two engines were shut down when the throttles were inadvertently moved through idle to cut off during power modulation tests.

4. The attitude indicator showed 5° to 10° left wing down after rolling out of a turn. This deficiency, coupled with the restriction to forward visibility, is a serious handicap to the pilot.

5. The hydraulic fluid replenishing, wing tip fold and hydraulic system head pressure selector knobs are identical which can lead to an error in selection and movement.

6. The shock pressure ratio markings, as used on Air Vehicle No. 2, are not incorporated on the shock position indicators of this airplane.

7. Engine performance during the afterburner lights and power modulation tests was excellent.

8. The manual test brakes and EGT gage caution lights are great improvements.

RECOMMENDATIONS

1. Provide more down elevator for the landing.

2. Improve the throttle cut off guard.

3. Provide forward visibility which will permit view of the horizon.

4. Safety guard the hydraulic replenishing selector knob.

5. Provide shock position indicator markings each tenth shock pressure ratio.

Joseph F. Cotton

JOSEPH F. COTTON, Colonel, USAF
XB-70A Test Director - Copilot

COPILOT COMMENTS

XB-70A FLIGHT 2-23 10 MARCH 1966

INTRODUCTION: The flight was scheduled for 0900 and became airborne seven minutes early at 0853. It had originally been scheduled 7 March but slipped one day at a time until 10 March. Flight objectives were primarily AICS tests which included inlet unstarts at 2.4 and 2.7 Mach, inlet pressure measurements with various throat deviation settings, flight in "High" inlet performance for the first time, and 2.8 Mach speed power. Maximum speed and altitude scheduled were 2.8 Mach and 66,000 feet. The majority of the test objectives were completed and the maximum speed and altitude attained were 2.76 Mach and 67,000 feet. The flight duration was one hour and 56 minutes.

PREFLIGHT AND TAXI: All engine starts were normal and the only problem encountered prior to taxi was in the roll augmentation and trim system. The primary roll trim knob would not return to zero when engaged and the roll augmentation disengaged several times during the flight control checks. The taxi out was uneventful.

TAKEOFF AND CLIMB: Total fuel remaining six minutes prior to brake release was 268,500 pounds. The compass heading was 218 degrees when lined up on runway 22, which has a heading of 223 degrees. After retracting gear and flaps and setting wing tips at 25 degrees, the FACS was engaged and the airplane was climbed at 425/.95 to 32,000 feet. The AICS was set in "auto" at around 10,000 feet and remained at that setting until just prior to landing.

ACCELERATION: The nose ramp was extended and with engines still at max A/B, the airplane was accelerated level at 32,000 feet and then climbed to reach 57,000 feet at 2.4 Mach. AICS indication during this time were as follows:

Comments	Airplane Mach	Throats	Bypass
	1.4	179/1.79	Lt Opening to 590/Rt Closed
	1.44		590/Rt Opening to 500
	1.90	1.96/1.94	600/520
	2.00	2.00/1.97	600/510
Both inlets already started	2.08	205/2.00	880/820
Rt inlet Dev adjusted	2.19	2.18/2.18	
	2.35	2.34/2.34	685/660
Deviations set 006/993	2.42	2.41/2.38	680/500

INLET UNSTARTS AT 2.4 MACH:

With the airplane established at 2.4 Mach, 57,000 feet, the left inlet was unstarted by counterclockwise rotation of the left deviation control. The inlet unstart occurred with a throat indication of 2.49. The automatic restart functioned perfectly and the deviation control was reset at 006. Light airframe buffet persisted until the reset button was depressed and the inlet returned to normal/automatic operation.

The right inlet was unstarted in a similar manner and with the airplane at 2.42 Mach, the unstart occurred with the throat indicating 2.51. After the automatic restart, the deviation control was reset to 993 and prior to resetting the throat and bypass their indications were 2.09 and 1270. Resetting returned the inlet to automatic operation.

CLIMB AND ACCELERATE TO 2.7 MACH AT 64,000 FEET:

The throats were set to airplane Mach number at 2.42 Mach and required deviation settings of 002 and 980. The acceleration continued with some deviation adjustments needed to maintain the desired limits on throat readings.

Airplane Mach	SPR	Throats	Bypasses	Deviation
2.41		2.41/2.41		002/980
2.50		2.51/2.52	600/410	002/987
2.55		/2.52		004/996
2.55	.67/.67	2.55/2.50		
2.64		2.64/2.62	550/370	
2.68		2.65/2.66		

Considerable light to moderate turbulence was encountered between 40,000 and 62,000 feet during the climb. This caused the acceleration to be very slow. A light airframe buffet was felt through the rudder pedals as the airplane neared 2.7 Mach.

INLET UNSTART AT 2.7 MACH:

With the airplane established at 2.70 Mach, the throat indications were 2.67 and 2.70 with the deviations still set at 004 and 996. The left deviation control was turned counterclockwise to obtain an unstart. The unstart occurred with the throat at 2.88. The system went through an automatic restart cycle but the inlet did not actually restart until the left deviation control had been reset to 004. The throat and bypass showed 2.37 and 1300 prior to depressing the "reset" button. The unstart occurred with a "bang" which was followed by moderate airframe buffet which persisted until the reset button was actuated causing normal operation to be regained.

AICS PERFORMANCE:

At a speed of 2.7 Mach at 64,000 feet, the throat deviation controls were set at 991/983 to give throat indications of .07 greater than airplane Mach. All engine and AICS indications were normal and there was a noticeable smoothing out of airplane vibrations. Turbulence caused airplane speed to jump around slightly and caused throats to oscillate ± .02.

Prior to beginning a turn, the deviation controls were reset to 004 and 996 to provide a greater margin of safety in the inlets. After completion of the turn, the inlets were set at 014/009 to provide .10 less than airplane Mach. The airframe buffet increased although it was still light. All indications were normal at 2.70 Mach and the inlet performance switch was selected to "high" for the first time. The throats indicated 2.63/2.62 prior to the "high" selection and indicated 2.73/2.72 at 2.69 Mach after the change. Airframe buffet reduced markedly as the inlets went into high performance and the SPR's went to .70 on both sides. With the inlets still set to "high" performance, the throttles were advanced to max A/B to begin an acceleration to 2.80 Mach, however, the roll augmentation disengaged several times and it appeared that the augmentation might be causing some unwanted control input since ½ left rudder and some left aileron was required to zero the yaw with the wings level. As the airplane reached 2.76 Mach, it was decided to decelerate. The inlets were set back to "normal" and throttles were reduced to military power.

DECELERATION:

The deceleration was normal except that the right yawing tendency persisted until below 2.0 Mach. The automatic AICS worked extremely well throughout the deceleration. The right bypass doors closed at 1.2 Mach and the left bypass closed at 1.17 Mach.

DESCENT AND LANDING:

The airplane was returned to the pattern and with 30,000 pounds of fuel remaining the flare speed was computed as 190 knots. Touchdown was at approximately 175 knots. The parachute failed to deploy and during slow speed braking the right brake was slow to release. The compass heading again indicated 218 degrees when lined up on the runway.

SYSTEMS:

1. Environmental Control: The regrigeration unit failed early in the flight and the remainder of the flight was flown using ammonia cooling from

the "aux cool" unit. This kept the electronic equipment satisfactorily cooled, however, the ammonia quantity gauge was inoperative prior to the takeoff. On an airplane which is so dependent upon cooling and heat dissipation, it is undesirable to fly with the refrigeration unit inoperative. The cockpit temperature seemed to be fairly comfortable until the deceleration when it became warmer than desired.

2. Hydraulic: The hydraulic system operation was satisfactory, however, most of the flight was flown with three of the six utility pump status lights illuminated. The hydraulic replenishing system knob was noted to be too similar and too close to the wing tip selector knob. It was very nearly moved when the intention was to raise the wing tips.

3. Compass System: The compass system is unacceptable since the heading frequently fails to change when the airplane is obviously turning.

ITEMS OF INTEREST:

1. The pilot's sun visor dropped down in front of his face during the landing roll.

2. The turbulence encountered caused a severe penalty in acceleration performance and delayed starting the high speed tests. Jumps in the Mach indications were encountered and probably were caused by the turbulence.

3. A loud background noise was encountered on the primary frequency of 351.4. Both radios picked up the noise and communication between the airplane and the ground control station was interrupted.

CONCLUSIONS:

1. Turbulence is a very real problem at high altitude when trying to accelerate and climb on a high speed airplane such as this one.

2. The automatic inlet operation was excellent and the "high" performance selection should be further investigated.

3. The inlet unstarts at 2.4 and 2.7 Mach were handled very well by the automatic AICS. The 2.7 Mach unstart caused moderately heavy airframe buffet.

4. The airplane was decelerated because of an unexplained right yaw above 2.7 Mach.

5. Most of the flight was flown with the "regrigeration unit" inoperative.

6. The compass system is unacceptable as it presently operates.

MAINTENANCE DISCREPANCIES:

1. U_1, U_3 and U_4 hydraulic pump status lights on during most of flight.

2. Freon package inoperative during most of flight.

3. Roll augmentation disengaged with full control movement on ground checks and several other times in flight.

4. Drag chute inoperative.

5. The #1 right hand buzz light came on several times during flight.

6. AICS cool warning light came on during landing roll.

7. Rain removal system would not check after flight.

8. The #2 engine fire warning light would not illuminate during test.

9. The #3 engine fire warning light would not test in forward position.

10. Fuel leaked back into tank 6 at an excessive rate (5000 pounds).

11. Roll trim would not reset to zero when roll augmentation was engaged.

RECOMMENDATIONS:

1. Correct the maintenance discrepancies noted.

2. Continue investigating the "high" inlet performance.

3. Correct the compass system errors or redesign the system to give correct indications.

4. Investigate further the adviseability of high speed flight with the "refrigeration unit" inoperative.

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
Copilot XB-70A

COPILOT COMMENTS

XB-70A FLIGHT 2-24 15 MARCH 1966

INTRODUCTION: The flight was scheduled for 0900 hours and brake release occurred at 0908. Flight objectives were Air Induction Control System tests at 2.7 and 2.8 Mach, stability and control tests at 2.8 Mach, and tests of the ram purge system at 2.8 Mach. All scheduled tests except a sideslip maneuver were completed. Maximum speed and altitude scheduled were 2.8 Mach and 66,000 feet. The maximum speed and altitude attained were 2.85 Mach and 69,500 feet. Flight duration was one hour and 59 minutes.

PREFLIGHT AND TAXI: All engine starts were normal except #5 and #6. The #5 engine primary hydraulic pump did not go into the pumping mode until the third start. The #6 engine would not start on normal ignition and the air start switch had to be used. The brakes chattered during the stop prior to taking the runway.

TAKEOFF AND CLIMB: Total fuel remaining three minutes prior to brake release was 265,000 pounds. The brake release was very rough since it appeared that the left brake hung up and did not release until one or two seconds after the right brake. The acceleration time between 70 and 150 knots appeared to check well as the speed was only 2 knots low at the end of the computed 18.5 seconds. After completing the "after takeoff" check list the airplane was climbed with max A/B to 32,000 feet.

ACCELERATION AND CLIMB:

Using max A/B, the airplane was accelerated level at 32,000 feet until reaching 575 knots IAS. The AICS was set in automatic and at 1.31 Mach the throats were indicating 1.76/1.77 and the bypasses were 90/100. Most of the acceleration at 32,000 feet was done under IFR conditions. After reaching 575 knots a climbing acceleration was initiated to reach the test condition of 2.7 Mach. Indications were:

Mach	Throats	Bypass Doors	
1.80	1.93/1.91	610/520	
2.00	1.96/1.95	600/520	
2.06		880/	Left inlet started
2.11		/830	Right inlet started
2.13	2.10/2.03	860/810	
2.23	2.22/2.16	750/725	Deviations 000/990
2.26	2.25/2.19		
2.46	2.47/2.47		
2.50	2.51/2.45		
2.52	2.54/2.51	650/460	SPR's = .69/.68
2.65	2.67/2.66	550/380	
2.65	2.66/2.64	540/400	SPR's = .68/.68
2.69	2.68/2.69	540/360	

Light to moderate turbulence was encountered up to 62,000 feet and slowed the acceleration considerably. As the speed approached 2.7 Mach while still operating in "normal" inlet performance, a fairly high frequency rudder kick and noise was noted. It seemed to be of slightly greater magnitude than that experienced on flight 2-23.

AICS TESTS AND SPEED POWER AT 2.7 AND 2.8 MACH:

After reaching 2.7 Mach at 64,000 feet, the throats were set at .1 less than airplane Mach in preparation for selecting "high" performance. The deviation counters were positioned to 014/008 which gave 2.62/2.62 throats and 580/390 bypasses at 2.72 Mach. Rudder pedal "buzz" was considerably increased as the throats deviation counters were moved to the .1 less throat Mach position. Inlet performance was then selected to "high" and immediately there was a large change in noise and rudder pedal "buzz". Inlet performance data was obtained under the conditions listed below and speed power data was also obtained on the last five of the runs:

Speed	Throat Perf	Deviations	Throat Mach	
2.7	Norm	014/008	.1 less	
2.7	High	013/007	.05 greater	SPR's .71/.71
2.8	High	013/007	.05 greater	
2.82	High	013/007	.05 greater	
2.80	High	008/004	.07 greater	
2.81	Norm	991/985	.05 greater	
2.81	Norm	999/994	Same as airplane	(Bypass 455/280 (SPR's .68/.68

STABILITY AND CONTROL AT 2.80 MACH, 66,000 FEET:

With inlet performance set at "normal" and the throats set at .05 less than airplane Mach, stability runs were made. With FACS on, a windup turn to 1.6 'g' appeared to exhibit normal characteristics. The right throat Mach dropped off to 2.60 in the right windup turn. During sideslips, less than full rudder was needed to reach $1\frac{1}{2}$ degrees of sideslip. During sideslips, the throats changed considerably and were 2.85/2.65 with a right sideslip and 2.69/2.81 with a left sideslip. During the left sideslip, the bypass doors were 580 left and 290 right. A release from one degree sideslip had deadbeat damping although a small residual oscillation could be felt through the rudder pedals for 15 or 20 seconds.

With pitch augmentation off, a pull-up and release seemed to damp out the initial input within one or two cycles, but the nose rapidly came up

and was continuing to come up until recovery was initiated. It gave the impression that it would continue to diverge. A wind-up turn appeared to have a tendency to increase 'g' without much increase in pull force.

RAM PURGE TESTS:

The inlets were set into "high" with .05 greater than airplane Mach and with a speed of 2.8 Mach at approximately 68,000 feet. The sequence of events in the cockpit was as follows:

Approximate Time/Seconds	Comments
00	Ram purge selected
05	Few puffs of smoke in cockpit
15	Throttles being reduced
25	Cabin 31,000 feet
30	Inlet changed to "low" performance
40	2.78 Mach - throats 2.57/2.54 - bypasses 1130/1060
55	All engines at military power
60	2.70 Mach-throats 2.49/2.47-bypasses 1130/1060
75	EE temp - 38 degrees
80	Total temp 429 degrees F
105	Cabin 34,000 feet
110	2.50 Mach-throats 2.31/2.30-bypasses 1290/1280
125	EE temp - 36 degrees
130	Total temp - 345 degrees F
155	Repressurize selected - 405 knots IAS - 67,900 feet altitude
170	Cabin 25,000 feet - 2.2 Mach
185	Cabin 21,000 feet
190	EE Temp - 36 degrees
200	Cabin 11,000 feet
205	Cabin noted to be warm
220	Cabin 8,000 feet
240	2.0 Mach

The test went extremely well and it appeared that all operations were exactly as predicted.

DECELERATION: The airplane was decelerated to subsonic speed enroute to the landing. The AICS operated excellently during the deceleration.

HYDRAULIC REPLENISHING TESTS:

The P_1 hydraulic system was reserviced for 55 seconds and increased from a quantity indication of 158 to 200%. The U_2 system was then reserviced

for one minute and went from 130 to 150%. The P_1 reservice was accomplished using the primary bus and the U_2 was reserviced using the essential bus. The difference in apparent servicing rate was probably due to the difference in hydraulic reservior capacities. The guard on the replenishing system prevented the copilot from being able to read the detent markings.

DESCENT AND LANDING: The pattern was entered and the landing was made with approximately 21,000 pounds of fuel remaining. The sump low level light illuminated with 20,900 pounds of fuel remaining. Touchdown occurred at about 170 knots. All chutes operated satisfactorily. The pilot made a check of steering the airplane by using the ailerons and it was noted that left aileron caused right turning and right aileron caused left turning.

CONCLUSIONS:

1. This flight was an extremely successful one.

2. AICS operation was excellent.

3. The compass indicating system continues to be a serious problem and detracts the pilot from devoting full attention to important tests.

4. The ram purge system worked extremely well.

MAINTENANCE DISCREPANCIES:

1. The #6 engine would not start on ground start ignition.

2. On several occasions the brakes failed to release when the pedals were released. The right brake held for about 10 seconds after the pedal was released.

RECOMMENDATIONS:

1. Correct the maintenance discrepancies noted.

2. Accomplish further stability and control tests at high speed.

3. Place high priority on action to obtain satisfactory compass operation.

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Copilot

PILOT COMMENTS

XB-70A FLIGHT 2:25 17 March 1966

Copy 8

R-66-3-3
Edwards AFB

INTRODUCTION: The flight was airborne at 0847 hours. Flight objectives were inlet unstarts at 2.4 and 2.7 Mach, inlet tests at 2.7 and 2.8 Mach, and performance tests at 2.8 Mach. All tests were completed except the performance tests at 2.8 Mach. Turbulence slowed the acceleration and then a loss of communication with the ground station caused the start of the high speed testing to be delayed, therefore, insufficient fuel remained to accomplish the 2.8 Mach performance tests. The maximum speed and altitude attained was 2.85 Mach and 70,350 feet. The flight duration was one hour and 52 minutes.

PREFLIGHT AND TAXI: All engine starts were normal except for #5 which had to be shutdown after the first start because the primary hydraulic pressure was at zero. The pressure was normal on the second start. Brake operation during taxi out appeared to be very good and the only chatter encountered was just prior to stopping in the runup area.

TAKEOFF AND CLIMB: Total fuel four minutes prior to brake release was 264,500 pounds. The brake release was the smoothest this pilot has ridden through. All FACS was turned on prior to the takeoff and appeared to make the pilot workload less. Lift off was at 204 knots on the vertical airspeed indicator. After retracting gear and flaps and setting the wing tips to 25 degrees, the airplane was climbed to 32,000 feet. The AICS reset light would not illuminate when the reset button was held depressed, however, the automatic AICS appeared to give satisfactory operation.

ACCELERATION AND CLIMB: Using max A/B, the airplane was accelerated at 32,000 feet. A light rudder buzz was noted even before the airplane became supersonic. Both bypass doors began to open around 1.4 Mach. Considerable difficulty was experienced in holding heading and in maintaining the desired climb schedule. The heading indicator was very sluggish and did not show a turn when it was apparent that the airplane had changed heading. The attitude indicator was so insensitive to small pitch changes that the airplane would go from a climb to a descent without any detectable change on the attitude indicator. The automatic inlet starts were normal and occurred at 2.06 Mach on the left and at 2.10 Mach on the right. The acceleration and climb was continued to 2.40 Mach where the throats were 2.42/2.31 and the bypasses were 660 and 630.

INLET UNSTARTS: After stabilizing at 2.40 Mach, 56,000 feet, the left deviation control was turned counterclockwise until an unstart occurred. The throat indicated 2.50 at the unstart. The automatic restart was almost

instantaneous. After resetting the AICS system, the right deviation control was also rotated counterclockwise. An unstart on the right inlet occurred with the throat at 2.49 and again the restart was immediate. The inlet was reset and the airplane was accelerated to 2.7 Mach at 64,000 feet for another unstart on the left side. The 2.7 Mach unstart occurred when the throat reached 2.92. The deviation control was returned to near zero and the automatic restart was very rapid. As the unstart occurred, a momentary drop of approximately 50 degrees EGT was noted on engines 1, 2 and 3. The recovery was rapid and required no pilot action. The unstart at 2.70 Mach was considerably more violent than the unstarts at 2.40 Mach. The unstart was characterized by a sudden loud "bang" followed by moderate airframe buffet.

AICS PERFORMANCE: With the airplane still stabilized at 2.7 Mach at 64,000 feet, data was recorded with the throats set at airplane Mach, .07 greater, .05 less and at .10 less. The duct performance was then set to "high" which caused a slight increase in smoothness throughout the airframe. While still in "high" performance, the throats were set at .05 greater than airplane Mach. The throats were then reset to "normal" performance in preparation for stability tests.

STABILITY AND CONTROL AT 2.8 Mach, 66,000 FEET:

The airplane was accelerated to 2.8 Mach, With the duct performance set at "normal" and deviation controls at airplane Mach, the airplane was stabilized with FACS on for stability tests. A pull up and release from 1.25 "g" damped fairly good except that the nose continued to rise slowly. A left sideslip at 1.5 degrees required near ½ right rudder and about 3 degrees of right aileron. The throats were 2.76/2.89 while holding 2.83 Mach in the sideslip. The right sideslip required left rudder and left aileron of approximately the same magnitude. The throats were 2.89/2.75. A release from one degree of sideslip had near deadbeat damping. A wind-up turn to 1.4 "g" had a normal force build-up.

With pitch augmentation off, a pull up and release had unsatisfactory damping since the nose continued to rise and approximately a thousand feet of altitude was gained before recovery was initiated. A wind-up turn to 1.4 "g" was well stabilized using about 50 degrees of bank. The force gradient was still positive although the gradient did appear to become shallower as the "g" increased. With all augmentation off, a 1.5 degree left sideslip required 1/3 to 1/2 right rudder and about 5 degrees of right aileron. The airplane was fairly easy to stabilize in a steady sideslip and the negative dyhedral effect was much the same with FACS on or off. A release from one degree of sideslip had surprisingly good damping and was almost completely damped out in two cycles.

PERFORMANCE CLIMB: With all FACS on, the duct performance was set to "high" and the deviation controls set at .1 greater than airplane Mach. With max A/B power set, the airplane was climbed at 2.81 Mach from 66,000 feet to 70,350 feet. The climb rate appeared initially to be high but around 70,000, it decreased rapidly and at the peak altitude had dropped almost to zero.

DECELERATION AND DESCENT: With the duct performance set at "normal" the airplane was decelerated to 400 knots IAS while holding a near level altitude. The airplane was then returned to the pattern area.

APPROACH AND LANDING: With approximately 25,000 pounds of fuel remaining the touchdown was around 175 knots. The chute failed to deploy but the airplane was easily stopped using wheel brakes only. After landing the E.E. temperature increased to 80 degrees with aux cool on, however, after a few minutes, the temperature began to decrease.

SYSTEMS:

1. The AICS system worked extremely well.

2. The hydraulic system caution lights operate in an unsatisfactory manner since three utility pump lights were illuminated during most of the flight even though hydraulic system operation was normal.

CONCLUSIONS:

1. The directional stability at 2.8 Mach with all FACS off was surprisingly good.

2. It was extremely difficult to hold a constant altitude at high speed since the attitude indicator was so insensitive that the airplane could go from a climb to a dive without any detectable change in pitch on the attitude instrument.

3. The heading indicator lagged very badly during turns and added greatly to the pilot's workload.

4. The inlet unstart at 2.7 Mach caused much heavier airframe buffet than the unstarts at 2.4 Mach.

MAINTENANCE DISCREPANCIES:

1. The #2 engine fire warning light would not illuminate during test.

2. With the sideslip ball centered, the yaw indicator shows 1/2 degree right.

3. Drag chute failed to deploy.

4. Cabin record light stays on steady when selected to the ready position.

5. E.E. temperature went to 80 degrees after landing even with the "aux cool" on.

6. TACAN broke lock often.

RECOMMENDATIONS:

1. Correct the maintenance discrepancies noted.

2. Redesign the hydraulic warning system to illuminate only when a hydraulic problem exists.

3. Procure and install a more satisfactory pitch indicating system.

4. Redesign the heading indicating system to give correct headings at all times.

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Pilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT A. S. White

FLIGHT NO. 2-26 COPILOT V. H Shepard

DATE OF TEST 19 March 1966 FLIGHT TIME 1:57

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #315 - Capt. Hoag/Col. Cotton
Chase 2 - B-58 #662 - Maj. Bach/Lt. Col. Fulton
Chase 3 - F-104 #817 - Maj. Parsons
Helicopter H-21 #389 - Capt. Flannagan

PURPOSE OF FLIGHT

1. Airplane performance at 2.9 Mn with the inlets in HIGH performance mode.
2. Performance climb at 2.9 Mn
3. Stability and control at 2.9 Mn

1.0 PREFLIGHT AND TAXI

During the preflight check of the airplane it was found that the engine fire detection system did not test properly on engine #1. However, further checks in the engine bay showed that fire detection system was usable. The malfunction was in the test system. All engines were started, but a malfunction occurred in the secondary nozzle control of the #6 engine. The engines were shut down and the A9 relay changed on #6 engine. After this delay, the engines were restarted with no further difficulty.

2.0 TAKEOFF AND CLIMB

The brakes were released at 1039, and the takeoff was normal. After raising the gear and flaps and lowering the tips to one-half, the inlet system was reset and placed in the AUTO mode.

The airplane was leveled at 32,000 ft. for the acceleration to 575 knots where the climb was continued. The climb and acceleration to 2.7 Mn were normal, except that moderate to heavy turbulence was encountered between 35,000 ft. and 60,000 ft. The heaviest part of this turbulence occurred at between 55,000 and 60,000 ft., causing rather wild oscillations of the shock position needles. In one instance, in a severe gust, the #4 engine compressor vibration pickup hit 100 per cent for a few seconds. The vibration indication then returned to normal and did not get out of limits for the remainder of the flight.

The operation of the inlet ducts in the fuel system is outlined in the enclosed copilot's summary.

3.0 MISSION TESTS

The acceleration was stopped momentarily at 2.7 Mn, 64,000 ft., and the inlet performance was changed to HIGH. The throat deviation controls were used to set the throat Mn at .12 greater than the air vehicle Mn for the climb to 2.9. The airplane was then climbed to 2.9 Mn at 68,000 ft.

The airplane was stabilized as well as possible at 2.9 Mn, 68,000 ft., for a speed-power run. The first 30 seconds of the run were the best data. The airplane Mn was stable; however, the altitude changed slightly during the run.

After making the turn around Rock Springs and Grand Junction, the airplane was again stabilized at 2.9 with the throat Mn set at .07 above airplane Mn. Another speed-power run was made at this flight condition.

The throats were then readjusted to .12 greater than airplane Mn, and a maximum power climb was started. 2.9 Mn was held during the climb and the airplane climbed to 74,000 ft. before the rate of climb dissipated to below 300 fpm.

The inlet system was then returned to NORMAL and the throat Mn was adjusted to air vehicle Mn. A descent was made to 70,000 ft., holding 2.9 Mn for a stability and control set. This set consisted of a pullup to 1.3G and release, slow sideslips to the left and right to 1.5 degrees, a release from 1 degree of sideslip, and a wind-up turn to 1.55G--all with FACS ON. The pitch augmentation was then turned OFF for a pullup and release and a wind-up turn to 1.5G. All FACS were then turned OFF for a steady state sideslip to 1.5 degrees and a release from one degree. The pilot was surprised with the ease with which these last two maneuvers were accomplished with all augmentation OFF. The airplane did not get into the lateral-directional wallowing that was so prevalent in the stability and control tests of Ship #1 at high Mach number.

The inlet system was again switched to HIGH performance and the throats adjusted to .12 greater than air vehicle Mn for a performance run at 2.9 Mn at 70,000 ft. During this performance run, the Mach number was stable.

At this time the total fuel remaining was 37,000 pounds and the airplane was going away from the base. It appeared wise to discontinue further testing and decelerate and descend for landing.

The deceleration was made at 70,000 ft., with the inlet system in normal and throat Mach number set equal to the air vehicle Mach number. The left inlet unstarted at 2.23 Mn for no apparent reason during the deceleration. The inlet was automatically restarted by the AICS and was reset to NORMAL performance prior to deceleration to Mach 2. The remainder of the descent to the landing was normal. The landing was made with approximately 20,000 pounds of fuel remaining in the sump. The drag chute was deployed after landing, but did not operate.

4.0 SUMMARY

The performance of the inlet system was excellent on this flight. The airplane encountered more heavy turbulence after inlet starts on this flight than on any previous flight, and the AICS performed very well throughout this entire period. In the HIGH performance mode, the airplane is free of any of the buffeting encountered at times in NORMAL and LOW performance.

The handling qualities of the airplane with FACS OFF are better at high Mach number than in Ship #1.

This flight left no doubt in the pilots' minds that a sustained 30-minute flight at Mach 3 could be accomplished.

5.0 DISCREPANCIES

1. #1 engine fire detector light on initial test.
2. Seal from safety wire on fire detector bus selector switch lost in capsule.
3. Drag chute inoperative.
4. #1 engine would not start on 4-joule ignition.

A. S. White
Aircraft Commander

HANDLING QUALITIES QUESTIONNAIRE

FLIGHT 2-26 PILOT A. White CONFIGURATION Tips - 65°; Windshield - Up

LONGITUDINAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Airspeed, Altitude, Attitude	2.9 Mn 70K	FACS ON	5	Part of the reason for these low Cooper Ratings is due to lack of adequate flight information. Very small attitude changes cause rather rapid altitude changes. Altitude and altitude control then become difficult with heavy forces and a low response airplane. Speed control is difficult also due to lack of power level indications and low response to power changes at this very high speed.
		FACS OFF	5	
MANEUVERABILITY - Ability to change: Airspeed, Altitude, Load Factor		FACS ON	4.5	Maneuvering the airplane is difficult due to the pilot's inability to see properly, poor instrument presentation, and the characteristics mentioned above.
		FACS OFF	5	
RESPONSE TO TURBULENCE			4	
RESPONSE TO CONFIGURATION CHANGES			3	
OVERALL LONGITUDINAL RATING			4.5	

LATERAL-DIRECTIONAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Heading, Bank Angle	2.9 Mn 70K	FACS ON	4	The airplane is not difficult to fly in this axis from the standpoint of controlling it; however, it is difficult to fly precisely due to the wandering attitude and heading information.
		FACS OFF	4	
MANEUVERABILITY - Ability to change: Heading, Bank Angle		FACS ON	4	
		FACS OFF	4	
RESPONSE TO TURBULENCE			4	
OVERALL LATERAL-DIRECTIONAL RATING			4	
CONTROL HARMONY			4.5	

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT A. S. White

FLIGHT NO. 2-26 COPILOT V. H. Shepard

DATE OF TEST 19 March 1966 FLIGHT TIME 1:57

1.0 COPILOT'S SUMMARY

Automatic inlet was selected while climbing near 0.6 Mn and throats started scheduling normally near 1.1 Mn. At 1.41 Mn, the left bypass opened slowly to 590 sq. in., and the right opened to 500 sq. in. at 1.46 Mn. Throats were observed reading 1.86 and 1.87 Mn, left and right, at 1.65 airplane Mach number. Continuous data were obtained of the inlet starts--the left started first at 2.075 Mn with the bypass opening to 870, then stabilizing near 820 sq. in. The right inlet started at 2.14 Mn with the bypass opening to 900, then stabilizing near 870 sq. in. At 2.2 Mn, the right throat was observed lagging excessively. The deviation was decreased to 972, which resulted in a 2.21 right throat at an airplane Mach number of 2.22; the left throat indicated 2.17 Mn. Ground advised to increase the right throat height to a deviation of 990 sq. in., which resulted in a right throat lagging .10 to .11 Mn below airplane Mach; but was probably a good idea, remembering that throats are most critical in the 2.2 Mn area.

Turbulence was moderate from 55,000 to 59,000 ft. from 2.2 to 2.45 Mn. The inlet instrumentation was a sight to see! All needles and readouts were oscillating wildly as the airplane jumped around. In light turbulence, an average reading was obtained at 2.3 Mn of 2.27 and 2.24, left and right throats respectively. Deviations were zero and 990, left and right. In level flight at 2.5 Mn, observed inlet readings were:

	Left	Right
Throat	2.51	2.46
Bypass	580-610	450-480
Shock Position	.68	.67

At 2.70 airplane Mn, throats read 2.70 and 2.72 Mn and bypasses read 520 and 270 sq. in., respectively. Then HIGH performance was selected for the climb to 2.9 Mn and the throats were closed by setting the deviation to 003 left and 997 right. The following readings were observed in the climb:

	Throat		Bypass		Shock Position		
Mn	L	R	L	R	L	R	Remarks
2.76	2.88	2.86	-	-	-	-	-
2.85	2.96	2.98	420	110	.7	.68	-
2.90	3.01	2.99	400	120	.7	.72	Right deviation increased to 999 because throat exceeded .12 A/P Mn

After a stability set at 2.9 Mn in NORMAL inlet performance with the throats set to read airplane Mn, HIGH performance was selected for a performance run with the throats 0.12 greater than airplane Mn. The following readings were observed at 2.91 Mn:

	L	R
Throat	3.03	3.02
Bypass	400	80 sq. in.
Shock Position	.68	.70

Then a level deceleration to 400 KIAS at 70,000 ft. was accomplished at Military Power; inlets set at AUTO, NORM with deviation at 000. Then a constant 400-knot descent was started shortly thereafter in a right turn near 68,000 ft. The left inlet unstarted at 2.23 with bypass opening to 1540 sq. in. automatically on the restart. With the unstart light out, the RESET button was pushed and the left inlet returned to schedule. (Near 2.5 Mn, it was observed that the left throat was close to airplane Mn and possibly lagged somewhat. This lagging in the 2.2 Mn region while in a right turn probably caused the unstart.) The remainder of the descent was normal with the right inlet unstarting normally above 2.0 Mn (bypass closed to 620 sq. in.), then left inlet unstarted at 1.98 Mn (bypass closed to 690 sq. in.). The bypasses closed completely at 1.19 and 1.17 Mn, right and left respectively.

2.0 FUEL SYSTEM MALFUNCTION

The fuel system operated in automatic excellently, except that 1900 to 2200 pounds of fuel could not be obtained from tank 4. This prevented tank 5 from feeding; and since tank 2 fed with tank 4, tank 7 started to feed before 5. With tank 5 on (manually), tank 7 had to be turned off because its four pumps were overpowering the two pumps in tank 5.

3.0 CONCLUSIONS

1. Automatic inlet operated excellently in NORMAL and HIGH performance modes, except for the left unstart at 2.23 Mn during the deceleration.
2. High-speed buffet appears to decrease when inlet HIGH performance mode was selected.

V H Shepard

V. H. Shepard
Copilot

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT Col. J. Cotton

FLIGHT NO. 1-38 COPILOT V. H. Shepard

DATE OF TEST 22 March 1966 FLIGHT TIME 2:11

CHASE AIRCRAFT AND PILOTS

Chase 1 - T-33 #688 - Capt. Livingston/Capt. Bowline
Chase 2 - T-38 #598 - Maj. Sorlie/Al White

PURPOSE OF FLIGHT

1. Bypass airflow calibration, 1.8 Mn, 55,000 ft.
2. Automatic bypass shock control, 2.0 to 2.4 Mn
3. Encapsulated descent from 1.4 Mn, 41,000 ft.
4. Longitudinal static stability, 15,000 and 10,000 ft.
5. Level flight performance, .8 Mn, 15,000 ft.
6. Longitudinal and directional dynamic stability, .8 Mn, 15,000 ft.
7. Static directional, .8 Mn, 15,000 ft.
8. Longitudinal accelerated stability, .8 Mn, 15,000 ft.
9. Five-engine constant Mach number (.43) climb

1.0 GENERAL COMMENTS

Takeoff acceleration from 70 to 150 KCAS resulted in an elapsed time of 20.8 versus 18 seconds computed from handbook data. This resulted in the acceleration being 11 to 12 knots low in the allotted time. As recommended before, this discrepancy must be uncovered before new pilots begin flying this airplane this summer.

Cabin altitude would not remain below 10,000 ft. when the airplane ascended above 15,000 ft.; therefore, most of the above tests were not accomplished. In order to accomplish tests near 15,000 ft., the cabin repressure switch had to be repeatedly held down to keep the cabin below 10,000 ft.

Longitudinal static gradient was very shallow from .7 to .9 Mn, resulting in a two-pound pull at .7 and essentially zero force at

.9 Mn after trimming at .8 Mn with wingtips at one-half. The gradient with wingtips up, around a trim point of .6 Mn was light, resulting in a five-pound pull at .5 Mn and a five-pound push at .7 Mn.

Longitudinal accelerated stability gradient appeared light and shallow at .8 Mn, 15,000 ft., as the pilot overshot 1.6 G on the first dynamic pullup. Difficulty was encountered in maintaining a constant 1.4 G in a windup turn, possibly because of the sensitivity and shallow gradient.

Cockpit ammonia fumes were excessive (eye burning and impossible to breathe) from the time the ammonia cooling was turned on, prior to taxi, until the airplane had reached near 20,000 ft. Since the Freon cooling system was inoperative, the ammonia system could not be turned off on the ground; and the only reason the flight was not aborted was that pressure suits were worn. Cabin repressure was utilized repeatedly on the ground; however, this extra air had no significant effect on the ammonia trapped in the closed cockpit environmental system. A tailwind was believed to have caused the ammonia entrance into the cockpit, since the cabin regulators are forward of the ammonia outlets. However, when the airplane was parked crosswind and into the wind for at least ten minutes prior to takeoff, the ammonia remained.

Capsule ejection seat pin was very difficult to remove with pressure suit gloves on. In fact, it took more than two minutes to remove the pin. It appeared that the pin was too short, making it very difficult for one to pull out when the pipper pin was held in. Furthermore, the pipper pin had sharp edges which catch on the pressure suit when egressing from the seat.

2.0 CONCLUSIONS

1. Ammonia fumes were excessive in the cockpit during taxi, takeoff, and initial climb.
2. Without a pressure suit, this flight would have been aborted at the run pad because of dangerous ammonia fumes in the cockpit.
3. Airplane takeoff acceleration was slow when timed against the copilot's VSI airspeed tape and compared to the handbook data.

3.0 RECOMMENDATIONS

1. That the reasons for the ammonia fumes be investigated thoroughly, such as tracing the path of the overboard fumes with smoke or some suitable agent to see if the influx was external or if this was an internal system problem.

2. The lock-unlock pipper on the seat pin should be redesigned to a "cooly hat" form so as to protect the pressure suit from sharp objects and enable one to get a firm grasp on the pin for removal.

4.0 DISCREPANCIES

1. Four-joule ignition would not start #2 engine.
2. #2 engine turns on high vibration caution light, but meter reads 2 to 3 mils.
3. Cabin would not hold pressure altitude below 10,000 ft. when airplane ascended above 15,000 ft.

V H Shepard

V. H. Shepard
Copilot

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R-66-3-6
Edwards AFB

PILOT REPORT

XB-70A No. 62-001 22 March 1966

Flight 1-38

INTRODUCTION

Pilot - Col Joseph Cotton
Copilot - Mr. Van Shepard
Max Altitude - 32,000 feet
Max Mach - .97
Max KIAS - 450

Takeoff Time - 0906
Flight Time - 2+11
Supersonic Time - None

The flight objectives were many and included: AICS sideslips at 1.8 Mach, automatic operation of the left inlet, duct performance to 2.4 Mach, airflow calibration, subsonic and supersonic stability and control, and an encapsulated descent.

The freon package was not installed --- it had been removed for installation in ship 2. The ammonia fumes in the cockpit were very strong. Burning of the eyes would have caused an abort had pressure suits not been worn. Failure of the environmental system to maintain the cabin pressure below 10,000 feet required an alternate subsonic test plan. Speed effect, performance climb, and stability and control data points were obtained to 16,000 feet and .9 Mach. The hand operated manual brake control was used with excellent results --- chatter no longer exists.

PREFLIGHT, ENGINE START AND TAXI

Engine start was initiated at 0737 and required 38 minutes because of a throttle cut off malfunction on No. 4 engine and 4 joule ignition failure on #2 engine. The control column position with the trim-for-takeoff (TTO) light on was 8°. The ground observer reported the actual elevon positions were correct. Fuel totalizer at start of taxi was 258,000 lbs.

Ammonia Fumes - Prior to and during taxi the ammonia fumes were so strong in the cockpit that Shep and I closed our pressure suit face plates. This was by far the strongest fumes we've experienced - we suspected it was caused by the strong tailwind from the northeast. Opening the face plate for only a second caused severe burning of the eyes. The flight would have been aborted had we not been wearing pressure suits. There must be something more than re-circulation causing this condition.

Brake Tests - Data was taken during a stop from 20 mph using the hand operated manual brake control in position 10. Other stops and speed reductions were made with the hand control at positions 8 to 15.

I had positive control during the stops which were completely free of chatter. This is a great improvement --- we can now stop the airplane without abusing it.

Seat Safety Pin - Shep and I both commented on two undesirable features of the ejection seat safety pin. It snags the pressure suit and is unnecessarily difficult to remove. The two-hand removal operation is tolerable but the risk of tearing the suit is unacceptable.

TAKEOFF AND CLIMB

The takeoff runway was 04, wind 040° to 070° at 18 knots with a temperature of 53°F. Fuel totalizer, 2 minutes prior to brake release, was 251,500 lbs. Shep timed the acceleration from 70 to 150 knots at 20.8 seconds using the CADS airspeed. I rotated on the standby airspeed (round dial) at 180 KIAS and was in the air at 205 KIAS. The gear retracted normally at 250 KIAS. The high vibe light remained on most of the time; however, there was no vibe indication over 5 MILS.

Cabin Pressure Trouble - The standard 425 KIAS climb was proceeding normally when the CABIN OVER 10,000 caution light came on after we passed through 20,000 feet. We leveled at .9 Mach and 25,000 feet. I held the REPRESSURE switch down, the cabin altitude came down below 10,000 feet, the light went out and we climbed to 32,000 feet. In spite of our corrective attempts the cabin altitude would not hold below 10,000 feet so we proceeded with alternate low altitude tests.

TESTS PERFORMED

Gear Cycled - Because of the gear problem on the last flight it was extended and retracted at 265 KIAS and 10,000 feet. Chase report and cockpit indications were normal.

Speed Effect - With gear, flaps and tips up and FACS off I trimmed hands off at 10,600 feet, 325 KIAS and .59 Mach. Throttles 2, 3, 4, and 5 were advanced, leaving 1 and 6 constant for position markers. With a very slight nose down attitude, speed was increased to 392 KIAS, .70 Mach at 10,300 feet. The throttles were reduced to their original starting position. The force was very light but was not estimated. In a slight nose up attitude, engines 3 and 4 were reduced and we slowed to .50 Mach, 268 KIAS at 11,000 feet. With the throttles returned to the original position I estimated a 5 lb pull force. There were no trim changes throughout these speed changes.

At 16,000 feet I trimmed out at .55 Mach and accelerated to .85 Mach. Without retrimming, the forward control force was 3 to 4 lbs. Throttle positions were the same at both speeds.

With FACS off, tips half, .81 Mach, 16,000 feet I took a trim shot and accelerated to .9 Mach with 3 and 4 engines in MAX A/B. At .9 Mach

the two throttles were returned to the original throttle angle and we held speed without retrimming or applying any force on the wheel. We decelerated to .7 Mach and with the original power I held a 2 to 3 lb pull force at 16,300 feet.

Slow Speed Climb - With the cockpit high vibe light on, and Data Control reporting T/M showing high vibes on #2, it was idled. With gear and tips up, windshield down and FACS on, a five engine MAX A/B climb was made at .43 Mach from 8,000 to 15,000 feet. The angle of attack was 9° at 8,000 feet and 11.5° at 15,000 feet. The maximum rate of climb was 2200 ft/min and reduced to 1200 ft/min at 14,000 feet. Flying quality alone would result in a Cooper Rating of 2 but the lack of forward visibility reduced it to an overall rating of 2-1/2.

Stability and Control - With windshield down, tips 1/2, augmentation on a pull up and release was completed at .80 Mach and 15,600 feet to an indicated 1.62 G. Control was resumed at 18,000 feet and .72 Mach. With the same configuration a 3° right sideslip was completed at 409 KIAS, .80 Mach and 15,250 feet. The rudder release was made from a 2° right sideslip.

Two pullup and releases were completed with FACS off at .81 Mach and 15,600 feet. The indicated G was 1.5 and 1.38.

With FACS off, 15,500 feet, I applied left rudder to a 3.2° right sideslip. With power applied the speed held steady at 400 KIAS. Slowly I came out of the right sideslip and fed in right rudder to stabilize on 3°. This was a slight climbing point at .795 Mach and 400 KIAS. The yaw angle varied from 2.8° to 3.2° due to my inability to hold the very sensitive aileron control steady. The left sideslip was more difficult to stabilize than to the right. The rudder release was made from just under 3°.

A FACS off windup turn to the left was completed in a constant power descent near .8 Mach between 408 and 411 KIAS. The maximum bank angle was 45°. The indicated G was difficult to stabilize and varied between 1.3 and 1.4.

Speed Power - With windshield down, tips half and FACS on, a 1-1/2 minute point was completed at 404 KIAS, 15,300 feet, .795 Mach. Turbulence was encountered and the run was continued for an additional minute and a half at 398 KIAS.

DESCENT AND LANDING

With ammonia remaining dictating our landing time we started the let down with 170 lbs indicated. Simulating the loss of three engines we idled 1,2, and 3 and made the descent and approach with 4, 5, and 6 in afterburner. The tips were retracted and the gear extended at 260 KIAS.

After the low approach, with the ammonia quantity at 90 lbs and fuel total 66,000 lbs., we remained in closed traffic for a landing on runway 04. The wind was 60° from 12 to 18 knots. The best flare speed was 195. All FACS were on for the landing. Speed down final varied from 210 to 220 KIAS. I didn't observe the touchdown speed. The crosswind landing was not difficult. I used a crab and wing down technique. I took the crab out but believe I rolled out too much and touched on the left main gear first. The touchdown was smooth at an estimated 2500 feet from the end. Two chutes opened initially with the third one developing under 100 knots.

Data was recorded during a stop from 30 mph with the manual brake control set at 15. A stop was initiated with the control set at 10 and backed off to 8, 6, and 5 which permitted us to continue rolling.

Ammonia fumes reappeared; the quantity was 50 lbs at shutdown.

FLIGHT SQUAWKS

1. 4 joule ignition would not start #2 engine.

2. No. 2 engine lights high vibe but meter reads 2 to 3 MILS.

3. Cabin would not hold pressure altitude below 10,000 feet when airplane was above 15,000 feet.

SYSTEMS SUMMARY

Landing Gear - The doors are slower than those of ship #2.

Brakes - The manual hand controlled stops were all easy to execute and void of any chatter. The normal toe brake stops at low speed were not as violent as usual.

Hydraulics - System pressure, head pressure, fluid level and pump status were all normal. The replenishing system selector knob guard blocks the pilot's view of the P_1 gage.

Engines - High vibes were bothersome throughout the flight. Some were real and some were erroneous indications.

Flight Controls - The TTO position on the control column was not correct.

Environmental - The freon package was not installed. Excessive ammonia fumes entered the cockpit. The cabin pressure could not be maintained below 10,000 feet. In short this system was very unsatisfactory.

Drag Chutes - Two canopies developed initially and the third developed just prior to jettisoning.

The following systems performed satisfactorily:

Nose Wheel Steering	Communications
Flaps	TACAN
Wing Tip Fold	IFF
Fuel	Oxygen
Electrical	Instrumentation
Flight Instruments	Fire Detectors

The ILS and AICS were not used.

RECOMMENDATIONS

1. Expedite freon package installation and eliminate cause for ammonia fumes in the cockpit.

2. Install the manual hand operated brake system in the No. 2 airplane as soon as possible.

3. Correct control column markings so they agree with elevator position when trimmed for takeoff.

4. Reduce size of hydraulic replenishing selector guard so as to provide pilot with good visibility of the P_1 fluid level gage.

Joseph F. Cotton

JOSEPH F. COTTON, Colonel, USAF
XB-70A Test Director - Pilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. Shepard

FLIGHT NO. 1-39 COPILOT Col. J. Cotton

DATE OF TEST 24 March 1966 FLIGHT TIME 2:00

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #315 - Capt. Livingston/Capt. Roosa
Chase 2 - F-104 #316 - Capt. Gentry/Capt. Roosa

PURPOSE OF FLIGHT

1. New brake lining tests
2. Inlet sideslip airflow calibration, 1.6 and 1.8 Mn
3. Automatic shock control, 2.0 to 2.4 Mn
4. Bypass airflow calibration, 1.8 Mn, 55,000 ft.
5. Inlet and power control during encapsulated descent
6. Level flight acceleration, 15,000 ft.
7. Level flight performance, .75 Mn, 15,000 ft.
8. Airstart, 10,000 ft. at 15 per cent rpm
9. Longitudinal static stability, 1.7 to 2.0 Mn, 55,000 ft.

1.0 BRAKE TEST - NEW LINING

A normal stop was accomplished using new chemically treated linings. The stop was slightly better with the new lining, but braking at speeds below 15 knots was still unsatisfactory because of chatter. If the brakes were used very lightly, satisfactory braking could be obtained with only a quivering action; however, distances required to stop were still excessive.

On taxiing in after landing, the brakes appeared to be significantly better at low speeds. If light braking was used, the stops were satisfactory with acceptable stopping distances.

2.0 INLET AIRFLOW IN SIDESLIPS

Full left and right rudder sideslips were accomplished with bypass areas at 400 and 800 sq. in. at 1.6 Mn, 41,000 ft., and 1.8 Mn, 45,000 ft. The sideslips were stabilized near 1.5 degrees of yaw for full rudder. When holding full left rudder, rudder pedal feedback in excess of 300 pounds was felt, which caused the airplane to

oscillate ± 0.2 degree. This augmentation feedback would force the pedal off full deflection in a two-second period. This feedback was not experienced with full right rudder.

3.0 AUTOMATIC SHOCK CONTROL - LH INLET

The left-hand inlet was started by placing the bypass mode switch in AUTO with the airplane stabilized near 2.05 Mn. The bypass area opened slowly, but started oscillating the shock position needle from a bottomed-out position to the top of the green in a one and one-half second period. The bottomed-out position was in the crosshatch, and the needle was bottomed out for one-half second or more. The bypass area was oscillating ± 10 to 15 sq. in. All engine information was normal.

Data were then obtained of a climb to 2.4 Mn, 58,000 ft., with AUTO bypass selected on the left inlet and manual bypass on the right inlet. At 2.4 Mn the left inlet duct performance switch was placed in LOW, stabilizing for 15 seconds, then back to NORMAL. No engine difficulties were observed as the bypass opened and as the downstream shock (DSP) was controlled by the automatic bypass.

Data were obtained of a deceleration to 2.05 Mn, 55,000 ft., of the left-hand inlet shock control and of switching the left-hand mode switch to MANUAL to unstart the inlet.

4.0 LONGITUDINAL STATIC STABILITY - 1.7 to 2.0 MN

A trim shot was obtained in a slight climb at 1.8 Mn using maximum afterburner power. Then attempting to stabilize near 1.9 Mn, a good stable point was obtained at 2.03 Mn in a moderate climb requiring four to five pounds of push force. The airplane was restabilized at 1.69 Mn and the airplane was essentially in trim--possibly a slight push force.

5.0 BYPASS AIRFLOW CALIBRATION - 1.8 MN

Data were obtained of stabilized runs: all engines at 100 per cent; #1 engine at 90 per cent; and #1 engine at IDLE (80 per cent), while the copilot held the left shock at .7 SPR. The last two runs required 1100 and 1320 sq. in. of bypass, respectively. Then leaving #1 engine in IDLE, #2 engine in MAX A/B, #3 engine was retarded to 90 per cent and IDLE (79 per cent). This required the left bypass to be opened to 1710 and 2040 sq. in. respectively, to hold a constant .7 SPR. During the run the airplane descended to 50,000 ft., and the #1 engine idle speed reduced to 79 per cent during the last run.

6.0 CONTROL OF INLET AND POWER FROM THE CAPSULE

At 1.4 Mn, 41,000 ft., the copilot entered the capsule. The data did not run as anticipated, and the data was turned on manually by the pilot. The copilot started flying the airplane with the trim button; however, he complained of not being able to unlock his shoulder harness, which held him tightly back in the seat. He tried to unlock the shoulder harness in order to be able to observe the engine instruments for the first test, but was unsuccessful. The throttle retard button was pressed momentarily and both bypasses rapidly opened to 2300 and 2240 sq. in. left and right. Engines operated normally with this wide-open bypass. Then the copilot "blipped" the throttle retard button, and the engines were observed to decrease in afterburner power. After approximately three blips, engines #1 and #3 exhibited minimum afterburner instability. At least three more throttle blips were required by the copilot before minimum afterburner instability ceased. The copilot continued the descent and deceleration, and his flying of the airplane was satisfactory. The wingtips were inadvertently left at full down, and they were retracted near Mach 1 to the one-half position. This gave the copilot a mild nose-down trim change which he handled satisfactorily. The throttles were beeped back several more times; and while descending near .9 Mn, 20,000 ft., the following rpm's were observed: 1-99 per cent; 2-90 per cent; 3-94 per cent; 4-94 per cent; 5-91 per cent; 6-97 per cent. Near .9 Mn, 15,000 ft. in the descent, the copilot had to be cautioned to observe airspeed as he was approaching 460 knots. The copilot egressed from the capsule near 8,000 ft., 350 knots and the throttles were adjusted to near observed rpm and the RESET button was pushed wherein normal throttle control was obtained.

7.0 LEVEL FLIGHT ACCELERATION PERFORMANCE

With the airplane trimmed up at .5 Mn, 15,000 ft., data were obtained of a simultaneous six-engine afterburner lightoff and throttle burst to maximum afterburner. The airplane was allowed to accelerate to .95 Mn, 492 KIAS, and climbing approximately 500 feet during the acceleration to offset the position error due to Mach number change. The acceleration was rapid and excellent.

8.0 LEVEL FLIGHT PERFORMANCE - .75 MN, 15,000 FT.

An excellent level flight stabilized point was obtained at 15,500 ft., .6 Mn, 484 KIAS, with the wingtips at one-half and the nose ramp down. The angle of attack was 2.2 degrees. Then with the data still running, the wingtips were positioned full up and one minute of data were obtained in a stabilized point in a slight climb at .765 Mn, 488 knots.

9.0 AIRSTARTS

The #1 engine was shut down at .6 Mn, 10,000 ft., where the windmill rpm was observed to be 20 per cent. The airplane was slowed to .43 Mn at 10,000 ft. in order to hold a constant 12 per cent windmill speed. The airstart was attempted with the throttle at IDLE and the 40-degree position twice with no results. Then holding level flight, the airplane was accelerated to .49 Mn, 271 knots, in order to maintain an engine windmill speed of 15 per cent. The engine started satisfactorily on the first attempt at this new windmill speed.

10.0 CONCLUSIONS

1. The new chemically treated brake lining improved the braking characteristics especially during taxi-in; however, further improvement was needed in order to classify the overall braking as satisfactory.
2. Level flight acceleration subsonic performance at 15,000 ft. using maximum afterburner power was excellent. (320,000 lbs.)
3. Engine airstarts at 10,000 ft. were unsuccessful at 12 per cent rpm, but were successful at 15 per cent rpm.
4. Automatic bypass - shock control was only marginally acceptable due to excessive shock oscillation - manual shock operation was much superior to the automatic operation.
5. Copilot encapsulated control of the airplane during a descent from 1.4 Mn was satisfactory.

11.0 RECOMMENDATIONS

1. That automatic bypass - shock control be repeated by controlling the shock near .6 SPR or slightly above.

V. H. Shepard

V. H. Shepard
Pilot

COPILOT REPORT

XB-70A No. 62-001 24 March 1966

Flight 1-39

INTRODUCTION

Pilot - Mr. Van Shepard	Takeoff Time - 0941
Copilot - Col Joseph Cotton	Flight Time - 2+00
Max Altitude - 60,000 feet	Supersonic Time - 1+06
Max Mach - 2.42 Mach	Mach 2+ Time - 0+21
Max Speed - 580 KIAS	

The following objectives were achieved during this flight: AICS sideslips at 1.6 and 1.8 Mach; the first complete automatic control of the left inlet which included the start, climb, performance in normal and low, deceleration and unstart; longitudinal static stability check at 1.9 and 1.7 Mach; bypass airflow calibration; encapsulated control and descent; subsonic level flight acceleration and performance at .75 Mach; and, airstart of #1 engine at 15% windmill rpm. The only objective scheduled and not achieved was the sawtooth climbs.

The freon package was not installed and the ammonia fumes in the cockpit were extremely strong. During the rudder sideslips to the right the left rudder feedback was sufficiently great as to prevent full rudder application. The encapsulated control and descent tests were successful. The left inlet automatic shock (bypass) control was very poor. The #1 engine would not airstart at a 12% windmill rpm but did light off at 15% near 9,500 feet and 270 KIAS. The heading system is unsatisfactory.

The climb out and descent were made through cloud. The tops in the local area were 31,000 feet. Only light turbulence was encountered and that only once over the Sierras.

The mission was considered very successful with excellent data obtained.

PREFLIGHT, ENGINE START AND TAXI

At engine start the fuel totalizer was 268,500 lbs. During the 24 minute engine start No. 1 engine would not continue to rotate unless the ground start was held on continuously. All start EGT peaks were below 580°C. The hydraulic replenishing system was used to service the primary #1 system fluid level because of a malfunction in the ground service unit.

At start of taxi the fuel totalizer was 256,000 lbs. Ammonia fumes were so bad in the cockpit that we had to keep our pressure suit face plates down continuously. Opening the face plate caused severe eye burning and throat irritation. Without the pressure suits this flight would have been aborted before leaving the run pad. This cannot be just a recirculation problem --- there must be leakage in the system. The turn needles were inoperative. Tire skid and airframe shuddering resulted during an automatic system foot brake stop. A manual hand brake stop, starting at position 10 and backing off to 7, resulted in no skidding or chatter.

TAKEOFF AND CLIMB

The takeoff runway was 04, temperature 55°F and wind 060° at 18 knots. Fuel totalizer at brake release was 247,500 lbs, ammonia 485 lbs. Shep planned to rotate 30 knots prior to unstick. We failed to get the acceleration time. He called rotation at 173 on the standby airspeed. I observed us in rotation at 186 on the tape airspeed and definitely airborne at 211 KIAS.

Gear retraction appeared slow; flaps retracted and wing tips extended normally. We entered cloud near 6,000 feet, were on top of the first deck at 13,000 feet and on top of all clouds at 31,000 feet. The cockpit ammonia fumes were still strong, with the face plate lifted, and continued until we were supersonic at 32,000 feet, 10 minutes after brake release.

Wing tips were selected down at 1.36 Mach and indicated full down at 1.45 Mach. The heading did not change during an 8° banked turn --- the ground track showed a heading change. The 575 KIAS climb was held to 1.6 Mach which was maintained to 41,000 feet.

AICS SIDESLIPS

Over Coaldale, with a fuel total of 173,500 lbs., 1.6 Mach and 41,000 feet, I set the bypass areas at 410 left and right. Shep applied right rudder and advanced engines 1, 2, 5, and 6 to hold Mach. At full right rudder, 1.59 Mach, the #1 yaw vane showed 1.2° right yaw and vane #2 indicated 2°. Full left rudder resulted in a 1.4° yaw on vane #1. In this direction the rudder feedback and force were very heavy and prevented him from holding full rudder.

With bypass areas set at 800 square inches full right rudder was applied at 1.61 Mach. With 8° left wing down aileron the yaw was 1.3°. With the ball centered and yaw vane #1 at zero the #2 vane indicated .6° right. At 1.61 Mach full left rudder application was attempted but Shep reported he could not hold it in continuously. Heavy feedback caused the yaw to oscillate from .8 to 1.8° every 2 seconds.

At 1.8 Mach, 45,000 feet I set bypass areas at 400 square inches. Full right rudder was applied at 1.82 Mach and resulted in a stabilized 1.2° yaw. Forty miles west of Battle Mountain, fuel total of 151,000 lbs, Shep attempted to apply full left rudder and, as previously, the feedback caused the yaw to oscillate. The yaw 1 indication was from 1 to 2 degrees so the full rudder point was abandoned.

800 square inch bypass areas were set with throat Machs at 1.81. Full right rudder resulted in a steady 1.3° sideslip at 1.79 Mach, 44,600 feet and 539 KIAS. At approximately 7/8 left rudder there was no pedal feedback and the yaw could be held steady at 1.2°. Full pedal depression again resulted in feedback and yaw oscillation.

The air was smooth and the Mach was easy to stabilize so these points should have all been very good ones.

With 400 square inch bypass areas we accelerated to 575 KIAS at 45,000 feet and climbed to Mach 2 and 50,000 feet.

FULL AUTOMATIC OPERATION OF LEFT INLET

In a 30° banked right turn at Rome, 2.07 Mach, with bypass areas 400 square inches and both throats at 2.08 Mach in automatic, I selected the left bypass mode to automatic. The bypass opened to 810 square inches and the inlet started. The shock needle oscillated continuously from .64 SPR to the crosshatched (XXXX) area. The bypass area varied from 830 to 850 square inches. During each cycle the shock needle bottomed in mid XXXX for a second; the engine instruments remained steady. The shock control was poor.

I manually started the right inlet by opening the bypass doors with the wheel control to 800 square inches. The shock needle dropped to the XXXX and I closed the doors slowly until the needle moved forward to .6 SPR (mid green) and held steady.

During the acceleration and duct performance change the following data were reported:

A/C Mach	Throat Mach Left	Throat Mach Right	Bypass Area Left	Bypass Area Right	Shock Needles (SPR) Left	Shock Needles (SPR) Right	Comments
2.07	2.08	2.08	810	800	.64 to XXXX	XXXX then .6	Left auto start Right manual start.
2.09	2.1	2.1	780	750	.63 to .35	.6	30° right bank Auto mode left inlet - poor shock control.
2.15	2.16	2.16	720	690	.63 to top XXXX	.6	30° right bank Left inlet - poor auto shock control.
2.3	2.31	2.31	600	580	.63 to top XXXX	.6	20° right bank Left needle oscillates Right inlet manual control.
2.4	----	----	550	570	Oscil-lates	XXXX	58,000 feet Left inlet - auto Right inlet - manual Duct perf. - normal.
2.4	2.2	2.2	830 to 790	660	.6 to .5	.65	Duct perf. - low Left inlet - auto Right inlet - manual Left inlet - poor shock control.
2.3	2.31	2.31	640	600	.63 to .4	.6	Min. afterburner In deceleration Left inlet - auto Right inlet - manual
2.04	2.02	2.02	---	---	------	----	55,000 feet Unstart inlets

NOTE:- Although the left inlet automatic shock control was poor in both normal and low performance, the engine operation remained normal. Automatic throat operation was satisfactory.

LONGITUDINAL STABILITY

With 100,000 lbs of fuel, 1.8 Mach, 55,000 feet, 428 KIAS and FACS ON, a trim shot was taken with MAX A/B on all engines. A gentle push-over and increase to Mach 2.03 resulted in a 4 to 5 lb push force - practically neutral.

Without changing the longitudinal trim, the throttles were reduced to military in a slow climb. At 1.7 Mach, with MAX A/B on all engines, the push force was reported at 2 lbs --- again very near a neutral force.

BYPASS AIRFLOW CALIBRATION

Starting at 1.83 Mach, 55,000 feet and ending at 1.81 Mach and 50,000 feet in a slight descent, airflow data was obtained with the rpm lock-up released and the left bypass doors opened to maintain .7 SPR. The following engine rpms and bypass areas were observed:

No. Engine	No. 2 Engine	No. 3 Engine	Left Bypass Area
100%	100%	100%	880 square inches
90%	100%	100%	1100 square inches
80% (Idle)	100%	100%	1320 square inches
Idle	100%	80%	1710 square inches
79% (Idle)	100%	79% (Idle)	2050 square inches

CAPSULE TESTS

I removed the descent control, often called "the potato," prior to encapsulating. The latches on its container are very difficult to close with the control removed. My seat was near the full down position when I manually encapsulated. Once encapsulated I could not release my shoulder harness and was pinned low and aft in the capsule. Had I been aware of the restrictions imposed by this position I would have come out of the capsule, raised the seat and re-encapsulated while leaning forward and holding the harness unlocked.

I encapsulated at 1.4 Mach, 41,000 feet, FACS on, wing tips full down, bypass areas 400 square inches, the windshield down, and all engines in the afterburner range. Data did not come on continuously when I encapsulated, as I had expected.

I depressed the throttle retard button momentarily and the bypass areas increased to 2,300 square inches left and 2,240 square inches right. I couldn't see the engine instruments but Shep reported some decrease in power. I saw the MASTER CAUTION light and Shep reported the RIGHT BUZZ light on. Engines 1 and 3 were unstable in MIN A/B so I beeped the throttle retard switch until Shep reported the power stable. I could feel a slight deceleration with each push of the button.

After going subsonic Shep retracted the tips to half. This change coupled with a 10 to 15 degree bank caused the rate of descent to increase to 10,000 feet per minute. We descended through cloud in a turn. Bank angle control was easier than I expected --- pitch control was not so easy. I seldom moved the trim switch more than one beep at a time. Shep never once took control of the airplane but did coach me on the power reductions since I could not see the engine instruments.

Three different power settings resulted in the following rpms:

No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
100	97	98	99	96	100
99	90	94	94	91	97
* 94	80	88	85	82	82

* NOTE:- No. 1 engine would not reduce below 94% with the power beeped fully off.

I descended through 22,000 feet at .94 Mach at 1500 fpm, rate of descent. I attempted to level at 8,000 feet but actually terminated the capsule work in a 20° bank at 7,300 feet and 315 KIAS. I controlled the aircraft while encapsulated for a total of 16 minutes.

In Summary - The descent would have been easier and controlled more precisely had the wing tips been raised to 1/2 prior to descent, the seat position been higher and the shoulder harness been unlocked while encapsulated. Access to and stowage of the descent control is very poor.

LEVEL FLIGHT ACCELERATION AND PERFORMANCE

With tips half, a level acceleration was made from .50 Mach and 15,300 feet to .95 Mach (492 KIAS) with maximum afterburner. The throttles were advanced from 40° to 70° throttle angle simultaneously and the A/Bs lit without any irregularity.

A 2 minute speed power was completed with a fuel totalizer of 38,500 lbs, tips 1/2, FACS on, .76 Mach, 15,500 feet, 483 KIAS and 2.2° angle of attack.

With tips up, 35,500 lbs of fuel, 15,420 feet, .765 Mach and 488 KIAS a 1 minute speed power was completed.

NO. 1 ENGINE AIR START

At .60 Mach, 10,000 feet, #1 engine was shut down. Windmill rpm at .44 Mach, 252 KIAS and 9,400 feet was 12%. With airstart ignition on, the throttle was placed in idle for 30 seconds, 40° T/A for 15 seconds, off for 5 seconds, idle for 30 seconds, and 40° T/A for 15 seconds without a light off.

After cooling in idle for 2 minutes the windmill rpm was increased to 15% at 9,600 feet, .49 Mach and 271 KIAS. The throttle was in idle and the ignition was turned on. The engine lit off immediately. Although chase reported fire out of the tailpipe for 20 seconds during start the EGT remained normal. The data was not on.

DESCENT AND LANDING

The gear extended normally at 230 KIAS --- flap extension was normal. The utility #4 status light was on steady. Landing was on runway 04 with the wind 50° at 8 to 16 knots. The gross weight on final was 290,000 lbs. The totalizer was 27,000 lbs and the SUMP LOW light came on at 21,000 lbs in tank #3. All augmentation was on. On final the airspeed was 210 KIAS at a 6-1/2° angle of attack. The estimated touchdown speed was 185 KIAS, 2,500 feet from the end of the runway. The touchdown was a very soft one. Landing camera was on. Touchdown was at a CADS tape airspeed of 175. Two chutes deployed initially with the third one developing later. With 5,000 feet remaining the speed was 85 KIAS. Chute jettison speed was approximately 50 knots.

Engines No. 1 and 6 were shut down on the runway. Data was on for two manual hand brake stops at positions 15 and 10 --- there was no chatter. We overshot the turn off and did a 180° turn on the runway. The flaps refused to retract until the lever was cycled; the indicator would not show the proper flap position until it was tapped.

With engines No. 1 and 2 shut down and #3 at idle the P_1 pressure was 3600 psi and U_1 3550 psi. With Nos. 5 and 6 shut down and No. 4 at idle the P_2 pressure was 4,000 and U_2 4050 psi.

At shut down, time 1207, the fuel totalizer was 20,500 lbs with the sump at 14,500 lbs. The ammonia level was 130 lbs.

FLIGHT SQUAWKS

1. No. 1 engine has to be started by holding ground start switch.

2. Left rudder feedback at full rudder - 300 lbs of pedal force will not overcome feedback.

3. Both turn needles inoperative.

4. Right hand burr on several times at 1.3 and 1.1 Mach.

5. Flaps would not retract on first attempt after landing.

6. Nose wheel steering disengaged when going from takeoff and landing to taxi.

7. Copilot capsule pressure low at end of flight.

SYSTEMS

Nose Wheel Steering - Although it intermittently hunts in both modes it has not progressed to the point of being unacceptable. Disengagement was experienced when selecting from T. O. & LAND to TAXI --- the design of this switch will result in a cutoff if there is any rearward movement of the switch when it's raised.

Brakes - Manual hand control stops were excellent. Auto toe brake stops resulted in tire skidding and chatter.

Flaps - Failed to retract after landing until the lever was cycled. Indicator sticks and had to be tapped.

Hydraulics - Fluid levels were recorded as follows:

	U_1	U_2	P_1	P_2
Prior to taxi	8.3	11.1	4.2	4.1
After landing	9.2	10.9	5.0	5.3

The utility #4 pump status light was on steady during the last of the flight.

AICS - The left inlet automatic shock control was very poor.

Flight Instruments - Both turn needles were inoperative. The heading system hangs up, drifts after turns are stopped, and in general, appear unreliable.

Communications - Aircraft radios appear weak. Lost contact with Data Control several times in flight.

Environmental - Freon package was not installed. Ammonia fumes were extremely heavy in the cockpit during taxi and initial climb. A non-pressure suit flight would have been aborted. We must stop accepting system operations such as this.

Drag Chutes - One of the three was late in developing.

Fire Detectors - The No. 2 ADS light stays out during the "lights on" test.

The following systems gave satisfactory operation:

Landing Gear	TACAN
Wing Fold	IFF
Hydraulics	Flight Controls
Engines	Instrumentation Package
Fuel	Oxygen
Electrical	Windshield Ramp

The ILS was not used.

RECOMMENDATIONS

1. Continue airstart procedure and envelope expansion tests.

2. Improve access to and method of stowing the capsule descent control.

3. Install the freon package and eliminate the ammonia leakage.

4. Investigate cause of and, if possible, eliminate the feedback to the left rudder pedal.

5. Improve automatic shock control of the left inlet.

6. Provide a satisfactory heading system.

7. Change the hydraulic pump status indicators so as to cause them to illuminate only when a true pump problem exists.

Joseph F. Cotton

JOSEPH F. COTTON, Colonel, USAF
XB-70A Test Director - Copilot

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R-66-3-4
EDWARDS AFB

PILOT COMMENTS

XB-70A FLIGHT 2-27 24 MARCH 1966

INTRODUCTION:

The flight was scheduled off at 0600 hours and was actually airborne at 0605. The flight objective was a cross-country flight from Edwards AFB, California, to Carswell AFB, Texas, in order that the airplane could be displayed during the Air Force Association Convention on 24 March and during "open house" days at Carswell AFB on 25 and 26 March. The flight plan called for an acceleration to 2.70 Mach and then cruising at 2.70 Mach at 64,000 feet until decelerating for landing.

The flight was flown exactly as planned and required 59 minutes from lift off to over Carswell AFB at 6,000 feet. The maximum speed and altitude attained was 2.73 Mach and 65,000 feet. The flight duration was one hour and 32 minutes.

PREFLIGHT AND TAXI: All engine starts were normal and the taxi out was routine.

TAKEOFF AND CLIMB: Total fuel three minutes prior to brake release was 229,000 pounds. The brake release was slightly rough. Using max A/B, the acceleration appeared normal and lift off was around 200 knots on the vertical airspeed indicator. After retracting gear and flaps, and setting wing tips to 25 degrees, the airplane was climbed at 425/.95 with max A/B to 32,000 feet. The AICS was set in automatic during the climb and remained there throughout the high speed portion of the flight.

ACCELERATION AND CLIMB: The airplane was accelerated level at 32,000 feet, using max A/B, until reaching 575 knots IAS (1.48 Mach). The tips were set at 65 degrees down just prior to 1.4 Mach. After obtaining 575 knots, a climbing acceleration was made to the cruise speed and altitude of 2.70 Mach at 64,000 feet. The AICS provided excellent automatic operation of the inlets.

CRUISE AT 2.70 MACH: The stabilized cruise portion of the flight was quite routine and only lasted 13 minutes. Three separate speed power runs were accomplished at approximately 2.71 Mach. The effort required in flying the airplane on a mission of this type was considerably less than required on the usual XB-70 test missions.

DECELERATION AND DESCENT: The deceleration was initiated when over Lubbock, Texas, which is 238 nautical miles from Ft Worth. The airplane

became subsonic when approximately 58 miles from Ft Worth. It then crossed over Carswell Air Force Base at 6,000 feet altitude, exactly one hour after brake release (approximately 59 minutes after lift off).

FT WORTH LOCAL AREA FLYING AND LANDING AT CARSWELL AFB: After passing over Carswell, the airplane was leveled at approximately 5,000 feet altitude and flown around the outskirts of Dallas and back to Carswell. A low pass at 300 knots was flown over the runway at Carswell with the gear and flaps up and the wing tips at 25 degrees. The airplane was then placed in the landing configuration and another low pass over the runway accomplished. That was followed by a full stop landing with 55,000 pounds of fuel remaining. The flare speed was computed as 197 knots and the touchdown was between 180 and 185 knots. The airplane was easily stopped with the drag parachute and light wheel braking.

TIME - HOUR AND MINUTES - COMMENTS:

:00 Brake release.

:01 Lift off, picking up 91 degree great circle heading.

:04 15,000 feet and climbing.

:08 1.0 Mach at 32,000 feet.

:09 Over Daggett (65 N.M. from Edwards).

:14 1.4 Mach

:17 Abeam Needles (168 N.M. from Edwards), 39,000 feet, changing heading to 85 degrees.

:19 Total fuel = 145,500 pounds.

:21 2.0 Mach.

:23 Abeam Prescott (267 N.M. from Edwards).

:26 2.4 Mach, changing heading to 75 degrees.

:28 2.55 Mach, 59,000 feet altitude, total fuel = 121,000 pounds.

:29 2.61 Mach, 61,000 feet altitude.

:30 Over St John (434 N.M. from Edwards), changing heading to 85 degrees.

:31 2.70 Mach, 64,000 feet altitude.

:33 Changing heading to 75 degrees.

:34 C/N 2228, speed power at 2.71 Mach.

:34½ Abeam Socorro (551 N.M. from Edwards).

:36½ Total fuel = 104,000 pounds.

:38½ C/N 2628, speed power at 2.71 Mach.

:41½ C/N 2785, speed power at 2.71 Mach - Total fuel = 91,500 pounds.

:44 Over Lubbock (793 N.M. from Edwards), power reduced to military to decelerate.

:48 2.0 Mach, decelerating.

:48½ Total fuel = 87,000 pounds.

:51 1.5 Mach, 90 miles to Ft Worth.

:54½ 1.0 Mach, decelerating.

:57½ 25 miles from Carswell at 20,000 feet altitude.

1:00 Over Carswell at 6,000 feet altitude at 400 knots IAS (1031 N.M. from Edwards).

1:32 Landing at Carswell.

SYSTEMS:

1. The compass system gave unsatisfactory operation. Flying the computed Great Circle heading of 91 degrees caused the airplane to go right off course. When changing airplane heading, the compass was slow to indicate a change in heading.

2. Although the fuel system fed the engines satisfactorily, the overall operation was not satisfactory. Due to a viton repair in tank 6, the fuel in tank 6L and 6R was loaded asymmetrically and caused a requirement to use a non-standard fuel usage sequence. This non-standard sequence required an excessive amount of copilot attention.

3. The AICS provided excellent automatic operation.

4. The engines provided excellent operation.

ITEMS OF INTEREST:

1. Although most of the flight was flown by reference to the flight instruments, the pilot's workload was relatively low during high speed cruise. Once the airplane had been stabilized under high speed conditions, the airplane could be held close to the desired speed and altitude with only a small amount of attention. This was done primarily by holding the Mach indication constant and letting the altitude drift slightly. Small power adjustments were made to compensate for deviations from the desired altitude.

2. The flight departed Edwards early in the morning and was flown almost directly into the rising sun. The glare on the pressure suit face plate was very bad. It was impossible to see the instruments until the glare shield had been adjusted to completely block the window in front of the pilot.

3. Navigation was not a problem since the TACAN set gave good operation and the FAA provided radar vectors toward Carswell during the last part of the flight.

4. It would be desirable to have TACAN stations located approximately 300 miles apart and to have a TACAN radio that would lock on the stations at that distance.

CONCLUSIONS:

1. The flight from Edwards to Carswell went as planned and was a very successful flight.

2. Three well stabilized supersonic speed power runs were completed.

MAINTENANCE DISCREPANCIES:

1. The pilot's rate of climb indicator was stuck at a high rate of descent

2. Yaw augmentation #1 disengaged while trimming the rudder. It was reset and operated satisfactorily.

RECOMMENDATIONS:

1. Correct the maintenance discrepancies noted.

2. Improve the compass heading system.

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Pilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. Shepard

FLIGHT NO. 1-40 COPILOT Col. J. Cotton

DATE OF TEST 28 March 1966 FLIGHT TIME 1:41

CHASE AIRCRAFT AND PILOTS

Chase 1 - B-58 #662 - Lt. Col. Fulton/Maj. Cross
Chase 2 - F-104 #316 - Col. Sorlie/Capt. Curtis

PURPOSE OF FLIGHT

1. Automatic shock control, 2.0 to 2.4 Mn
2. AICS Automatic to Manual mode - switching
3. Longitudinal static stability - 1.9 to 2.1 Mn
4. Bypass airflow calibration
5. Capsule-inlet buildup tests, 1.8 Mn, 45,000 and 50,000 ft.
6. Airstarts at 1.4, 1.3 and 1.2 Mn, 35,000 ft.

1.0 TAKEOFF

An acceleration time of 18 seconds was computed from the Handbook to accelerate from 70 to 150 KCAS using a takeoff weight of 520,000 pounds at 60°F. The copilot timed the acceleration, and 148 KCAS was observed on the instrumentation airspeed dial, neglecting position error. Previously the accelerations had been timed against the copilot's (VSI) airspeed, and 11 or 12 knots discrepancy in the unsafe direction had been observed; but using the accurate airspeed resulted in only two knots low, which was satisfactory. The takeoff was accomplished in a calm wind, and rotation was started 30 knots below computed lift-off speed. The airplane flew off the ground smoothly as the nose passed through 10 degrees pitch attitude. Acceleration after takeoff was satisfactory.

2.0 ENGINE COOLING DOORS

Cooling doors on engine #1 would not close above .9 Mn. Chase reported doors still open at 1.3 Mn; therefore, afterburner power was not utilized on #1 engine above .95 Mn. The remainder of the supersonic flight and tests were accomplished with this engine at Military Power or below.

3.0. AUTOMATIC SHOCK CONTROL - 2.0 to 2.4 MN

Both inlets were started separately by moving the bypass mode switches from MAN to AUTO with the airplane stabilized between 2.0 and 2.1 Mn. Both inlet shock positions oscillated excessively after the start, and the right inlet's shock had a frequency about one-half of the left shock's frequency. The airplane was then accelerated to 2.4 Mn, 58,000 ft., in NORMAL inlet performance using maximum afterburner on five engines. Acceleration was excellent, considering it was accomplished in a turn with #1 engine at Military Power.

Stabilized at 2.4 Mn, data were obtained of switching inlet performance from NORM to LOW and stabilizing for 15 seconds, then back to NORM. Then the copilot switched the left mode from AUTO to MAN with the wheel inadvertently at the UPDATE position 3, resulting in 1400 sq.in. on the left bypass. No difficulty was encountered with this aft shock. He repeated the run by going back to AUTO and updating the wheel to indicated area plus 200 sq. in., which resulted in a wheel inboard reading of approximately 850-800 sq. in. Extreme care was used to make sure AUTO to MAN was selected when bypass area was increasing, as it was impossible to switch when the bypass area was constant because of the oscillating area on automatic shock control. This MAN mode was held for 15 seconds, then AUTO was reselected. This test was repeated on the right inlet with no problems; however, again Col. Cotton remarked that he was unable to switch to MAN mode on the right bypass at a constant area because the area was never constant.

Then data were obtained of a climbing deceleration, in AUTO mode, from 2.4 to 2.0 Mn and from 58,000 to 60,000 ft.

4.0 LONGITUDINAL STATIC STABILITY - 1.9 to 2.1 MN

The airplane was trimmed out in a slight climb at 2.01 Mn, then a stabilized point was obtained at 2.1 Mn where four to five pounds of push force were required. A stabilized point at 1.87 Mn was obtained near 64,000 ft. where a seven- to nine-pound pull force was required. The gradient was shallow but positive.

5.0 BYPASS AIRFLOW CALIBRATION - 1.9 Mn

Following the static stability run, it appeared that excessive time would be required to accelerate to 2.0 Mn because #1 engine afterburner could not be used with the cooling doors open. Therefore, the airflow calibration was accomplished at 1.9 Mn. Data were obtained of stabilized runs; all engines at 100 per cent; #1 engine at 90 per cent; and #1 engine at IDLE (81 per cent) while the copilot

held the left shock at .7 SPR. This required 880, 1140, and 1360 sq. in. of bypass, respectively. Then leaving #1 in IDLE, #2 engine in MAX A/B (100 per cent), the #3 engine was retarded to 90 per cent and IDLE (79.3 per cent). This required the left bypass to be opened to 1690 and 1990 sq. in. respectively, to hold a constant .7 SPR. The airplane descended to near 54,000 ft. and #1 engine idle speed also reduced to 79.3 per cent for the last run.

6.0 CAPSULE-INLET BUILDUP TESTS

At 1.8 Mn, 50,000 ft., the three left engines were placed in unlocked idle and the left bypass was opened rapidly from 1100 to 2320 sq. in., and stabilized data were obtained for 10 seconds. Then the bypass was closed to 1100 sq. in. At 1.77 Mn, 46,000 ft. climbing, the three left throttles were placed at a 40-degree throttle angle. The bypass was opened rapidly from 1100 sq. in., and the engines started to stall (the compressor stalls could be felt in the cockpit). Throttles were retarded, and at least one EGT overtemperature light was on. The stalls ceased. At IDLE, the engines were running normally. The bypass was closed sometime shortly after the stalls were felt. This 40-degree throttle angle test was repeated at 45,000 ft., 1.8 Mn, by opening the left bypass again from 1100 sq. in. with the standby switch. Engine #3 stalled this time. All three throttles were retarded to IDLE while the bypass was closed. Stalls ceased as throttles were pulled back, and engines ran normally at IDLE. The copilot reported the stalls occurred near 2000 sq. in. of bypass area.

7.0 AIRSTARTS - 1.4, 1.3 and 1.2 MN, 35,000 FT.

The #1 engine was shut down and throttle moved to IDLE. Then after rpm stabilized near 73 per cent with EGT reading 90°C, the airstart switch was turned on. No indications of a start were observed (EGT did not rise) and after thirty seconds, the throttle was moved forward to the 40-degree position where the engine was observed to accelerate immediately. This occurred at all three Mach numbers. (Later instrumentation revealed the engines had started shortly after placing the airstart switch on; however, EGT did not rise, but the rpm increased 6 per cent over windmill speed.)

8.0 LANDING

The landing was satisfactory. Height was not called out by the chase pilot, and there was a tendency to level off approximately five feet high. Touchdown was recorded on the copilot's VSI at 176 KIAS. The chute was deployed at 168 KIAS and it was jettisoned late, near thirty knots or less, with no damage to the airplane. Data were taken of an excellent hand brake test stop using a reostat setting of 15.

9.0 CONCLUSIONS

1. Airplane takeoff acceleration was normal and within limits when checked with the instrumentation airspeed.
2. Right-hand inlet normal shock oscillates (1/2 cycle per second) near one-half the frequency of the left shock during automatic shock control from 2.0 to 2.4 Mn.
3. Mild longitudinal 'g' (Nx) changes were felt during the normal shock oscillations while accelerating from 2.2 to 2.4 Mn.
4. No difficulty encountered in switching from AUTO to MAN bypass, if care was exercised to switch when the bypass area was increasing.
5. Longitudinal static stability was satisfactory from 2.1 to 1.87 Mn near 60,000 ft. The gradient was shallow, near 40 to 50 #/MN, but positive.
6. Engine operation at idle was satisfactory at 1.8 Mn, 50,000 ft., when the bypass was opened rapidly. However, the engines stalled when the bypass was opened rapidly with all three engines at the 40-degree throttle position at 1.8 Mn, 45,000 ft.
7. Airstarts were satisfactory at 1.4, 1.3, and 1.2 Mn at 35,000 ft.
8. Drag Chute was jettisoned satisfactorily at less than 30 KIAS.

10.0 DISCREPANCIES

1. LH Buzz (#1) on twice on the ground with engines not started.
2. Vibration light on at less then 5 mils (probably #6 engine).
3. No. 3 and No. 4 utility status caution lights on most of flight.
4. No. 1 engine cooling doors would not close.
5. No. 3 engine stalled and temperature above 1000°C for an unknown time.

V. H. Shepard

V. H. Shepard
Pilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT V. H. Shepard

FLIGHT NO. 2-29 COPILOT A. S. White

DATE OF TEST 29 March 1966 FLIGHT TIME 1:51

CHASE AIRCRAFT AND PILOTS

Chase 1 - B-58 #662 - Lt. Col. Fulton/Col. Cotton
Chase 2 - F-104 #817 - Capt. Gentry

PURPOSE OF FLIGHT

1. Pilot familiarization at 2.9 Mn
2. Thirty-minute heat soak at 2.9 Mn
3. Sideslip unstarts at 2.4 and 2.7 Mn
4. Level flight performance at 1.425 Mn
5. Power modulations at 1.4 Mn, 41,000 ft.
6. Longitudinal accelerated and dynamic stability at 1.6 Mn, 45,000 ft.
7. Directional dynamic and static stability at 1.6 Mn, 45,000 ft.
8. Sonic boom test

1.0 TAXI

The brakes on this airplane above five knots were better than those on #1 airplane in that less chatter occurred with pedal deflected just passed detent. Below five knots the brakes chattered excessively and were worse when compared to the brakes on #1 airplane. If extreme care was taken in the use of the brake pedals, the airplane could be stopped acceptably; but excessive distances were required, making the overall braking system unsatisfactory.

2.0 TAKEOFF

The rotation was started at 182 knots, and higher forces were required to rotate the airplane to takeoff attitude compared with #1 airplane. A higher attitude was required for the lift-off and the airplane was rotated to approximately 12 to 13 degrees, whereas #1 airplane would generally come off the ground at 10 to 11 degrees. Acceleration was slow immediately after lift-off, and the attitude was reduced to improve the acceleration.

3.0 MISSION TESTS

The primary mission of pilot familiarization at high-speed flight and a heat soak at 2.9 Mn was aborted because the automatic AICS system was inoperative. The following tests were substituted during the round robin cross country back to Edwards:

3.1 LEVEL FLIGHT PERFORMANCE - 1.425 MN

A speed-power point was obtained at 41,000 ft., 1.425 Mn, 462 KIAS (round dial). The data were started at C/N 5400 and the power was changed at 5470 and 5525. Then one and one-half minutes of stabilized level flight data were obtained. During the last 30 seconds in light turbulence the airplane tended to gain speed, and a 100-fpm climb had to be established to hold the constant 462 knots.

3.2 POWER MODULATIONS - 1.4 MN, 41,000 FT.

The #3 engine was burst rapidly from IDLE to MIL and stabilized, then MIL to IDLE with no difficulties. The bypass was set at 400 sq. in.

The three left engines were then moved slowly from IDLE to MIL power and allowed to stabilize, then slowly back to IDLE with 700 sq. in. of bypass. Then all three engines were burst rapidly from IDLE to MIL and stabilized, then back to IDLE using this 700 sq. in. of bypass. The engines accelerated and decelerated normally. Then this fast burst was repeated using the three left engines.

3.3 LONGITUDINAL ACCELERATED AND DYNAMIC STABILITY - 1.6 MN, 45,000 FT.

Two pullups and releases with FACS ON were accomplished to 1.2 and 1.32 G. The resulting oscillation was deadbeat. Then with FACS OFF, a pullup and release was accomplished at 1.62 Mn where two cycles were required for the oscillation to damp to less than one-tenth amplitude. The damping was satisfactory.

Two wind-up turns to 1.6G were accomplished--one with augmentation ON and one with pitch augmentation OFF. The gradients were linear with no lightening observed. The gradient was significantly steeper with pitch augmentation OFF as compared with pitch augmentation ON. The pitch augmentation OFF data were considered excellently stabilized at 1.6 Mn at 1.62 indicated G.

3.4 DIRECTIONAL DYNAMIC AND STATIC STABILITY - 1.6 MN, 45,000 FT.

Directional static stability was obtained, both left and right, by pushing out to full rudder, where only 1.2 to 1.3 degrees of yaw were obtainable. The gradients were linear, but appeared to shallow out for rudder deflections greater than one-half. With the augmentation OFF, the full rudder constant heading sideslips were difficult to stabilize because very small aileron deflections would constantly oscillate the sideslip angle $\pm$ 0.8 degree. In fact, to stabilize the sideslip, the ailerons had to be "locked" at a certain deflection. The dihedral was mildly negative.

Two rudder releases were accomplished and the damping appeared deadbeat on both releases--one with augmentation OFF, and one with augmentation ON. However, it appeared that the release with augmentation OFF was not stabilized and the resultant oscillation was toward zero sideslip when the release occurred--probably resulting in poor data.

3.5 SONIC BOOM TEST

A level pass was accomplished just south of the Edwards TACAN at 1.605 Mn, 44,300 ft., with 45,000 lbs. of fuel remaining. The angle of attack was 3.2 degrees. Another boom was generated on a pass from west to east in level flight at 1.405 stabilized Mn, 35,500 ft. Fuel remaining was 34,000 lbs. and the angle of attack was 2.9 degrees as the airplane indicated five miles TACAN range.

4.0 CONCLUSIONS

1. Brakes were unsatisfactory during low-speed taxi.
2. Longitudinal accelerated stability at 1.6 Mn, 45,000 ft., was satisfactory. The gradient was moderate and linear. The gradient was steeper with pitch augmentation OFF.
3. Difficult to fly the airplane with FACS OFF at 1.6 Mn because of lateral-directional wandering induced by small aileron movements.
4. Dihedral effect was slightly negative at 1.6 Mn.

5.0 DISCREPANCIES

1. U_5 status light on 50 per cent of the time in A/B.
2. Automatic AICS inoperative.
3. AICS cool inoperative, both systems.
4. Excessive fuel transferred back to 8R.

V. H. Shepard

V. H. Shepard
Pilot

HANDLING QUALITIES QUESTIONNAIRE

FLIGHT 2-29 PILOT V. H. Shepard CONFIGURATION Tips - 65°, Windshield - Up

LONGITUDINAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Airspeed, Altitude, Attitude	1.6 Mn 45K	FACS ON	3.5	Longitudinal gradient around center is excessive. Longitudinal static (stick free) stability only slightly positive.
		FACS OFF	4	
MANEUVERABILITY - Ability to change: Airspeed, Altitude, Load Factor		FACS ON	2.5	Stick force/G is excessive with FACS OFF
		FACS OFF	3.5	
RESPONSE TO TURBULENCE			-	
RESPONSE TO CONFIGURATION CHANGES			-	
OVERALL LONGITUDINAL RATING			3.5	

LATERAL-DIRECTIONAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Heading, Bank Angle	1.6 Mn 45K	FACS ON	$2\frac{1}{2}$	
		FACS OFF	5	
MANEUVERABILITY - Ability to change: Heading, Bank Angle		FACS ON	$3\frac{1}{2}$	The airplane was fairly easy to fly, but excessive adverse yaw due to aileron deflection made for a poorer rating.
		FACS OFF	-	
RESPONSE TO TURBULENCE			-	
OVERALL LATERAL-DIRECTIONAL RATING		FACS ON	3	
		FACS OFF	5	
CONTROL HARMONY			4	Longitudinal forces much too high around center, and lateral forces are on the light side.

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT V. H. Shepard

FLIGHT NO. 2-30 COPILOT A. S. White

DATE OF TEST 31 March 1966 FLIGHT TIME 2:10

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #316 - Col. Sorlie/Col. Fulton
Chase 2 - F-104 #314 - Capt. Curtis
Chase 3 - F-104 #316 - Col. Sorlie/Col. Fulton

PURPOSE OF FLIGHT

1. Inlet tolerance to sideslip at 2.4 and 2.7 Mn.
2. Pilot high-speed familiarization
3. Thirty-minute heat soak above 2.9 Mn.
4. Longitudinal dynamic and accelerated stability, 2.9 Mn.
5. Directional dynamic and static stability, 2.9 Mn.
6. Ram purge test at 2.9 Mn, 70,000 ft.

1.0 TAKEOFF

The brakes were released with the airplane weighing 542,000 pounds, and maximum afterburner in overspeed was used for take-off power. Acceleration and lift-off (202 KIAS - VSI) were satisfactory. The airplane accelerated and climbed slowly until 400 KIAS was reached.

2.0 SIDESLIP UNSTARTS - 2.4 AND 2.7 MN

With the airplane trimmed up in normal inlet performance and both throats closed to indicate 2.49 Mn at 2.44 airplane Mn, a right inlet unstart occurred just as pressure was applied to the left rudder. Yaw at unstart was negligible before the unstart occurred. No difficulty was encountered in controlling the airplane, as the only transient observed was a mild right rolling moment requiring approximately five pounds of left aileron. The copilot reset the inlet on two different occasions, and the right inlet unstarted repeatedly. Finally, both inlets unstarted simultaneously. The throat deviations were then increased sufficiently to allow both inlets to remain started after the final reset.

With the airplane trimmed up at zero yaw and both threats closed to indicate 2.75 Mn at 2.7 airplane Mn, full left rudder was applied slowly where 1.8 degrees of yaw were observed. No unstart occurred.

The airplane was then returned to zero sideslip, and the copilot closed the throats to indicate one-tenth greater Mn than the airplane Mn. Again, full left rudder was applied slowly; and with full rudder, stabilized at 2.71 Mn, 63,700 ft., the inlets did not unstart. The airplane was returned to zero sideslip and the copilot closed both throats to indicate .15 Mn greater than the airplane Mn. Just as the rudder was touched, the right inlet unstarted. The airplane rolled mildly to the right, and approximately one degree of yaw was observed due to the unstart transient. The copilot indicated that this yaw in roll caused the left inlet to unstart. It was very easy to control the airplane, as the transients were mild. The unstarts appeared mild as far as noise, shaking, and buffet were experienced.

3.0 EGT'S

The following engine EGT's were observed during the climb acceleration:

Total Temp.	#1	#2	#3	#4	#5	#6
350°F	820	815	820	810	815	815°C
470°F	821	818	821	811	821	817°C

4.0 LONGITUDINAL DYNAMIC AND LONGITUDINAL ACCELERATED STABILITY - 2.9 MN

The resulting oscillation from a pull-up and release with augmentation ON was deadbeat. With augmentation OFF, however, three cycles were required to reduce to less than one-tenth amplitude. The airplane was steady after four cycles and no residual oscillations were observed.

Two wind-up turns were accomplished--one with augmentation ON and one with pitch augmentation OFF. The gradients were moderate and linear and no lightening was observed up to 1.5 G. In the last wind-up turn, the airplane almost ran out of the bottom of the envelope at 68,000 ft., even though the maneuver was started near 72,000 ft. with full power. Longitudinally, the airplane appeared sensitive (impression of aft CG), and more care had to be exercised to prevent aggravating mild oscillations; but one would consider completing the mission with the pitch augmentation OFF.

5.0 DIRECTIONAL DYNAMIC AND DIRECTIONAL STATIC STABILITY - 2.9 MN

Slow left and right sideslips were accomplished to 7/8 rudder deflection where 1.8 degrees of sideslip were observed. The airplane demonstrated mild negative dihedral effect on both sideslips. With all augmentation OFF, the airplane was stabilized at 7/8 rudder, 1.8 degrees of sideslip, where small directional oscillations were observed if the ailerons were not held absolutely still. All directional gradients appeared normal and satisfactory with no lightening observed.

Two releases from approximately one degree of sideslip were accomplished where the damping was deadbeat with augmentation ON; but with it OFF, the damping appeared low. The test was discontinued prematurely because of increasing bank angle. The observed period was less than that experienced on a previous flight at 1.6 Mn. With all augmentation OFF, the airplane appeared to fly better at 2.9 Mn as compared to 1.6 Mn, as far as lateral-directional characteristics were concerned.

6.0 LEVEL FLIGHT PERFORMANCE - 70,000 FT., 2.9 MN

A performance run was started with engines #1, #2, #5, and #6 in MAX A/B and engines #3 and #4 in MIN A/B; however, the airplane accelerated and engines #1, #2, #4, and #6 were pulled back near 103-degree throttle angle. The run was discontinued after about one minute in order to make a space-positioning turn. The data were not considered stabilized. In this turn, the nose ramp was lowered and the pilot could see the horizon and wished it had been this way during the climb-acceleration, as his workload would have been reduced considerably.

7.0 RAM PURGE - 2.9 MN, 70,000 FT.

While stabilized at 70,000 ft. at 2.9 Mn, in a 20-degree bank angle to the right, the following data were observed:

Cabin altitude	-	8,500 ft.
EE temperature	-	40°F
Ammonia quantity	-	450 pounds
Total temperature	-	533°

Then the ram scoop was extended. The cabin altitude increased moderately fast to 36,000 ft., requiring approximately 5 - 7 seconds. At this time, MIL power was selected on all engines and the EE temp. was observed at 33°F with total temperature reading 480°F at 69,200 ft. The airplane was decelerated in level flight; and after one minute and thirty seconds, the ram scoop was retracted at 68,000 ft. Then the EE temperature started to rise, and the OVERHEAT caution light came on for approximately 15 seconds with EE temperature indicating 38°F. As the cabin repressurized, the REPRESSURE switch was released at 25,000 ft. cabin altitude. It was noticed at this time that the cabin was getting hotter. Near-level flight was held until 400 knots was reached. Then a 400-knot descent was accomplished. The cabin stabilized at 8,500 ft. in this descent at 65,000 ft. with total temperature reading 225°F and EE temperature stabilized at 38°F.

8.0 GENERAL

During the descent, utility status lights 1, 3, 4, and 5 were observed illuminated. This was an unsatisfactory condition because the crew or the ground personnel do not know the accurate status of the pumps, and a single failure in the electrical system could present many problems

to the crew in recovering the airplane if two pumps were inoperative in utility system #2.

It is recommended that pressure switches be set near 1,000 to 1500 pounds psi on these hydraulic pumps to prevent reset pressure near 2700 psi from turning on the hydraulic status pump lights. This also would prevent the primary status lights from blinking on the final approach in moderate turbulence due to large control motions.

9.0 SPEED STABILITY SYSTEM

The speed stability system was turned on at .9 and .6 Mn at 34,000 and 10,000 ft., respectively. Then the Mach number was reduced approximately .05 Mn in a longitudinal static test fashion. Then the resulting force was released slowly to see if the airplane would return to trim. It was determined that after doing these tests and comparing them with basic airplane characteristics, the speed stability system was inoperative at both Mach numbers.

10.0 CONCLUSIONS

1. Upstream unstart transients at 2.4 and 2.7 Mn were very mild with the primary transient being a rolling moment into the unstarted inlet.
2. Primary problem encountered during the climb from 2.2 to 2.7 Mn was a continual varying of the climb schedule airspeed ± 15 KIAS. Good attitude information and a non-linear gearing system around trim to lighten the forces would help the situation considerably.
3. Once the airplane was leveled out at 2.9 Mn, it was much easier to fly.
4. Airplane was slightly sensitive longitudinally with pitch augmentation off at 2.9 Mn.
5. Airplane was easier to fly lateral-directional wise at 2.9 Mn compared to 1.6 Mn with augmentation off because of ailerons being less effective at the higher Mach number.
6. Aileron deflections produced adverse yaw at 2.4, 2.7, and 2.9 Mn.
7. Dihedral effect was mildly negative at 2.9 Mn.
8. Hydraulic pump status lights should not come on unless the pressure decreases to 1000 to 1500 psi.
9. Speed stability system appeared to have no effects on the airplane's longitudinal characteristics at .6 and .9 Mn.

11.0 DISCREPANCIES

1. Mach tape decreased from 2.35 to .4 Mn for 30 seconds, then came back to 2.43 and operated OK.
2. Loud squealing and grinding noise in UHF #2.
3. Flaps did not extend on first attempt.
4. Water shutoff valve stuck open.

V. H. Shepard
Pilot

COPILOT COMMENTS

Copy

XB-70A FLIGHT 1-41 1 APRIL 1966

R-66-4-1
Edwards AFB

INTRODUCTION: The flight was airborne at 1245 hours. Flight objectives were AICS tests at 2.4 Mach, engine airstarts from .8 Mach to 1.8 Mach, bypass airflow calibration at 1.6 Mach, and longitudinal stability tests at 1.6 Mach. All scheduled tests were accomplished and, additionally, two low approaches were made for determination of ground effect. The maximum speed and altitude attained was 2.45 Mach and 58,800 feet. Flight duration was two hours and 9 minutes.

PREFLIGHT AND TAXI: All engine starts were normal except #4 which failed to light off on the first attempt and required use of the airstart switch for starting. During taxi, the nose wheel steering had random oscillations and appeared to have a hard over signal just prior to reaching the runway. It was re-engaged and seemed to be normal except for the oscillations.

TAKEOFF AND CLIMB: Total fuel five minutes prior to brake release was 255,000 pounds. The nose wheel steering was turned off at 120 knots during the takeoff roll since it had exhibited erratic operation during taxi out. Engine overspeed was used for the takeoff and taking the throttles out of overspeed was found to be very awkward. The airplane was accelerated and climbed on the normal schedule to 2.4 Mach, 58,000 feet. The throats operated normally in automatic throughout the acceleration. The bypasses were manually controlled and both inlets were started at approximately 2.0 Mach using 870/860 on the bypass doors. The right-hand shock indicator was steady when positioned to the upper green area, however, the left-hand shock indicator had a slight oscillation.

AICS TESTS DURING SIDESLIPS: After stabilizing at 2.4 Mach, 58,000 feet, with the duct performance set at "normal", the shock positions were set in the "top green" area and the airplane was slowly sideslipped one degree to the left and then to the right. The shock positions were then set in the "bottom green" area and the same sideslips accomplished. The duct performance was set to "low" and with the shock positions at "bottom green", rudder was applied in an attempt to obtain three degrees of sideslip, however, full left rudder produced only 1.5 degrees of sideslip and full right rudder produced only 1.3 degrees of sideslip.

ENGINE AIRSTARTS: Engine airstarts attempts were made at speed from .8 Mach to 1.8 Mach. The airstart procedure was the relatively new one for use with a modified nozzle on engine #1, and consisted of throttle idle, airstart ignition on, wait 30 seconds, if no start throttle to

40 degrees throttle angle for 15 seconds, if no start throttle off for 2 to 5 seconds and then back to idle; if no start, go to 40 degrees throttle angle for 15 seconds and if still no start, place throttle at off and turn air ignition off. The procedure seemed to work moderately well and resulted in successful airstarts on seven out of ten attempts. The conditions tested are listed below:

Speed	Altitude	Windmill RPM	Comments
1.8 Mach	50,000 Ft	77.5%	Started immediately after throttle was moved to 40 degrees angle
1.6 Mach	50,000 Ft	70%	Started immediately after airstart turned on
1.5 Mach	50,000 Ft	66%	Started 9 seconds after airstart turned on
1.4 Mach	50,000 Ft	63.5%	No start
1.4 Mach	45,000 Ft	Not Noted	Started immediately after airstart turned on
1.1 Mach	35,000 Ft	54%	No start
.90 Mach	30,000 Ft	33.5%	No start
.91 Mach	25,000 Ft	33%	Started immediately after airstart turned on
.80 Mach	25,000 Ft	29%	Started immediately after airstart turned on
.85 Mach	20,000 Ft	35%	Started immediately after airstart turned on

BYPASS AIRFLOW CALIBRATION: At 1.6 Mach in a slight descent at approximately 50,000 feet, airflow data was obtained with the RPM lock-up released and the bypass doors adjusted to set the SPR at .7. The engine RPM's were set as follows for each condition:

Engine #1	Engine #2	Engine #3	Left Bypass Opening
100%	100%	100%	Not Noted
90%	110%	100%	1090
80%	100%	100%	1370
Idle	100%	100%	1500
Idle	100%	90%	1880
Idle	100%	80%	2310 Bypass full open-SPR .71
Idle	100%	Idle	2310 Bypass full open-SPR .73

LONGITUDINAL STABILITY TEST: The airplane was stabilized at 1.60 Mach at 50,000 feet and a trim shot obtained. Without changing the longitudinal trim, the airplane was accelerated level to 1.7 Mach and the power reset to the same angle. The trim change was so small that it was within the friction band and the airplane was stabilized "hands off". The airplane was then decelerated to 1.5 Mach without changing the trim. After resetting the power, the trim change was again found to be negligible and within the friction band. The longitudinal static stability apparently has a very flat curve in the 1.5 to 1.7 Mach speed range.

DESCENT, LOW APPROACHES AND LANDING:

Data was recorded during the gear extension and 27 seconds were required for the landing gear to fully extend.

Two low approaches to investigate ground effect were made. The first at 200 knots had an angle of attack of 8 to 8.5 degrees and the second at 240 knots had an angle of attack of 5.5 to 6 degrees.

With 22,000 pounds of fuel remaining, the airplane was landed and all three chutes operated satisfactorily. The pilot held the nose off the ground until approximately 120 knots and that may have been a factor in causing all three chutes to function.

SYSTEMS: The entire flight was flown with the "aux cool" on since the "REFER" package was inoperative and had been removed prior to flight. The EE temperature was 60-70 degrees throughout the flight, however, the cockpit temperature was uncomfortably warm and both pilots commented on the lack of cockpit cooling. Pushing down on the crew air shut-off handle only increased the flow of warm air.

CONCLUSIONS:

1. The flight went extremely well and should have provided excellent data.

2. The new airstart procedure worked moderately well and seven out of ten airstart attempts were successful.

MAINTENANCE DISCREPANCIES:

1. Nose gear steering oscillates at random intervals causing very erratic steering in both modes.

2. High vibration light illuminated on engine #6 compressor frame above 2.0 Mach - became inoperative near end of flight.

3. L-H lower rotating beacon inoperative.

4. Holding brake would not engage at end of flight.

5. Engine #2 fire warning light would not illuminate in test position.

6. Pilot's clock stopped.

RECOMMENDATIONS:

1. Correct the maintenance discrepancies noted.

2. Continue investigating the airstart procedure.

3. Reinstall an operative "REFER" package.

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Copilot

PILOT REPORT

XB-70A No. 62-207 4 April 1966

Flight 2-31

INTRODUCTION

The objectives of this flight included inlet unstarts in yawed flight at 2.4 and 2.7 Mach, stability and control and performance at 2.9 Mach at 70,000 ft and a 30 minute heat soak at 2.9 Mach.

Pilot - Colonel Joseph Cotton	Takeoff Time - 0858
Copilot - Mr. Al White	Total Flight Time - 1+57
Max Altitude - 70,000' plus	Supersonic Time - 1+30
Max Mach - 2.95	Time Over Mach 2 - 1+09
Max KIAS - 580	Time Over Mach 2.8 - 0+31
Max Total Temp - 555°F	

SUMMARY

The flight was delayed from last Saturday, 2 April, due to an oil leak in the forward section of engine #5. The 2.9 Mach performance with the nose ramp down was not obtained due to fuel shortage. The mission was highly successful. Thirty minutes at or in excess of 2.9 Mach were obtained.

The one and only TACAN set was inoperative and in some areas communications with Data Control were not existent. Clear air turbulence was forecast to be moderate at 55,000 ft near Rome and Boise; however, only light turbulence was encountered between Lovelock and Rome. Overcast skies existed south of Owens Lake.

The roll attitude indications were not grossly in error but the heading drifted excessively. The attitude indicator response in pitch was totally inadequate for use during the work at 2.9 Mach. The sensitive accelerometer blocks the pilot's view of the top of the rate of climb indicator. Constant illumination of the utility hydraulic system pump status lights was very distracting and confidence destroying --- this condition must be eliminated. Yaw excursions were experienced during wing tip extension from half to full.

Inlet unstart margin at 2.4 Mach was much less than predicted. Unscheduled unstarts occurred near zero yaw. The single item causing most concern during the flight was the requirement to hold excessive right rudder to maintain zero yaw with the gear up.

The aircraft's natural (unaugmented) lateral directional stability at 2.9 Mach is excellent. Natural damping with all FACS off at 2.9 Mach was very impressive and appeared strongest in the order of yaw, roll and pitch.

It was a near impossibility to stabilize on a given altitude or zero the rate of climb. The absence of forward visibility, a useless pitch attitude display, and high longitudinal stick forces makes pitch attitude control extremely difficult and very undesirable. The damping in pitch is probably adequate but I could not evaluate it qualitatively at high speed since the forward visibility and instrument display are inadequate.

ENGINE START AND TAXI

Pilots were in the cockpit at 0740, OAT 51°F and wind 090° at 3 knots. The major aircraft squawk concerning the pilots was that fuel leaks back in tank 8 right and its primary 2 pump was inoperative for this flight. Gross weight at engine start was 546,300 lbs. Engine start required 9 minutes. No. 6 engine would not rotate until system pressure was reduced by flight control movement. TACAN bearing would not lockon the Edwards station.

We started taxi to runway 04 at 0823, fuel totalizer 267,000 lbs and wind 030° at 6 knots. The TACAN did lockon Palmdale station while taxiing. Taxiing was very comfortable - we rolled along about 15 mph with idle power. The automatic toe brakes displayed their usual chatter when coming to a stop. The right forward brake did not release properly and required we delay to inspect and cycle it prior to lineup. The fuel totalizer, 3 minutes prior to brake release, was 259,500 lbs.

TAKEOFF AND CLIMB

Overspeed was used for takeoff. Acceleration from 70 to 150 KIAS was 18 seconds. I started rotation at 190 KIAS on the standby airspeed and we were airborne at 206 KIAS. Al selected gear up and pulled the throttles out of overspeed; overspeed time was just over a minute. Gear and flap retraction and wing tip extension were all normal.

The 425 KIAS and .95 Mach climb to 32,000 ft was made to a point 45 miles northeast of Edwards, with a left turn to Coaldale. By this time it was apparent that the TACAN would not hold lockon any station. The windshield was raised soon after going supersonic at 32,000 ft.

The wing tips were selected to full down just after reaching 1.3 Mach. Yaw excursions were experienced while the tips were going down. This condition has not always existed, does not occur consistently, and should be investigated.

The climb from 32,000 ft was initiated at 565 KIAS, but in spite of my attempt to climb slower than normal, it gradually increased to 580 KIAS. With an indicated zero yaw (aircraft and T/M) and 1° right wing down aileron I had to hold 1/4 to 1/3 right rudder. This was the most distracting condition experienced on this flight.

In an attempt to change heading I held an 8° left wing down bank for nearly a minute without any change in the indicated heading. The mag synch needle indicated full right.

Light turbulence and rudder pedal vibration was experienced at Mach 2. The left inlet started at 2.08 Mach and the right at 2.13 Mach. We lost contact with Data Control between Coaldale and Lovelock and established contact with Salt Lake Center for position and heading information since the TACAN was inoperative and I didn't trust the heading system.

INLET UNSTARTS

We leveled at 2.4 Mach and 56,700 ft in normal duct performance. In spite of the right rudder required, we were still yawed .3° to the left. Al was advancing the left throat Mach toward 2.47, with the deviation control, when it unstarted at a throat Mach of 2.43. The airplane disturbance was mild and easy to control.

We turned right for Boise and after rolling out I established a zero yaw at 2.41 Mach at 57,000 ft in normal duct performance. Al increased the left throat Mach slowly and the inlet unstarted at 2.44 Mach. The inlet restarted automatically and went back on the normal schedule when Al reset.

After rolling out wings level for Rock Springs I established an indicated zero yaw at 2.71 Mach and 64,250 ft in normal duct performance. Al increased the right throat to .05 Mach greater than the aircraft Mach and the left throat on to .1 Mach greater. I slowly applied left rudder until I felt pedal feedback. At 2.725 Mach and 64,100 ft we indicated 2° left yaw and the inlet remained started. When returning to zero yaw the left inlet unstarted at 1.3° left yaw. I relaxed on the left rudder and returned toward zero yaw faster than I applied the rudder. I feel confident this caused the unstart. The aircraft disturbance was not violent and the control was easy and natural in every way. It automatically restarted and came back on schedule when reset. We continued on to 2.9 Mach.

2.9 MACH WORK

Prior to leaving 2.7 Mach Al went to high performance on the inlets and planned to maintain .07 greater in the turns and .12 greater when wings were level. While maintaining a 12° right bank the throats controlled well and remained started at .10 Mach greater than aircraft Mach.

The climb schedule certainly isn't easy to maintain since the indicated speed must be reduced every 2,000 ft. I favored the slow side of the schedule in the climb.

We arrived at 2.9 approximately 60 miles south of Rock Springs at 0956. The altitude was 70,000 ft and 532°F total temperature.

Initially I pulled off too much power and slowed to near 2.85 Mach before the push came back again after the throttle advance. Before I got with the stabilizing technique I was up to 2.95 and 540°F. Over 2.9 Mach there was a general buffet in the airframe. The right wing felt a bit heavy; Al reported tank 8 right up to 3,000 lbs with a 2° left wing down aileron trim. I again applied too much power and increased to 2.95 and observed a total temperature of 555°F, maximum for the flight.

FACS on: With duct performance normal and the throat Mach .05 less than aircraft Mach, the following maneuvers were performed at or near 2.9 Mach and 70,000 feet.

Test Condition	Comment
Pullup and release from 1.1g	Feeling my way, one for practice
Pullup and release from 1.3g	Took control sooner than desired to prevent excessive climb
Yaw left and right to 1.5°	Slow rudder application Dihedral effect not prominent
Release from 1° right yaw	Slight roll off left after release
Windup turn right to 1.42g	Angle of attack increased from 5° to 6-1/2°

All maneuvers were executed conservatively. The lateral - directional damping and handling in yaw and roll was very good. Control of the pitch attitude is not good due to the deficiency in forward visibility, absence of a good attitude indicator and heavy control forces. Both inlets stayed started and controlled well in the auto - normal mode.

PITCH AUG off: With duct performance normal I retrimmed at 2.9 Mach, pulled up and released at 1.22g and completed a windup turn to the right to 1.42g. The inability to see the pitot boom and its position on the horizon, and the concern for regaining control from the resultant climb, made longitudinal damping evaluation difficult. Opinion based on the cockpit feel and flight instruments did not leave me with a very favorable opinion of the damping in pitch. Recovering from the pullup and release was neither comfortable nor easy.

All FACS off: With duct performance normal, I yawed left to 1.5° at 2.92 Mach and slowly out to the right to 1.5° at 2.93 Mach. Rudder application was very slow and I was very careful to deflect the ailerons as little as possible to maintain heading. I released from approximately 1° right yaw and allowed the aircraft to seek its own for 30 seconds without any control input. The damping and general behavior was better than with pitch augmentation only off. It was very stiff directionally and had little or no tendency to roll off. I was pleased with the maneuver and pleasantly surprised with the aircraft response. There was no strong evidence of dihedral effect or excessive yaw due to aileron inputs.

FACS On - Roller-Coaster: I trimmed at 2.9 Mach near 70,000 ft and observed a 4° angle of attack. Al set the inlets to .05 less than aircraft Mach in normal performance and I increased to 5° angle of attack. I allowed this climb to continue for a few seconds and reduced the angle to 4° to level off and slowly pushed over to 3°. The recovery near 70,000 ft and 2.9 Mach was not difficult or uncomfortable.

Overall Opinion: These stability and control maneuvers left me with the following impressions:

1. Lateral - directional damping was excellent.

2. Longitudinal damping was difficult to evaluate but the cockpit ride and flight instruments left me with the opinion it was weak.

3. Yaw and roll control was easy and comfortable but pitch control was difficult and uncomfortable.

Damping and control evaluation in order of preference was directional, lateral, then longitudinal.

DESCENT AND LANDING

At the end of this 30 minutes at or above 2.9 Mach we were 150 miles northwest of the base so I reduced power to minimum afterburner and established a 40° to 45° right bank and lowered the nose ramp at 2.94 Mach. Its operation was normal. Power was reduced to military with a fuel total of 34,000 lbs. The speed, descending through 61,000 feet, was 1.7 Mach.

The pilot's left inlet buzz light came on twice during the descent at 1.58 Mach at 57,000 feet and 1.26 Mach at 47,000 feet. Instead of the usual 400 KIAS I slowed to 350 KIAS at 50,000 feet and held that during the descent. Tips were retracted to half at 1.4 Mach and 48,000 feet. Near Mach 1 the YAW AUG 1 caution light came on; I re-engaged the FACS and the light went out. TACAN was still inoperative so radar vectored us through the cloud to Mojave. Once VFR I turned all FACS off but still had to hold 1/4 to 1/3 right rudder.

The tips retracted normally. At 260 KIAS the gear was extended. The nose gear green light did not come on; chase reported it down and locked. I changed bulbs with the left main gear and it indicated safe. The landing runway was 04 with the wind 060°, 10 to 20 knots. The SUMP LOW light came on during a straight in from Rosamond Dry Lake. Best flare speed 186 KIAS. The rudder pedals were back even once the gear was extended. No. 6 engine compressor vibes went to 6 mils. Speed down final was 203 to 205 KIAS at 7° angle of attack --- did not observe touchdown speed. Landing was normal. Two chutes deployed and were jettisoned at 55 KIAS.

FLIGHT SQUAWKS

1. No. 1 probe erratic on fuel tank No. 2.

2. TACAN inoperative.

3. Background static when transmitting on No. 2 UHF.

4. No. 2 UHF No. 1 digit on manual frequency not aligned.

5. Left throat unstarts .04 above air vehicle Mach at 2.4 Mach, 57,000 ft and zero yaw.

6. One-third right rudder required to hold zero yaw gear up.

7. YAW AUG 1 light came on during flight.

8. No. 6 engine compressor vibes 6.5 mils at 100% rpm.

9. Nose wheel steering wanders in takeoff---land and taxi.

10. Left main gear green light bulb burned out (changed with nose gear position).

11. Pilot's left inlet buzz light came on in flight.

SYSTEMS SUMMARY

Nose Wheel Steering: Lack of positive control in the pedal centered position. The nose goes left and right without pedal input. I keep wondering when it will go hard over or when I'll lose steering completely.

reason? why?

Brakes: The usual level of chatter; no serious skids or excessive tire wear. The right forward brake did not release properly during lineup for takeoff.

Landing Gear: Burned out nose gear bulb was discovered with gear extension. This was the second one in recent flights. It was very comforting to have chase report a down and locked indication while the bulb was being changed. A dual indicator system, like the British use, seems more sensible all the time.

what is involved

Hydraulics: Excellent overall operation. Engines No. 3 and 4 utility pump status lights were on constantly during the flight. This distracting nuisance should be corrected.

Engines: No. 3 and No. 6 high vibe indications were a nuisance and required excessive attention.

Fuel: Although the overall operation was satisfactory I was some concerned about the fact that fuel leaks back in tank No. 8 right and its primary #2 pump was inoperative. Wing heaviness can result. I'm not impressed when the airplane is turned in to fly with such conditions.

AICS: The left inlet unstart margin at 2.4 Mach is not adequate. With zero yaw it unstarted in normal performance with a throat Mach of .04 greater than airplane Mach.

Flight Instruments: The primary indicator was improved over previous flights. The sensitive accelerometer blocks the view of the top of the pilot's rate of climb instrument. Heading not responsive and drifts.

TACAN: It was inoperative for all but the first 5 minutes of the flight. A second set is certainly a need in this airplane.

Communications: Very poor on the northern portion of the flight. Background static on set 2 very bad. A good HF set seems to be the only solution to get constant communications on the high range.

Flight Controls: The 1/3 right rudder required to hold zero yaw was the greatest distraction. The YAW AUG 1 light came on once during descent.

Drag Chutes: Only 2 chutes deployed properly.

The following systems performed satisfactorily:

Flaps	Oxygen
Wing Fold	Instrumentation
Electrical	Nose Ramp
Fuel	Fire Detection
IFF	Hydraulics
Environmental	Flight Instruments

ILS was not used.

RECOMMENDATIONS

1. Install a second TACAN set --- preferably one with a lockon capability in excess of 200 nautical miles.

2. Eliminate constant illumination of utility hydraulic status lights on satisfactory operating pumps.

3. Determine cause for low inlet unstart margin at 2.4 Mach.

4. Improve heading and pitch attitude display systems.

5. Move pilot's sensitive accelerometer to eliminate blocking view of the top portion of the rate of climb indicator.

6. Determine and correct cause of the yaw excursions during wing fold to the full position.

7. Investigate cause for less than predicted inlet unstart margin at 2.4 Mach.

8. Cease turning-in the airplane for high speed flight with combinations of malfunctions or conditions such as existed on the fuel system for today's flight --- i.e., fuel leaks back into tank #8 right and one boost pump was inoperative in that tank.

9. Eliminate cause for having to hold 1/4 to 1/3 right rudder pedal at zero yaw with the landing gear extended.

Joseph F. Cotton

JOSEPH F. COTTON, Colonel, USAF
XB-70A Test Director - Pilot

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT Lt. Col. F. Fulton

FLIGHT NO. 1-42 COPILOT V. H. Shepard

DATE OF TEST 5 April 1966 FLIGHT TIME 2:01

CHASE AIRCRAFT AND PILOTS

Chase 1 - B-58 #662 - Col. Cotton/Maj. Doryland
Chase 2 - F-104 #817 - Capt. Hoag
Chase 3 - F-104 #316 - Capt. Streface
Chase 4 - F-104 #817 - Capt. Hoag

PURPOSE OF FLIGHT

1. Inlet mapping at 2.2 and 2.4 Mn.
2. Airstarts.
3. Ground effects study.
4. Automatic brake tests

1.0 ENGINE START AND TAXI

Start engine fuel was 266,000 pounds (indicated) at 21.4 per cent c.g. (forward limit). Six minutes were required to start all engines. No problems were encountered.

Taxiing was commenced as Tank 1 reached 37,500 pounds. On the second turn, slightly faster than normal with Tank #1 reading 36,800 pounds, full left nosewheel steering would not straighten the airplane out of the right turn. It appeared that the steering was inoperative; however, the status of the nosewheel steering light was unknown during this time. The airplane was stopped abruptly to prevent traveling off the taxiway in a right turn. Steering operated satisfactorily once the airplane was stopped. Subsequent steering problems were not encountered.

2.0 INLET MAPPING - 2.2 Mn, 52,000 FT.

LF THROAT UNSTART

At 2.21 Mn, the left throat was closed slowly, maintaining the shock near the CROSSHATCH (.4 SPR - Shock Position Ratio) by closing the bypass as the throat was closed. The unstart occurred with the throat reading 2.33 Mn and bypass area at 430 and shock at .42 SPR. After the unstart occurred, the pilot commented that the buffet increased to light. Then, while opening the throat slowly, shock was controlled aft by opening the bypass. The inlet started at a throat reading of 2.18 Mn.

RH THROAT UNSTART

The right inlet was unstarted using the same procedure as above. Unstart occurred at the same throat Mn as the left--2.33 Mn, and bypass indicated 580 at .45 SPR. The restart occurred at 2.16 throat Mn and the bypass area had reached 800 sq. in. while maintaining shock in CROSSHATCH (.38 SPR).

LH BYPASS UNSTART

At 2.205 Mn, the left throat indicated 2.22 Mn. The left bypass was closed slowly where 470 sq. in. were observed at .7 SPR. The unstart occurred at .72 SPR, 380 sq. in. Then the bypass was opened to 850 sq. in. where the shock bottomed out, but the unstart light stayed on. Bypass was opened to 1000 sq. in.; still the unstart light remained on. Then the throat wheel was placed near 2.15 Mn and MAN throat was selected. The unstart light extinguished as the throat opened to 2.17 Mn (writer could not tell whether throat disarmed the light or the inlet started) and throat stopped at 2.16 Mn. Then the bypass was closed to 830 sq. in.. where the shock was just bottomed out.

RH BYPASS UNSTART

At 2.21 Mn, the right throat indicated 2.22 Mn. The right bypass was closed slowly where 495 sq. in. were observed at .7 SPR. The unstart occurred at .72 SPR, 470 sq. in. As the bypass was opened, the inlet started at 810 sq. in. Throat indicated in AUTO at 2.21 Mn.

LH BYPASS, LOW PERFORMANCE UNSTART AT 2.18 Mn

Throats indicated 2.00 and 1.99, left and right. Left bypass was then closed slowly where 880 and 660 sq. in. were observed at .7 and .8 SPR, respectively. Then the shock needle became insensitive and tended to hang up. Ground reported the unstart as the caution lights were disarmed. Stabilized data were taken at .82 SPR at 420 sq. in. of bypass. The bypass was opened to 1080 sq. in. which bottomed the shock in the CROSSHATCH and ground reported the start.

RH BYPASS, LOW PERFORMANCE UNSTART

The right bypass was closed slowly and 890 sq. in. were observed at .71 SPR. The needle jumped down as bypass was closed (probably unstart indication). The needle then came up as the bypass was closed further and 690 was observed at .8 SPR. Ground reported the unstart and stabilized data were obtained at .81 SPR, 550 sq. in. of bypass. The bypass was then opened and ground reported a start with bypass reading 1040, shock bottomed out.

3.0 INLET MAPPING - 2.4 Mn, 58,000 FT.

LH THROAT UNSTART

At 2.4 Mn the left throat was closed slowly, maintaining the shock

near the CROSSHATCH by closing the bypass as the throat was closed. The unstart occurred at a throat reading of 2.52 Mn and bypass area of 500 sq. in. with the shock in the CROSSHATCH. After stabilizing, the throat was opened slowly and the shock was controlled aft by opening the bypass. The inlet started with the throat reading 2.34 Mn at 720 sq. in. of bypass -- shock in the CROSSHATCH.

RH THROAT UNSTART

The right-hand inlet was unstarted, using the procedure outlined above, and the unstart occurred with the throat reading 2.52 Mn with 400 sq. in. of bypass at a shock position of .45 SPR. The inlet was restarted by opening the throat to 2.32 throat Mn with the shock at .45 SPR and the bypass reading 700 sq. in.

LH BYPASS UNSTART

At 2.41 Mn, the left throat indicated 2.42 Mn. The left bypass was closed slowly and 430 sq. in. was observed at .7 SPR. The shock position needle then became sensitive as the bypass was closed further. The needle oscillated from .72 to .78 SPR. The unstart occurred at 270 sq. in. of bypass area. The bypass was then opened to 630 sq. in. to bottom the shock out at .42 SPR. Then the throat and bypass was opened and the restart with the throat indicating 2.35 Mn and bypass indicating 670 sq. in. The shock was at .5 SPR when the unstart caution light extinguished.

RH BYPASS UNSTART

At 2.4 Mn, the right throat indicated 2.41 Mn. The bypass was closed and 440 sq. in. was observed at .7 SPR. The unstart occurred with SPR reading .77 at 300 sq. in. of bypass. After stabilizing, the bypass was opened to 680 sq. in., which bottomed out the shock at .47 SPR. Then the throat was opened, and while controlling the bypass to maintain the shock in the CROSSHATCH, the restart occurred as the bypass was opened with the shock at .55 SPR and the throat was steady at 2.29 Mn. Stabilized data were obtained at 780 sq. in. of bypass with the shock at .43 SPR.

LH BYPASS LOW PERFORMANCE UNSTART

With LOW selected, both throats indicated 2.22 Mn at 2.4 airplane Mn. The bypass was opened slowly where 570 sq. in. were observed at .7 SPR. As the bypass was closed to 400 sq. in., the shock position needle rotated counterclockwise to the 12 o'clock position, then went back to .95 SPR when the unstart occurred with the bypass reading 360 sq. in. The shock needle was insensitive the majority of the time, but jumped excessively prior to unstart. The inlet started as the bypass read 610 sq. in. with the shock reading .7. After stabilized data were obtained, it was observed that 840 sq. in. of bypass were required to bottom out the shock.

RH BYPASS LOW PERFORMANCE UNSTART

The inlet was unstarted by closing the bypass slowly and, again, the shock position needle became very insensitive at times, then jumped around randomly and the inlet unstarted with the bypass closed to 420 sq. in. and the shock position needle reading .75 SPR. The restart occurred at 660 sq. in. of bypass with the shock steady at .7 SPR and 820 sq. in. of bypass were required to place the shock in the CROSSHATCH. After normal inlet performance was selected at 2.4 airplane Mn, the throats were observed at 2.42 and 2.41, left and right respectively.

4.0 AIRSTART, 1.8 Mn, 60,000 FT.

The No. 1 engine was shut down from flight idle of 80 per cent rpm and the airstart was immediate upon actuation of the airstart switch with the throttle in IDLE for cooling. E.G. increased first, then rpm came up slowly.

1.1 Mn AT 30,000 FT.

The #1 engine was shut down again; and with the throttle placed back in IDLE with a windmill speed of 56 per cent rpm, the engine would not start with the throttle in IDLE nor at 40 degrees throttle angle. After 45 seconds, the throttle was moved off for two and one-half seconds; then the start occurred immediately as the throttle was placed back in IDLE.

.48 Mn AT 10,000 FT.

After shutting #1 engine down, the airspeed was flown near 260 knots in order to hold a constant 13-1/2 per cent windmill rpm. With the throttle in IDLE, the airstart occurred immediately as the airstart switch was turned on.

5.0 GROUND EFFECT STUDY

Two stabilized runs were accomplished at 200 and 230 KIAS by adjusting the power on the final approach to stabilize the rate of descent near 300 to 400 fpm. Constant angle of attack was flown throughout the flare. The airspeed was observed to bleed off on both runs while flying constant altitude down the runway and airspeed did not stabilize. Due to turbulence on both runs, the writer considered the data marginal.

6.0 BRAKE TEST

After landing, data were obtained of a hand brake control box stop by leaving the brake control selector in AUTO and selecting a reostat setting of 10. As the master was turned on, the writer depressed his pedals, and no braking occurred at this setting of 10. The reostat was increased to 13, where a marginal stop was accomplished due to brake chatter. This test was repeated with the reostat selector moved

from 10 to 17 while the copilot depressed his pedals. This stop, also was unsatisfactory due to excessive brake chatter.

7.0 TRAPPED FUEL

The following trapped fuel was observed at shutdown:

Tank	Pounds	Tank	Pounds
1	400	7L	600
2	100	7R	200
4	500	8L	∅
6L	1100	8R	200
6R	700		

Sump indicated 19,000 and total fuel quantity indicated 24,000.

8.0 CONCLUSIONS

1. Both inlets appeared symmetrical from the standpoint of upstream and downstream transients.

2. Difficult to determine inlet unstarts and starts at 2.2 Mn with inlets in LOW performance because the unstart caution lights were disarmed.

3. Shock position versus bypass and throat position was much steeper than anticipated from the one tenth scale model tests.

4. Brake chatter was excessive at low speeds during a hand brake stop with the copilot pedals depressed.

9.0 DISCREPANCIES

1. Nosewheel steering did not return to center following a right turn (Tank #1 had 36,500 lbs.)
2. P_1 pressure gage 3600 lbs. - telemetering showed 4000 lbs.
3. #3 EGT gage stuck at 445° EGT.
4. Clamp came off AICS actuator during takeoff.
5. Instrumentation cool #2 light on near end of flight.
6. AICS cool light came on after touchdown.
7. #6 engine was slow to light-off during ground start
8. Flaps would not retract and flap pressure light remained on.
9. Copilot communication lead will not lock onto pressure suit lead.

V. H. Shepard
Copilot

8

Copy

R-66-4-2
Edwards AFB

PILOT COMMENTS

XB-70A FLIGHT 1-42 5 APRIL 1966

INTRODUCTION: The flight was airborne at 1026 hours after a delay due to minor mechanical difficulties. Flight objectives were six inlet unstarts at 2.2 Mach, six inlet unstarts at 2.4 Mach and three engine airstarts. All tests were completed and low approaches were also made to obtain ground effect data. The maximum speed and altitude attained was 2.43 Mach and 61,000 feet. Flight duration was two hours and one minute.

PREFLIGHT AND TAXI: All engine starts were normal except #6 which required 25 seconds to obtain a light off. Starting temperatures ranged from 475 to 545 degrees EGT. Taxi out was initiated with approximately 37,000 pounds of fuel in tank #1. This heavy nose gear load combined with the under powered nose wheel steering system was probably the cause of a serious problem during taxiing. While making the first right turn after leaving the run pad, the nose wheel would not return to center and the nose wheel remained deflected to the right. The brakes were rapidly applied and the steering disengaged to prevent running off the taxiway. The quick brake application caused the tires to skid and would have resulted in a flight cancellation if the damage had been any worse. The steering was re-engaged and appeared to respond normally. The airplane was taxied slowly to the runway and as the fuel in tank #1 was lowered to 34,500 pounds, the steering response improved.

TAKEOFF AND CLIMB: Total fuel remaining one minute prior to brake release was 251,500 pounds. When all throttles were advanced, it was noted that the EGT gauge was stuck at 445 degrees. It would not respond to throttle movement and a decision was made to make the flight with that gauge inoperative. The acceleration was satisfactory and lift off came at 208 knots. Shortly after that, the chase pilot reported that something had fallen from the nose gear area. It was later determined to have been a clamp around a protective covering over an AICS actuator in the "sugar scoop" area. The takeoff was made with all augmentation engaged and they appeared to reduce the pilot workload. The airplane was climbed at 425/.95 to 32,000 feet.

ACCELERATION AND CLIMB: An acceleration at 32,000 feet to 575 knots was followed by a climbing acceleration to reach 2.2 Mach at 52,000 feet. The inlets were started around 2.0 Mach by opening the bypass doors to 770 left and 730 right. The high speed portion of the flight was continued using automatic throats and manually controlled bypass doors.

INLET UNSTARTS AT 2.2 MACH, 52,000 FEET:

With the duct performance in "normal" and while manipulating the bypass doors to hold the shock position in the cross hatch area, the throat unstarts were done by individually closing the throats to obtain an unstart and then opening the throats to restart the inlet. The left unstarted at a throat setting of 2.33 with the bypass at 530 and the SPR at .42. The left restarted when the throat was opened to 2.18. The right inlet unstarted at a throat setting of 2.33 with the bypass at 580 and the SPR at .45. It restarted when the throat was opened to 2.16 with the bypass at 800.

The duct performance remained in "normal" for bypass unstarts. The throats were in automatic and the bypass doors were individually closed to obtain the unstart. The throats were restarted after each unstart. The left inlet unstarted at 380 bypass and .72 SPR. Even after opening the bypass to 1000, the left inlet did not start until the throat had been selected to manual and opened to 2.17. The right inlet unstarted at 470 bypass and .72 SPR. It restarted as soon as the bypass had been opened to 810 and no throat manipulation was necessary.

Light airframe buffet occurred during both the throat and the bypass unstarts with "normal" performance. The bypass unstarts had buffet of a slightly greater magnitude, but it was still light.

The next unstarts were with the duct performance in "low" and were bypass unstarts. The throats were in automatic and the bypass doors were closed to get the unstart and opened to restart. It was impossible to positively detect the unstart from within the cockpit since the throat position was below 2.17 which dims the unstart light and since the airframe buffet with "low" performance is no different than the airframe buffet during an unstart at 2.2 Mach. The ground station reported the unstart from telemetered data after the left bypass door was closed to 400. The restart was reported after it was opened to 880. The right unstart was reported with the bypass door closed to 550 and the restart was reported when it was opened to 1040.

INLET UNSTARTS AT 2.4 MACH, 58,000 FEET:

The unstarts at this speed were done the same as at 2.2 Mach, however, the buffet intensity was slightly higher. A small EGT oscillation was noted just as the unstart occurred for the unstarts in "normal" duct performance.

With "normal" duct performance, the left throat unstart occurred with the throat at 2.52 and the bypass at 500. The restart came when the throat

was opened to 2.34 and the bypass was at 720. The right unstart was with the throat at 2.52 and the bypass at 400. The restart was with 2.31 throat and 700 bypass.

The bypass unstarts in "normal" duct performance were with the throats in automatic, however, the throats had to be placed in manual and moved in order to get a restart. The left bypass was closed to 270 before the unstart occurred, however, the SPR was very sensitive and oscillated between .72 and .78 as the bypass was closed. The bypass was opened to 630 without getting a restart, but after setting the throats to 2.35 and the bypass to 670 the restart occurred. The right inlet was unstarted at 300 bypass and restarted at 2.29 throat and 780 bypass.

The left bypass unstart while in "low" performance came with 360 bypass and .95 SPR. There was a momentary indication of inlet buzz on telemetering as the unstart came, however, buzz was not detected in the cockpit. The restart was at 610 bypass. The right unstart was at 420 bypass and .75 SPR and the restart was at 660 bypass.

The airplane was then decelerated to do airstarts:

AIRSTARTS: Airstarts are listed below and were done using the following procedures:

(1) Throttle idle.

(2) Airstart on.

(3) If no light in 30 seconds, go to 40 degrees throttle angle.

(4) If no light in 15 seconds, throttle off.

(5) After 2 to 5 seconds, throttle to idle.

(6) If no light in 30 seconds, go to 40 degrees throttle angle.

(7) If no light in 15 seconds, throttle and airstart off.

Speed	Altitude	Windmill RPM	Bypass	Comments
1.79 Mach	60,400 Ft	70%	700	Light off immediately after airstart on.
1.1 Mach	30,000 Ft	56%	700	Light off immediately after throttle was placed in idle the second time (Step 5).
.48 Mach (262 KIAS)	10,000 Ft	13.7%	Closed	Light off immediately after airstart on. Peak EGT was 520 degrees.

APPROACH AND LANDING: The airplane was returned to the pattern to do low approaches for ground effect determination. The first low approach was at 200 knots and had an 8 degree angle of attack. The second low approach was at approximately 230 knots and 6 degrees angle of attack. The moderate turbulence in the pattern prevented holding a constant speed or angle of attack. The ground effect was quite noticeable and seemed to cushion the airplane. Flare speed was computed as 187 knots with 25,000 pounds of fuel remaining in tank #3. Touchdown was at approximately 178 knots. Only two chutes opened fully.

BRAKE TESTS: With the brake selector set in automatic, the hand brake was turned on at a setting of 10 while the copilot held his pedals depressed. No braking could be detected until the selector was increased to 15. Slight chatter was noted as the airplane stopped. A second run was made using a setting of 10 and then increasing to 18 after the switch was turned on. Again light chatter occurred as the airplane stopped. The hand brake did not appear to work as smoothly using the "automatic" brake selection as it did previously using the "manual" selection.

ITEMS OF INTEREST: The inlet unstarts apparently caused a section of the inlet ramp seal to fail and the metal seal resulted in damage to engines 1, 2 and 3.

CONCLUSIONS:

1. Inlet unstarts expose the engines to possible "foreign object damage."

2. The inlet unstarts appeared to be satisfactory from the cockpit.

3. Unstarts are difficult to detect when the throat Mach positions are less than 2.17.

4. All unstarts were satisfactory.

5. Extreme caution should be used when taxiing with a heavy nose gear load since steering may not give proper response.

6. The yaw angle was less than $\frac{1}{2}$ degree during inlet unstarts and engine airstart tests.

MAINTENANCE DISCREPANCIES:

1. Nose wheel steering did not return to center following a right turn.

2. Primary one hydraulic pressure gauge 3600# -T/M showed 4000#.

3. The #3 EGT gauge stuck at 445 degrees EGT.

4. Clamp fell off of AICS actuator during takeoff.

5. Instrumentation cool #2 light came on near end of flight.

6. AICS cool light came on after touchdown.

7. The #6 engine was slow to light off during the ground start.

8. Flaps would not retract and flap pressure light remained on.

9. Copilot's communication lead will not lock satisfactorily on pressure suit lead.

RECOMMENDATIONS:

1. Correct the maintenance discrepancies noted.

2. Accomplish further inlet unstarts only after reasonable assurance can be obtained that the inlet ramp seals will not fail.

3. Use extreme care when taxiing with a heavy nose gear load.

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Pilot

COPILOT'S FLIGHT REPORT

AIR VEHICLE	XB-70A #2 (207)	PILOT	V. H. Shepard
FLIGHT NO.	2-30	COPILOT	A. S. White
DATE OF TEST	31 March 1966	FLIGHT TIME	2:10

COPILOT'S SUMMARY

After selecting AUTO mode AICS, the climb to 2.4 Mn, 57,000 ft., was routine. When stabilized at 2.4 Mn, the DUCT PERFORM mode was checked in NORM and the throat deviation controls were used to set the throat Mn at .05 greater than airplane Mn. A slow nose left sideslip was started. Very little left yaw was generated before the right duct unstarted. The RESET button was depressed after the duct started; and as the duct was returning to NORM, it unstarted again. It was again reset. This time when it unstarted the copilot decided to change the deviation to keep it from unstarting again during the reset to NORM. The deviation control was rotated the wrong direction, and possibly the left deviation was changed inadvertently because the left duct unstarted very soon thereafter. Both deviation controls were then set to 990 and the RESET button pressed. Both ducts returned to normal performance without further trouble. The deviation control was then used to set the throat Mach numbers equal to air vehicle Mach for the acceleration to 2.7 Mn.

While stabilized at 2.7 Mn, 64,000 ft., the throats were set at .05 Mn greater than airplane Mach number. Full left rudder gave 1.6 degrees of yaw, but did not unstart the ducts. The deviation was changed to .10 greater and again, full rudder did not unstart the duct. The throat Mach number was then changed to .15 greater, and this time the right duct unstarted almost immediately after the nose left yawing maneuver. The unstart in the right duct caused the airplane to roll and the left duct unstarted immediately thereafter. The ducts were reset, throat Mn set to .05 less, duct performance switched to HIGH, and the throats were set at .12 Mn greater for the climb to 70,000 ft. and 2.9 Mn. At this flight condition, a stability and control set was completed with the DUCT PERFORM switch in NORM and the throats set at .05 Mn less than airplane Mn.

A performance run was started at 2.9 Mn at 70,000 ft.; but just after stabilizing, a space-positioning turn was required. The windshield was lowered during the turn, and it was then decided to abandon the attempt to do airplane performance in favor of completing the ram purge test at this flight condition.

With the airplane stabilized at 2.9 Mn, the duct performance in NORM, the throat Mn equal to airplane Mn, the CABIN AIR switch was placed in the PURGE position. The DUCT PERFORM switch was changed to LOW and Military Power was selected. With cabin altitude stabilized out at 36,000 ft.

during the Military Power deceleration to 400 knots. After approximately 1.5 minutes, the CABIN AIR switch was placed in the REPRESSURE position and held until the cabin altitude reached 25,000 ft. The return to normal cabin altitude was satisfactory. At 400 KIAS, the descent began and the DUCT PERFORM switch was returned to NORM. Just after going to the REPRESSURE position with the CABIN AIR switch, the EE OVERHEAT light came on momentarily. The EE temperature was 38 degrees and the ammonia quantity was 450 pounds remaining at this time. The cabin temperature was noticeably warm during the repressurization cycle.

A. S. White

A. S. White
Copilot

COPILOT'S FLIGHT REPORT

AIR VEHICLE	XB-70A #2 (207)	PILOT	V. H. Shepard
FLIGHT NO.	2-29	COPILOT	A. S. White
DATE OF TEST	29 March 1966	FLIGHT TIME	1:51

COPILOT'S SUMMARY

During the acceleration at 32,000 ft., the pilot observed that the airplane was right wing heavy. Approximately six degrees of left wind down aileron trim was required and this, in turn, was causing the airplane to yaw to the right. Approximately one-third left rudder was required to overcome the right yaw. Investigation showed that fuel tanks 8R and 6R contained more fuel than their corresponding left-hand tanks. The fuel imbalance was approximately 10,000 pounds. Part of the out-of-trim condition was corrected when tank 6 fed out; however, the airplane remained out of trim until tank 8 was emptied.

After accelerating to above 1.5 Mn, it was noted that the automatic inlet control system was not functioning properly. The AICS PKG PWR switch was cycled. After the cycle, the AICS COOL light remained ON. At this time it was decided to abandon the original flight plan, which called for a flight at 2.9 Mn, and do alternate tests at 1.4 and 1.6 Mn. The alternate tests completed were a speed-power run at 1.4 Mn, 41,000 ft., and the following engine power modulations at 1.4 Mn: (1) A fast cycle, IDLE to MIL to IDLE, on #3 engine with the left-hand bypass doors at 400 sq. in.; (2) a slow cycle, engines #1, #2, and #3, left-hand bypass at 700 sq. in.; (3) a fast cycle, IDLE to MIL to IDLE, engines #1, #2, and #3, left-hand bypass at 700 sq. in. Following these power modulations, a stability and control set was completed at 1.6 Mn, 45,000 ft.

Two sonic boom runs were made over Edwards. The first was at 1.605 Mn at 44,300 ft. with a total fuel remaining of 45,000 pounds. The second was made at 1.405 Mn at 35,500 ft. with a total fuel remaining of 34,000 pounds.

A. S. White
Copilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. H. Shepard

FLIGHT NO. 1-43 COPILOT Col. J. Cotton

DATE OF TEST 13 April 1966 FLIGHT TIME 2:03

CHASE AIRCRAFT AND PILOTS

Chase 1	T-38 #600	-	Lt. Col. Sorlie/Lt. Col. Fulton
Chase 2	T-38 #600	-	Lt. Col. Sorlie/Lt. Col. Fulton
Chase 3	F-4C #743	-	Capt. Gentry/Col. Matheson
Rescue	C-130 #131	-	Capt. Kurowski/Capt. Stroup

PURPOSE OF FLIGHT

1. Lateral-directional stability - 2.5 Mn, 60,000 ft. (bobweight free)
2. Longitudinal dynamic and accelerated stability - 2.5 Mn, 60,000 ft.
3. Inlet tolerance to sideslip
4. Airstarts - 1.0 Mn, 30,000 ft.
5. Handling qualities - .8 Mn, 20,000 ft.

1.0 AUGMENTATION-ON STABILITY - 2.5 Mn, 60,000 FT.

The takeoff and climb to 2.5 Mn, 60,000 ft., were normal and uneventful. Augmentation-ON stability set consisting of a full rudder sideslip, longitudinal and directional dynamic test, and a longitudinal accelerated wind-up turn to 1.4 G was accomplished with the following observations:

a. Pull-up and release from 1.25 G damped to one-tenth amplitude in three-quarters of a cycle.
b. Rudder release revealed an over-damped situation in that a slow return of the sideslip was observed.
c. The directional static gradient was moderate-heavy, but linear; however, rudder power was low as full rudder resulted in only 1.3 degrees of sideslip.
d. Full right rudder required five pounds of right aileron to maintain wings level.
e. Adverse yaw due to aileron deflection.

2.0 AUGMENTATION-OFF STABILITY - 2.5 MN

Each time the augmentation was disabled, the airplane rolled left mildly, requiring some aileron, which immediately caused a lateral out-of-phase overcontrol oscillation which in turn produced an in-phase divergent directional oscillation. Augmentation had to be engaged at least three different times in order to keep the directional oscillation below ± 3 degrees. It was apparent that the lateral control with the

pilot in loop induced both lateral and directional oscillations. An attempt was made to control the sideslip oscillations with rudders, but the indicator was backwards; i.e., reading "yaw" and the ball was too insensitive, barely moving for ± one and one-half degree oscillations. (The writer had spent all of his time on the design simulator flying sideslip for more than four years, and trying to fly the reverse sign of sideslip with rudder was impossible.) Finally, acceptable control was obtained by not touching the ailerons and flying by trim. A 90-degree turn and a wind-up turn were accomplished with augmentation OFF. The airplane was slightly sensitive longitudinally and the gradient was moderately heavy, but no lightening was encountered up to 1.4 G. Longitudinal dynamic data were obtained where four cycles were required to reduce to less than one-tenth amplitude.

Upon rolling out of the 45-degree bank required for the wind-up turn, augmentation had to be engaged due to another divergent yaw oscillation. After augmentation was engaged, the airplane was left wing heavy, which resulted in a left wing-down condition with more than one-half right rudder required to counteract the right aileron required to prevent further rolling to the left. Sometime during this gyration, the left inlet unstarted. This, of course, caused more left roll, but was not noticed while wrestling with this other problem. The airplane settled down with augmentation ON, the controls were relaxed, and level flight was regained. Then a directional dynamic and static test were attempted with augmentation OFF, but the use of aileron prevented any static stabilization and the release caused the airplane to roll excessively.

3.0 AUGMENTATION OFF - LATERAL BOBWEIGHT STABILITY, 2.5 MN

With augmentation OFF, still working hard with ailerons to prevent a divergent yaw oscillation, the lateral bobweight was unlocked--and what a relief! The airplane could now be flown satisfactorily with little effort. A stability set was accomplished with the following observations:

a. Adverse yaw due to aileron deflection appeared less.
b. Right aileron required to maintain wings level in right rudder push out (left sideslip)--no change in apparent negative dihedral effect.
c. Airplane rolled left upon releasing from a one-degree left sideslip (this dynamic case resulted in positive dihedral).

4.0 AUGMENTATION ON - LATERAL BOBWEIGHT STABILITY, 2.5 MN

A longitudinal dynamic pull-up and release resulted in one-tenth amplitude in three-quarters cycle and damped in one cycle. Directional dynamic was deadbeat, with no residual oscillations observed.

Full right rudder produced one and one-half degrees of sideslip, and right aileron was required to maintain wings level. The wind-up turn to 1.4 G was satisfactory.

5.0 AIRSTART - 1.0 MN, 30,000 FT.

With engines #2 and #3 in maximum afterburner, #4, #5, and #6 in Military Power, the #1 engine was airstarted at a stabilized indicated 1.0 Mn. The engine started immediately after turning the airstart switch on; the throttle had been in IDLE for at least 15 seconds prior to airstart switch selected to ON. Windmill rpm was 40.5 per cent.

6.0 HANDLING QUALITIES - .8 MN, 20,000 FT.

Handling qualities were accomplished with the wingtips at one-half, and longitudinally the airplane was rated 2 after performing a climb, level flight stabilization, and a descent with augmentation ON. The same maneuver was accomplished with augmentation OFF. The rating was reduced to $4\frac{1}{2}$ because of the airplane being overly sensitive because the CG was quite far aft and only 27,000 pounds of fuel remained in the sump.

Lateral-directionally, the airplane was rated $3\frac{1}{2}$ with FACS ON, and 4 with FACS OFF while performing coordinated turns. These same turns accomplished with aileron only resulted in a rating of 4--both FACS ON and OFF--because of near two degrees of adverse yaw with normal aileron inputs.

7.0 CONCLUSIONS

1. The lateral bobweight was required for satisfactory control of the airplane at 2.5 Mn with augmentation OFF.
2. The ADI inclinometer (ball) was too insensitive at 2.5 Mn.
3. One must be proficient on the simulator using either a "yaw" or sideslip indicator in order to maneuver at 2.5 Mn with all augmentation OFF and the lateral bobweight locked.
4. The airplane exhibited no change in dihedral effect during a static directional test with or without lateral bobweight. Dynamically, apparent positive dihedral was present with the lateral bobweight.
5. Rudder power was low at 2.5 Mn, resulting in only one and one-half degrees of sideslip with full rudder.

8.0 DISCREPANCIES

1. Lateral bobweight requires 30 seconds to FREE.
2. VIBRATION HIGH caution light on with all vibs reading 2-3 mils.
3. Tank 6L readout intermittent near 10,000 to 14,000 ft.
4. Centerline thermocouple lead loose on windshield.
5. Pitch augmentation disengaged once at 2.5 Mn, reengaged OK.
6. No. 6 utility status light on during flight.

7. Instrumentation cool #2 on during latter part of flight.
8. LH main gear green bulb fell in copilot's capsule.
9. No. 1 engine turbine vib. inoperative.
10. Utility #1 quantity decreased to 5.2 gallons in flight.
11. Hydraulic leak at left-hand fold actuator.

V. H. Shepard
Pilot

HANDLING QUALITIES QUESTIONNAIRE

FLIGHT 1-43 PILOT V. H. Shepard CONFIGURATION Windshield - UP; Wingtips - DOWN

LONGITUDINAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Airspeed, Altitude, Attitude	2.5/60,000'	FACS ON	3	
		FACS OFF	$3\frac{1}{2}$	
MANEUVERABILITY - Ability to change: Airspeed, Altitude, Load Factor		FACS ON	$2\frac{1}{2}$	
		FACS OFF	4	Airplane was overly sensitive
RESPONSE TO TURBULENCE				
RESPONSE TO CONFIGURATION CHANGES				
OVERALL LONGITUDINAL RATING			$3\frac{1}{2}$	

LATERAL-DIRECTIONAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Heading, Bank Angle	2.5/60,000'	FACS ON	3	
		FACS OFF	6	With lateral bobweight, this rating changed to 4.
MANEUVERABILITY - Ability to change: Heading, Bank Angle		FACS ON	3	
		FACS OFF	6	With lateral bobweight, this rating changes to 4.
RESPONSE TO TURBULENCE				
OVERALL LATERAL-DIRECTIONAL RATING		FACS OFF	6	The pilot had to fly ailerons only because of being confused with a yaw meter. (All previous training and flying had been accomplished with a sideslip indicator or sensitive ball.) Rudder was not used to stop directional oscillations induced by the ailerons with the pilot in the loop.
CONTROL HARMONY			5	If rudder had been used, the rating unquestionably would have been better.

COPILOT REPORT

XB-70A No. 62-001 13 April 1966

Flight 1-43

INTRODUCTION

The objectives of this flight included stability and control at 2.5 Mach and 60,000 feet, inlet (AICS) sideslips at 2.5 Mach, airstart of No. 1 engine at Mach 1.0 and 30,000 feet and handling qualities evaluation.

Pilot - Mr. Van Shepard	Takeoff Time - 1413
Copilot - Colonel Joseph Cotton	Total Flight Time - 2+03
Max Altitude - 63,000 feet	Supersonic Time - 1+05
Max Indicated Mach - 2.6	Time Over Mach 2 - 0+47
Max KIAS - 584	Time Over Mach 2.5 - 0+35
Max Total Temp - 418°F	

SUMMARY

The morning flight was delayed when, after engine start, the flight crew discovered the nose wheel steering was inoperative in the fail safe mode.

A pullup and release, with FACS off, bob weight free and the AICS sideslips at 2.5 Mach were not completed.

Two sonic booms were recorded at Edwards. The first one was in a 45° left bank, near 1.65 Mach, 45,000 feet, 1.4 g, 4.8° angle of attack and 69,000 lbs of fuel. Conditions of second boom were not recorded.

Lateral and directional control and roll trim problems, at 2.5 Mach and 60,000 feet with FACS off, were of sufficient concern as to require augmentation engagement. Handling qualities were not good with FACS off and bob weight locked or free. Negative dihedral effect and excessive adverse yaw degrade the stability and control qualities with FACS off. The high response in roll, sensitive ailerons and light aileron control forces add to the difficulty in controlling the unaugmented airplane. It is my opinion that airplane No. 2 handles better at 2.9 Mach with FACS off than this airplane did during the unaugmented conditions I observed on this flight.

The engines were shutdown after clearing the runway due to hydraulic leaks caused by a failure of the left main gear hop hamper and bogie.

ENGINE START AND TAXI

The engine starts, in 5-1/2 minutes, were normal except for No. 2 which was started last and had a first peak EGT of 660°C. The OAT at Mobilcom was 77°F, aircraft 78°F. Fuel totalizer at engine start was 255,200 lbs.

Fuel totalizer at start of taxi (time 1344) was 249,000 lbs. Taxied to runway 04 with a wind of 020° at 2 knots and tower reported temperature of 71°F. Manual hand brake control was not used, as briefed. Toe brake automatic stops produced the normal amount of chatter.

TAKEOFF AND CLIMB

Fuel totalizer at brake release was 240,000 lbs. Twenty second acceleration from 73 KIAS (standby) ended at 162 KIAS. Rotation speed estimated at 195 KIAS and takeoff 210 KIAS. Augmentation was off for takeoff. Gear doors were very slow to close --- particularly the left one. A 380 KIAS climb was made to 10,000 feet, then increased to .90 Mach at 21,000 and .95 at 32,000 feet. A left turn was made 45 miles northeast indicating Mach 1 at 32,000 feet with 209,000 lbs fuel on totalizer. Level acceleration was made at 32,000 feet, windshield raised near 1.20 Mach and wing tips selected to full at 1.35 Mach. Shep reported no lateral or directional trim changes as the tips went down --- the left tip indicator showed full down 2 seconds ahead of the right.

The throats were placed in automatic at 1.75 Mach; they increased properly during the acceleration. At Mach 2 I started the inlets by manually opening the bypass areas to 850 sq in left and 820 sq in right to position the shock needles in the crosshatched (XXXX) area (See AICS Data Sheet). Light airframe buffet experienced at 2.3 Mach. At 2.5 Mach I opened the bypass areas to lower the shock needles to the bottom of the green (.5 SPR) in preparation for the first stability and control point.

STABILITY AND CONTROL

Mach	Altitude	FACS	Bob Weight	Condition	Comments
2.5	60,000'	On	Locked	Right windup turn to 1.4 g	Good point.
2.54	60,000'	On	Locked	Pullup and release to 1.2 and 1.4 g	Tenth amplitude in 3/4 cycle.
2.49	60,000'	On	Locked	Release from 1° right yaw	Sluggish slow return - deadbeat. Residual fishtailing.
2.5	60,000'	Off	Locked	Pullup and release	4 cycles to tenth amplitude.
2.5	60,000'	Off	Locked	Windup turn (right)	Point very difficult to obtain. Left inlet unstarted.
2.5	60,000'	Off	Locked	Right rudder sideslip	Point no good.
2.5	60,000'	Off	Free	Release 1° right yaw	Rolled left on release - Pilot recovered.
2.53	60,000'	Off	Free	Windup turn (left)	Point O.K.
2.55	60,000'	Off	Free	Release 1° right yaw	Release 10° right wing down, a/c rolled left & pilot recovered.
2.5	60,000'	On	Free	Pullup and release	Tenth amplitude in 3/4 cycle.
2.51	60,000'	On	Free	Full rudder sideslip & release from 1°	Essentially deadbeat.
2.49	60,000'	On	Free	Windup turn right	1.4 g. 60° bank.

COMMENTS

The combination of negative dihedral effect, excessive adverse yaw generated by the ailerons, difficulty using roll trim and delicate aileron technique required, resulted in poor handling qualities with FACS off at 2.5 Mach with bob weight locked on free. It was necessary to re-engage augmentation to recover from apparent divergent lateral - directional oscillations when FACS were turned off and the pilot made aileron inputs. When FACS were turned off the aircraft was generally out of trim in roll and the pilot used aileron to pick up the heavy wing while he trimmed out the force. The adverse yaw and mild negative dihedral effect aggravated the condition and before long the sideslip increased

from +/- 1° to +/- 2° where FACS were re-engaged. Pilot aileron inputs and roll trim problems, with FACS off, generated an apparent divergent condition which necessitated the FACS be re-engaged. It was an uncomfortable and troublesome condition. There is no doubt but what the divergence is pilot induced, that aileron inputs mean trouble, but the technique required to prevent it is not readily apparent or easily achieved. The roll trim and aileron control systems may require improvement after further investigation. It has long been my opinion that the aileron forces are too low and now I tend to also feel that more positive centering would help to restrict the aileron inputs.

The negative dihedral effect is about the same with bob weight locked or free. When releasing from 1° sideslips with the FACS on, a residual fishtailing effect was felt in the cockpit for several seconds. Handling and control appeared some improved with the bob weight free.

ENGINE AIRSTART

No. 1 engine was shutdown just after the jump to subsonic. The bypass doors were closed. The windmill rpm was 40.5%. At .99 indicated Mach, 30,380 feet the throttle was advanced to idle. The rpm stabilized at 41% and when the air ignition was turned on lite-off occurred immediately, evidenced by an increase in both rpm and EGT.

HANDLING QUALITIES

The following climbs, letdowns and turns were completed to obtain pilot opinion of:

Mach	Starting Altitude	Wing Tips	FACS	Comments	Cooper Rating
.8	20,000'	1/2	On	Mil power climb to 25,000'. Max R/C 6,000 ft/min	2
.8	25,000'	1/2	On	Reduced power descent to 19,880' Max R/D 7,000 ft/min	2
.8	20,000'	1/2	On	Coordinated turns, 30° banks & heading changes. Ailerons sensitive and forces light.	3-1/2
.78	20,000'	1/2	On	Aileron only turns. 1 to 1-1/2° Adverse yaw experienced.	4
.8	20,000'	1/2	Off	Left coordinated turn. Very sensitive longitudinally.	4
.78	21,000'	1/2	Off	Aileron only. 1-3/4° yaw on rollout.	4-1/2
.8	20,700'	1/2	Off	Mil power climb. Max R/C 6200 ft/min. Oversensitive longitudinally. Care or over g.	4-1/2
.78	25,000'	1/2	Off	Descent to 20,000'. .5 g in descent.	4-1/2

Comments: Ailerons very sensitive and forces are light. Longitudinal sensitivity high with FACS off - easy to over g the airplane.

LANDING

Gear handle was placed down at 250 KIAS. Extension time was 28 seconds. The red light went out in the handle and the mains indicated safe but the nose gear green light was not on. The burned out bulb was exchanged with the left main and it indicated safe - by both the light and chase.

On a long final, over Rosamond Lake, for runway 04 the tower reported a wind from 300° at 4 knots. The gross weight was 292,000 lbs. Fuel totalizer 29,000 lbs with sump 19,000 lbs. Best flare speed 187 KIAS. The utility #1 fluid level was down to 5.2 gal and utility #2 was 13.6 gal. Final approach airspeed was 195 KIAS (standby) with 8-1/2° angle of attack. I did not observe the touchdown speed. The landing was not a grease job nor was it hard. Chase called out, "A nice one." I did feel an unusual ripple (a series of short period vertical accelerations) in the cockpit simultaneous with the landing and initial spin up of the wheels. The chute was deployed at 165 KIAS and developed very slowly. Due to my attention to nose wheel steering and hydraulic levels I failed to jettison the chutes until we were below 50 KIAS (estimated speed 20 knots). There was no damage to the upper aft fuselage skin.

Shep used light braking, rolled beyond the east end turn off and did a 180° turn to the right on the overrun. While checking and evaluating the steering and avoiding use of brakes he taxied past the turn off and did a 270° turn on the runway. The fluid levels were dropping in the utility systems - U_1 was 4.8 gal and U_2 was 6 gals. No. 1 and No. 2 engines were shutdown.

After clearing the runway Mobilcom reported a bad hydraulic leak at the left gear bogie hop damper. U_1 fluid level dropped further to 4.2 gal with a head pressure of 162 psi so we shut down No. 3 engine. Very soon thereafter 4, 5 and 6 utility pump status lights were on, U_2 pressure started dropping so we very hurriedly turned off all equipment and shut down engines.

The left main gear hop damper had pulled loose from the bogie and ruptured hydraulic lines.

FLIGHT SQUAWKS

1. Lateral bob weight requires 30 seconds to free.
2. High vibe caution light on with all vibes reading 2 to 3 Mils.
3. Tank No. 6 left readout intermittent near 10,000 to 14,000 lbs.
4. Centerline thermocouple lead loose on windshield.
5. Pitch augmentation disengaged once at 2.5 Mach, re-engaged O.K.
6. No. 6 utility pump status light on during flight.
7. Instrumentation cool #2 on during latter part of flight.
8. Left main gear green light bulb fell in copilot's capsule.
9. No. 1 engine turbine vibe inoperative.
10. Utility #1 quantity decreased to 5.2 gals in flight.
11. Hydraulic leak at left hand fold actuator.

SYSTEMS SUMMARY

Hydraulics: The engine start service levels were:

$$U_1 - 9.3,\ U_2 - 11.3,\ P_1 - 4.4,\ P_2 - 4.5$$

Fluid levels at shutdown were:

$$U_1 - 4.2,\ U_2 - 4.8,\ P_1 - 6.2 \text{ and } P_2 - 6.0$$

Utility 3, 4, and 6 status lights were on most of the flight --- a most undesirable condition.

Flight Controls: Bob weight indicator slow to drive from locked to free. Pitch augmentation disengaged once at 2.5 Mach.

Instruments: High vibe caution light remained on even though individual vibe levels were in limits.

Instrumentation Package: Cool 2 system came in operation during descent from the 2.5 Mach work.

Drag Chutes: Slow developing. Copilot errored and jettisoned slow.

Brakes: Didn't use manual hand brake control. Less than normal chatter using toe brakes.

Landing Gear: Main gear doors slow to close, especially the left one. Nose gear green light bulb burned out. Left gear hop damper pulled loose from bogie on landing.

Nose Wheel Steering: Caused delay of the flight. Operation much improved. Less wander near center.

Fuel: Tank No. 6 left quantity oscillated between 14,000 and 10,000 lbs during feed out.

The following systems performed satisfactorily:

Nose Wheel Steering	Flight Instruments
Brakes	Communications
Flaps	TACAN
Wing Fold	IFF
Engines	Environmental
Fuel	Oxygen
Electrical	Flight Controls
AICS	Instrumentation Package
Fire Detection	Nose Ramp

AICS DATA

Time	Aircraft Mach No.	Left Throat Mach	Right Throat Mach	Left Bypass Area	Right Bypass Area	Left Shock Needle (SPR)	Right Shock Needle (SPR)	Comments
1432	2.05	2.07	2.07	790	760	.6	.6	850 left & 820 right bypass started inlet.
1438	2.4	2.42	2.41	510	535	.6	.6	Both shock needles nervous - left worst.
1447	2.49	2.50	2.49	480	520	.5	.5	Set up for stability & control maneuvers.
1451	2.5	----	----	500	530	.4	.45	Shocks in white. FACS off work.
1457	2.4	2.50	2.49	495	525	--	--	Recovered from an unstart of the left inlet during yawed right turn.
1508	2.55	----	----	410	450	--	--	FACS off stability & control.
1512	2.51	----	----	465	465	--	--	FACS on full rudder sideslip.

RECOMMENDATIONS

1. Eliminate nuisance and unnecessary illumination of utility hydraulic status indicators on pumps which are operating satisfactorily.

2. Improve lateral control system. Reduce aileron sensitivity, increase wheel force and make wheel centering more positive.

3. Thoroughly investigate and fix the cause of the hop damper - bogie failure.

Joseph F. Cotton

JOSEPH F. COTTON, Colonel, USAF
XB-70A Test Director - Copilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. H. Shepard

FLIGHT NO. 1-44 COPILOT Lt. Col. F. Fulton

DATE OF TEST 19 April 1966 FLIGHT TIME 2:12

CHASE AIRCRAFT AND PILOTS

Chase 1 - T38 194 Col. Sorlie
Chase 2 - T38 600 Major Ludwig/Col. Cotton

PURPOSE OF FLIGHT

1. Directional dynamic - 2.0, 2.2, and 2.4 Mn
2. Airstarts - .85 Mn
3. Handling qualities - 240 KIAS, 5,000 ft.
4. Brake computer change

1.0 BRAKE TEST

Data were obtained of a normal brake stop from approximately 25 knots. As the pedals were applied, the deceleration was smooth with no roughness whatsoever. The brakes tended to grab just below 10 knots and the pedals were released slightly, but not completely, and the airplane stopped with no shaking or chatter. Except for the slight grabbing of the brakes just below 10 knots, the stop was excellent.

2.0 TAKEOFF AND NOSEGEAR PROBLEMS

Without using the brake pedals, the airplane was held in MIN A/B with the holding brakes. Brakes were released by rapidly depressing the pedals and releasing. Once the airplane started rolling, the airplane started veering slightly right, and it was apparent that the nosewheel steering was inoperative. The nosewheel steering light confirmed this, and the steering was engaged and operated satisfactorily during the remainder of the takeoff roll.

The takeoff was normal; however, the nosegear did not retract completely and all three gear retracted very slowly. Hydraulics were checked and the landing gear handle was placed in the DOWN position where all three gear lowered and locked normally. The remainder of the flight was conducted gear down, and an airspeed calibration was substituted for the above tests.

3.0 AIRSPEED CALIBRATION

The following pacer airspeed calibration points were obtained in smooth air with gear, flaps, and windshield down, and wingtips up:

AIRSPEED-KIAS			ALTITUDE-FT		ANGLE OF ATTACK/DEGREES
VSI	Instrumentation	Pacer	VSI	Pacer	
232	233.5	222	15,240	15,010	8
241	242	231.5	15,140	14,910	
251.5	251	243	15,340	15,040	10.3
250.5	250.5	242	15,530	15,260	10.2
263.5	260.0	254.5	15,760	15,490	10.0
275	269	263.5	15,980	15,650	9.0
224.5	225.5	218	15,660	15,460	11.6
210	210	202	15,700	15,600	13.2

The following points were obtained with the gear down, flaps up, windshield down, and wingtips up:

269.5	266.5	261.5	17,250	16,930	9.8
257	256	248.5	15,400	15,200	9.8
252.5	251.5	243	15,830	15,590	9.4
240.5	243	233	16,200	15,940	10.2
229	231.5	222	16,250	16,110	11.1
218.5	220	210	15,840	15,680	11.7
208.5	208.5	201	15,150	14,995	12.2
201.5	201.5	193.5	15,040	14,930	12.8
178.5	178.5	172	14,650	14,620	15.1

4.0 HANDLING QUALITIES

Handling qualities were accomplished at 12,000 ft. because of turbulence and clouds. With the airplane trimmed up at 240 knots, augmentation ON, a coordinated turn and an ailerons-only turn were accomplished by turning 30 to 40 degrees in a 30-degree bank angle. Turns were accomplished in both directions. The coordinated turn was rated a $3\frac{1}{2}$ due to excessive rudder required to counteract the adverse yaw. Also, the aileron was sensitive, causing overcontrol as the bank angle oscillated $\pm$ 2 degrees while stabilized at a 30-degree bank angle. The ailerons-only turn resulted in nearly three degrees of adverse yaw due to aileron deflection which, for the first impression, made the pilot rate this $4\frac{1}{2}$. (It is believed that this rating should be changed to 4 because when one reflects back, this is really not much adverse yaw when compared to most jet airplanes near power approach speeds. The yaw limit here is near 10 degrees. In view of the fact that we are so sideslip conscious because of normally low sideslip limits at higher Mach numbers, I believe that we have over-emphasized sideslip at landing

pattern speeds. However, one must always keep in the back of his mind that the static directional curve flattens out--especially near 5 degrees of sideslip. If this was encountered, the rating would change to a 5.)

Then with augmentation ON, after trimming out at 240 knots, 12,000 ft., a Military Power climb was made to near 17,000 ft. Then a descent was accomplished back to 12,000 ft. after stabilizing at 17,000 ft. The rating resulted in a 2½. Then with augmentation OFF, this longitudinal maneuver was repeated and the rating was increased to 3.

5.0 CROSSWIND LANDING

With 65,000 pounds of fuel remaining, a touch-and-go landing was accomplished in a 60-degree crosswind from the right with an average wind of 16 knots and gusts to 30. The airplane was flown slightly right wing down in a small crab to counteract the wind. As ground effect was entered, slight left aileron was used to bring the right wing up and this automatically decrabbed the airplane. The landing was excellent; and except for flying right wing down, it was almost the same as a no-crosswind landing. The nose was lowered to the runway and the nosewheel steering was checked out in the "takeoff/land" position. The steering operated satisfactorily in both directions. Then Military Power was applied and the airplane accelerated satisfactorily for takeoff and climb.

Later on, with 25,000 pounds of fuel remaining, the final landing was accomplished with approximately the same wind and no difficulty was encountered. However, the airplane landed in a slight crab; and as the nose was lowered, the right wing appeared to rise slightly. Chase reported the right bogie did not leave the runway.

6.0 ROLL (POSITION) TRIM KNOB

While setting up the ILS frequency, the roll trim knob was inadvertently moved to near 10 degrees right wing down without the pilot knowing that it had occurred. This occurred while turning final near 230 knots. At this time the pilot found himself holding quite a bit of left wheel because of the apparent right wing heavy. There was nearly two degrees of left yaw in the airplane; and as the pilot released the aileron to trim the airplane out, the airplane yawed out five degrees to the left, which was really confusing because normally when you release the aileron, the yaw will reduce such as generally occurs when you have a directional out of trim; i.e., one holds aileron to counteract the roll due to yaw, and as you release the aileron, the yaw will decrease. But on this occasion the out-of-trim was lateral and the releasing of the aileron actually made the yaw worse. Fortunately, shortly thereafter--10 seconds or so--I found the lateral position trim knob almost full over and quickly recenter this, which solved all my lateral-directional problems.

Considerable rudder--over half--was used to try to counteract the yaw while the aileron was held. This leads one to believe that we should investigate just how much lateral out of trim we can tolerate with full rudder.

7.0 CONCLUSIONS

1. Brakes were much improved with the computer change; except for grabbing near ten knots, stops would have been excellent!
2. Crosswind landing presented no problems, and it appears that the airplane will not be crosswind limited.
3. Roll (position) trim knob friction should be increased to prevent inadvertent movement. (This would also provide more feel, which is badly needed, in this knob.)

8.0 DISCREPANCIES

1. High vibration caution light on entire flight--engine vibration OK.
2. All three gear slow to retract.
3. Nosegear would not retract completely.
4. Engine #5 A-9 nozzle open three inches farther than other engines at Military Power.
5. Chase reported left vertical stabilizer shakes more than right with FACS OFF, gear and flaps down.
6. Nosewheel steering disengaged after brake release.

V. H. Shepard
Pilot

Copy 8

R-66-4-3
Edwards AFB

COPILOT COMMENTS

XB-70A FLIGHT 1-44 19 APRIL 1966

INTRODUCTION: The flight was airborne at 0909 hours. Flight objectives were stability and control at 2.0, 2.2, 2.35 and 2.4 Mach, handling qualities at .8 Mach and an engine airstart at .85 Mach. The nose gear failed to fully retract after takeoff, therefore, the landing gear was extended and remained down throughout the remainder of the flight. Seventeen airspeed pacer points, low speed flight maneuvers "Cooper rated" and cross-wind landings were accomplished. The maximum speed and altitude was 270 knots IAS and 17,000 feet. The flight duration was 2 hours and 12 minutes.

PREFLIGHT AND TAXI: All engine starts were normal with the maximum starting EGT 525 degrees. The brake computer was modified prior to this flight and the modification improved the brakes considerably. While taxiing up to 25 knots, the brakes could be applied without encountered chatter except in the 5 to 8 knot speed range. Even after encountering chatter, the airplane could be smoothly stopped by slightly relaxing the brake pedal pressure. The braking action was better than has ever been experienced on the XB-70.

TAKEOFF AND CLIMB: Total fuel remaining two minutes prior to brake release was 255,500 pounds. The takeoff was made with max A/B power and FACS on. When the brakes were released, the nose wheel steering disengaged but was quickly re-engaged. The nose wheel steering problem disrupted the acceleration check, however, the airplane appeared to accelerate normally and was airborne at 213 knots. The nose gear failed to fully retract and appeared to be stuck about 10 degrees from the full up position. The landing gear was re-extended but was very slow to go down. A decision was made in the Data Control room to leave the gear down for the remainder of the flight. Therefore, the flight plan was revised to obtain gear down data.

AIRSPEED CALIBRATION WITH T-38 PACER: After climbing to 15,000 feet, a T-38 pacer airplane was flown in formation with the XB-70 to calibrate the airspeed system. The points obtained were as follows:

VSI Airspeed Pilot/Copilot	Standby	VSI Altitude Pilot/Copilot	Flap Position	Pacer Airspeed	Pacer Altitude	Pacer OAT-Degrees C
232/233.5	-	15,240/	DOWN	223	15,010	-7
241.5/241.5	242	15,140/15,180	"	231.5	14,910	-5
251.5/252	251	15,340/	"	243	15,040	-6
250.5/251	250.5	15,530/15,620	"	242	15,260	-6.5
263.5/264	260	15,760/15,820	"	254.5	15,490	-6
275/276	269	15,980/16,000	"	263.5	15,650	-7
224.5/225	225.5	15,660/15,700	"	218	15,460	-10
210/211	210	15,700/15,820	"	202	15,600	-10
269.5/270	266.5	17,250/17,340	UP	261.5	16,930	-2
257/258.5	256	15,400/15,520	"	248.5	15,200	-4
252.5/253	251.5	15,830/15,880	"	243	15,590	-4
240.5/241	243	16,200/16,220	"	233	15,940	-4
229/229	231.5	16,250/16,420	"	222	16,110	-8
218.5/219	220	15,840/15,960	"	210	15,680	-9
208.5/209	208.5	15,150/15,160	"	201	14,995	-9
201.5/202	201.5	15,040/15,110	"	193.5	14,930	-6
178.5/179	178.5	14,650/14,760	"	172	14,620	-8

There was a slight increase in airframe buffet noted when the flaps were retracted. The final point at 178.5 knots on the pilot's VSI was flown with 75,000 pounds of fuel remaining and had an indicated angle of attack of 15.1 degrees.

CROSS WIND TOUCH AND GO LANDING: The wind had increased to about 20 knots, gusting to 30 knots, and was quartering from the right approximately 60 degrees off the runway heading. It was decided by Data Control that a touch and go landing should be accomplished and the nose wheel steering should be engaged for a check. This was requested to ascertain that the nose wheel steering had not failed when the landing gear malfunctioned. If the nose wheel steering had been found inoperative, a dry lakebed landing would have been required since the cross wind was high. With 70,000 pounds of fuel remaining, a flare speed of 199 knots was computed. As the airplane came down the final approach, the crab angle appeared to be 7 to 8 degrees, however, as the airplane was flared the pilot applied right aileron to drop the wing into the wind. The yaw due to aileron (adverse yaw) seemed to straighten the airplane out and the touchdown was extremely smooth with all crab removed as the airplane touched the runway. The touchdown speed was approximately 190 knots. The nose was lowered, steering engaged, and then power applied for the takeoff. The takeoff was routine and since the nose wheel steering operated normally, the airplane was climbed back to altitude for additional tests before the final landing.

MANEUVERS - COOPER RATED:

The first maneuvers were done at 240 knots, 12,000 feet, with the FACS on and the wing tips up. The maneuver consisted of bank 30 degrees and turn 30 degrees, roll out, bank 30 degrees in opposite direction and after turning 30 degrees, roll out and stabilize. Using aileron and rudder, a "Cooper rating" of $3\frac{1}{2}$ was assigned and the pilot commented that considerable rudder was required. Using aileron only, a rating of $4\frac{1}{2}$ was assigned because of the $2\frac{1}{4}$ to 2 3/4 degrees of adverse yaw that developed during aileron input. The ball was only displaced 1/3 ball diameter when the yaw angle was the largest.

The second series of maneuvers was at 240 knots, 12,000 feet, with the wing tips up. It consisted of a climb at constant speed for 5,000 feet, level off, descend at constant speed for 5,000 feet and then level off and restabilize. With FACS on, a rating of $2\frac{1}{2}$ was assigned and with FACS off, a rating of 4 was erroneously assigned. The instructions from Data Control were that the rating should be on overall flying qualities, however, only the longitudinal control should have been rated. It would probably have received a rating of 3 to $3\frac{1}{2}$.

APPROACH AND LANDING: The airplane was returned to the pattern with approximately 20,000 pounds of fuel remaining and the flare speed was computed as 187 knots. The landing wind was 270-290/20 knots gusting to 30 knots. Since the landing runway was 22, the cross wind was still strong from the right. The pilot used the same right wing down technique and the yaw again straightened the airplane out just before touchdown. It was decided ahead of time to wait until the nose was down with the nose wheel steering engaged before deploying the drag parachute. After the pilot lowered the nose, I engaged the nose wheel steering for him and then deployed the chutes. All three parachutes deployed. There was no tendency for the deployed parachutes to weathervane the airplane in the cross wind. The flaps failed to retract after taxiing from the runway. Brake operation was very good while taxiing in. The airplane could be easily stopped without encountering brake chatter.

CONCLUSIONS:

1. Wheel brake operation was the best ever encountered on the XB-70 airplane.

2. Cross wind landing characteristics were excellent.

MAINTENANCE DISCREPANCIES:

1. High vibration caution light on entire flight with normal engine vibrations.

2. All three landing gear slow to retract.

3. Nose gear would not retract completely.

4. The #5 Ag nozzle opened 3 inches more than others at military power.

5. Nose wheel steering disengaged after brake release.

6. Chase pilot reported left vertical stabilizer shakes more than right vertical when FACS is off, gear and flaps down. The problem was later found to be in the stabilizer rod end bearing which was replaced along with the attaching pin.

RECOMMENDATIONS:

1. Correct the maintenance discrepancies noted.

2. Continue to improve wheel brake characteristics.

3. Investigate further the cross wind landing characteristics.

4. Inspect all stabilizer rod end bearings and attaching pins on both airplanes.

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Copilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT V. H. Shepard

FLIGHT NO, 1-45 COPILOT Lt. Col. F. Fulton

DATE OF TEST 21 April 1966 FLIGHT TIME 2:02

CHASE AIRCRAFT AND PILOTS

Chase 1 - T-38 #194 - Capt. Roosa
Chase 2 - F-104 #763 - Capt. Curtis
Chase 3 - T-38 #194 - Capt. Roosa

PURPOSE OF FLIGHT

1. Directional dynamic - 2.4, 2.2, and 2.0 Mn, 60,000 ft.; and 2.2 and 2.0 Mn, 55,000 ft.
2. Longitudinal static stability - 2.0 and 2.4 Mn, 60,000 ft.
3. Airspeed pacer calibration - .88 Mn, .96 Mn
4. Airstart - .85 Mn, 16,000 ft.
5. Handling qualities

1.0 TAXI

Data were obtained of a normal brake stop from approximately twenty knots. The brakes tended to be somewhat touchy near 15 knots, and some chatter was experienced near 10 knots where the pedals had to be released completely. Mild chatter was then experienced all the way to the stop, using light braking. No changes had been made since the previous flight, where the brakes were rated as satisfactory; but this stop was different for some reason and must be rated unsatisfactory.

2.0 TAKEOFF

With the airplane weighing near 525,000 pounds at brake release, and with a temperature of 70°F, 19.5 seconds was computed from the handbook to accelerate from 70 to 150 KCAS. The actual acceleration after 19.5 seconds resulted in 148 KCAS, which was considered acceptable. The acceleration was clocked using the instrumentation airspeed.

3.0 YAW-RUDDER PHASING PRACTICE - 2.0 MACH NUMBER

Several hours of simulator flying with augmentation OFF, lateral bobweight locked, were accomplished in order to acquaint the pilot with the rudder technique required to stop the sideslip

oscillations using a reverse-wired sideslip indicator. The best technique resulted in applying half left rudder momentarily as the airplane approached zero yaw from the left. (In other words, it was almost a $\dot{\psi}$ technique in that opposite rudder was applied as the yaw rate commenced to increase.)

The airplane was climbed to Mach 2; and while climbing in the vicinity of 50,000 ft., the simulator technique was practiced in the airplane. It was found that the phasing learned in the simulator was satisfactory. It was apparent, however, that less rudder was applied in the airplane in the time required because of a steeper gradient. The writer was satisfied with his performance after two or three minutes of practice, and the climb was continued to 60,000 ft.

4.0 DIRECTIONAL DYNAMIC - 2.4, 2.2, and 2.0 Mn, 60,000 FT.

Rudder pulses were attempted at first to start the directional oscillation. However, the sideslip generated was too small--in the neighborhood of one-half degree--and the aileron-induced oscillation was much better, in that it was easy to induce one and one-half degrees. Data were obtained of oscillations both with augmentation ON and with roll and yaw augmentation OFF. Damping was deadbeat at all three Mach numbers with augmentation ON. With roll and yaw augmentation OFF, near four cycles were required for the oscillation to reach one-tenth amplitude. Fewer cycles were required at Mach 2. Good hands-off data were obtained on all directional dynamic maneuvers where near five cycles were required for the oscillation to stop completely. On the first release with augmentation OFF, the airplane did roll off; but the roll stopped and reversed as the sideslip reversed, resulting in a roll oscillation around level. Consequently, the controls were not grabbed as on the previous flight.

5.0 DIRECTIONAL DYNAMIC - 55,000 FT.

Data were obtained at 2.26 Mn and 2.0 Mn with augmentation ON and roll and yaw augmentation OFF. Damping was the same as described above.

At 2.2 Mn, a release was accomplished once at two and one-half degrees of sideslip; however, the controls had to be grabbed due to excessive bank angle, and the airplane was then leveled without the benefit of roll and yaw FACS. However, in the recovery, the right inlet unstarted, which produced no noticeable transients.

6.0 STATIC DIRECTIONAL STABILITY - 55,000 FT.

Half rudder steady-state sideslip were accomplished at 2.26 and 2.0 Mn with roll and yaw augmentation OFF. On both occasions right rudder required right aileron to maintain wings-level flight--mild negative dihedral effect.

7.0 LONGITUDINAL STATIC

A hands-off trim shot was obtained at 2.4 Mn, 60,000 ft., and the airplane was decelerated to 2.2 Mn where essentially no force was required to stabilize at this Mach number.

Then, after performing the directional dynamic test, another hands-off trim shot was obtained at 2.2 Mn and a longitudinal static point was obtained at 2.0 Mn, 60,000 ft., where near seven pounds of push force was required to stabilize. Both points were accomplished with the inlets started at a shock position of .6 SPR.

8.0 HANDLING QUALITIES, WINGTIPS FULL DOWN - .9 MN, 32,000 FT.

With the wingtips full down, the airplane demonstrated very slight negative--almost neutral--dihedral effect. Also, data were obtained of a directional dynamic test with the yaw augmentation OFF. The airplane was very stiff directionally and gave one the impression of a mild rate oscillation or snaking effect. No difficulty was encountered in flying the airplane; however, the ailerons seemed sensitive and snappy. No longitudinal problems were encountered in flying the airplane with 45,000 pounds of fuel remaining.

9.0 AIRSTARTS

The #1 engine airstarted successfully at .85 Mn, 16,000 ft. The engine started as soon as the airstart switch was turned on (the throttles had been in IDLE for approximately forty-five seconds prior to turning the airstart switch ON).

10.0 LONGITUDINAL SENSITIVITY - .85 MN

While setting up for the above airstart, an 180-degree turn was accomplished near 14,000 ft., and it was noticed that very little force was required to hold 1.5 G. The CG was well aft, as tank #1 was empty and the total fuel was 28,000 pounds with 23,000 pounds in the sump. This stick force per G was surprisingly light and should be investigated; also, the airplane was very sensitive in level flight.

11.0 AIRSPEED PACER CALIBRATION

The following airspeed pacer points were accomplished with the windshield down and the wingtips at one-half:

AIRSPEED-KIAS			ALTITUDE-FT.		
VSI	Round Dial	Pacer	VSI	Pacer	Mn
331	330	319	--	--	.96 (approx.)
317	315.5	305	35,470	34,500	.925 (approx.)
304	302	--	34,980	34,200	.885 (exact)

12.0 BRAKE FADE

Near the end of the landing roll, with approximately 1500 ft. of runway remaining, almost full brake pedal was applied to increase the deceleration from 30 knots. Brake pedal travel from one-half to near full travel appeared not to increase the deceleration. The brakes appeared to fade as the deceleration did not increase. Pedals were relaxed near 10 knots to prevent grabbing.

13.0 CONCLUSIONS

1. The bank angle was overcontrolled from 2.0 to 2.5 Mn with roll augmentation off; and with yaw augmentation off, the resulting directional oscillations were divergent.

2. Rudder phasing technique perfected on the simulator was satisfactory when applied to the airplane, and this rudder technique had to be used on several occasions to prevent divergent directional oscillations, if one continued to "fly" the ailerons.

3. Airplane rudder pedal gradient much steeper than that felt on simulator.

4. Directional oscillations above 2.0 Mn were difficult to generate using rudder only.

5. Directional dynamic stability was satisfactory at 2.0 and 2.4 Mn--damping to one-tenth amplitude in four cycles.

6. Longitudinal static (stick free) stability was neutral from 2.2 to 2.4 Mn and slightly negative from 2.0 to 2.2 Mn, 60,000 ft.

7. Airstarts were satisfactory at .85 Mn, 16,000 ft.

8. Near .85 Mn, 14,000 ft. at 23.7 percent CG, the airplane was very sensitive longitudinally and required special effort and concentration to prevent exceeding G limits with augmentation ON.

14.0 DISCREPANCIES

1. Right instrumentation Cool No. 1 light inoperative.
2. Copilot rate of climb stuck at 5500 FPM down at altitude.
3. Drag chute late incoming out.

V H Shepard

V. H. Shepard
Pilot

HANDLING QUALITIES QUESTIONNAIRE

Flight 1-45 Shepard Configuration Wingtips - 65° Lateral Bobweight locked

LATERAL-DIRECTIONAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Heading, Bank Angle	2.4/60,000'	FACS ON	3	Lateral bobweight locked
		FACS OFF	5-1/2	Rudder had to be used occasionally to prevent directional oscillations from becoming divergent. The rudder phasing was not straight forward and required special training.
MANEUVERABILITY - Ability to change: Heading, Bank Angle	2.4/60,000'	FACS ON	3-1/2	
		FACS OFF	5	Airplane appeared somewhat easier to ply once a turn was established in that the ailerons away from center resulted in less overcontrol.
RESPONSE TO TURBULENCE				
OVERALL LATERAL-DIRECTIONAL RATING	2.4/60,000'	FACS OFF	5-1/2	
CONTROL HARMONY			5	

Van Shepard

8

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R-66-4-4
Edwards AFB

PILOT COMMENTS

XB-70A FLIGHT 1-46 25 APRIL 1966

INTRODUCTION: The flight was scheduled for 0900 hours and brake release occurred at 0853. Flight objectives were directional stability at 2.0, 2.4 and 2.5 Mach, longitudinal static stability at 2.5, 2.4, 2.2 and 2.0 Mach, engine airstarts at 1.1, .90 and .80 Mach and airspeed calibrations with a T-38 pacer airplane. All tests were completed as scheduled except the .90 and .80 Mach airstarts and four of the low altitude airspeed calibration points. A sonic boom was flown over the Edwards ground station at 2.0 Mach, 50,000 feet.

PREFLIGHT AND TAXI: All engine starts were normal and all starting EGT's were under 600 degrees C. The brake operation was smooth during the taxi out to runway 22. Runway 22 was selected because of a 15 knot wind from the 220 degree direction.

TAKEOFF AND CLIMB: Total fuel remaining two minutes prior to brake release was 256,000 pounds. The takeoff was made using max A/B and with FACS on. The acceleration was timed from brake release and looked very good. At the computed time of 36 seconds to reach 150 knots (151 indicated), the indicated speed was 155 knots. Lift off was at approximately 209 knots. When the landing gear was selected up, it moved very slowly. Fifty seconds were required for the gear to go up and the doors to close. The flaps were retracted, the wing tips lowered, and the airplane was accelerated and climbed to the first test condition. The #4 nozzle area was reported by the chase pilot as being a redder color than the other nozzles. All instruments in the cockpit had normal readings. Shortly after going supersonic, a small right yaw indication of about one degree occurred as it has on most flights. The yaw was not trimmed out in an attempt to see if it would return to zero at some higher speed. At approximately 1.3 Mach, the yaw had decreased to near zero. An obvious conclusion would be to assume that the yaw indicating system provided erroneous indications in the low supersonic speed regime. This could be partially true, however, the airplane flew like the yaw indications were correct. There was a very definite directional trim change and not just a yaw indicator error. The acceleration was continued to the first test condition.

DIRECTIONAL STABILITY AT 2.0, 2.4 and 2.5 MACH:

The airplane exhibited excellent natural lateral directional dynamic stability with the roll and yaw augmentation off at 2.0 Mach, 50,000 feet; at 2.0 Mach, 60,000 feet; at 2.4 Mach, 60,000 feet, and at 2.5 Mach, 62,000 feet. A directional oscillation of 1 to $1\frac{1}{2}$ degrees of yaw could be easily

excited by manipulating the ailerons, but by releasing the controls it would damp to less than one-half amplitude within two cycles. It was extremely easy to couple with the directional oscillations and actually feed them by overcontrolling the ailerons. This was especially true when the wings were near level. During turns, the problem was not so apparent. However, any time a directional oscillation was excited it could be stopped by releasing the controls or by a concentrated effort to stop the small aileron movements which were partially caused from the high lateral control sensitivity near the neutral position. After a few minutes of practice with the roll and yaw augmentation off, the lateral overcontrolling ceased to be a problem but it could be a problem under emergency conditions where the pilot had his attention devoted to other things. Several continuous turns were accomplished with the roll and yaw augmentation turned off and the airplane flew almost as easily as with the augmentation on. Bank angles up to 30 degrees were easily held in prolonged turns with a maximum of $\pm \frac{1}{4}$ degree of yaw being experienced. No lateral overcontrolling tendency in turns with the roll and yaw FACS off was noted. This was true even in the light to moderate turbulence that was encountered up to 62,000 feet of altitude.

A descent at 2.0 Mach from 60,000 feet down to 50,000 feet was easily accomplished with the roll and yaw FACS off.

The airplane showed negative dyhedral effect as it always produced adverse yaw when the lateral control was moved. During a $1\frac{1}{2}$ degree steady state sideslip at 2.5 Mach, 62,000 feet, with $\frac{1}{2}$ right rudder, 10 degrees of right aileron was required to stabilize. A rudder application always caused a rolling tendency in the opposite direction.

The lateral directional stability was much the same at 2.0, 2.4 and at 2.5 Mach. It was not possible from a qualitative standpoint to detect any difference in the airplane stability from one speed to the next in that speed range.

The standby roll trim was used exclusively for lateral trim on this flight to prevent the airplane from being out of trim when FACS was turned on or off. This method worked excellently and no trim transients were experienced when engaging or disengaging FACS.

The lateral directional stability appeared to be very similar to that experienced on the simulator except for the rolling tendency. The simulator would frequently roll to an excessive bank angle during control manipulations, whereas, the airplane seemed to have more roll damping and the bank did not

tend to become excessive. This was probably due, in part, to the better visual cues in the airplane but was certainly not totally due to that.

LONGITUDINAL STATIC STABILITY FROM 2.0 to 2.5 MACH: The airplane was trimmed at 2.5 Mach, 62,000 feet, with the FACS on and a trim shot taken. The throttles were retarded until the airplane slowed to 2.4 Mach and then the throttles were reset to the original setting and another trim shot recorded. The same thing was done at 2.17 Mach, 2.06 Mach and at 2.0 Mach. The curve appeared to be completely flat or the curve was so shallow that the trim change was hidden within the friction band. There was no elevator trim change required to stabilize at any of the speeds between 2.5 and 2.0 Mach. Each time the power was decreased to change the speed, there was a mild nose down trim change, however, as soon as the power was reset the trim change disappeared.

SUPERSONIC AIRSTART: One airstart was accomplished at 1.08 indicated Mach at 29,600 feet. After the engine was shutdown the throttle was set into the idle position for several minutes prior to turning on the airstart switch. The engine lit off in less than 5 seconds after the airstart was turned on and then increased speed rapidly to idle RPM.

AIRSPEED CALIBRATION WITH T-38 PACER: After leveling at 32,000 feet, a T-38 pacer airplane was flown in formation with the XB-70 to calibrate the airspeed system. The points were all flown with the gear and flaps up and the wing tips at 25 degrees. They are listed below:

PILOT'S MACH	PILOT'S VSI AIRSPEED	STANDBY AIRSPEED	PILOT'S VSI ALTITUDE	PACER AIRSPEED	PACER ALTITUDE	PACER OAT-DEGREES C
1.0	373.5	376.0	31,860	361.0	30,480	-4°
.991	371.0	373.0	31,900	357.0	30,520	-4.5°
.982	365.0	367.0	32,030	353.0	30,780	-6°
.970	359.5	360.5	32,100	348.0	30,900	-7.5°
.960	356.5	357.5	32,010	345.0	30,890	-8°
.947	350.0	350.0	32,070	339.0	31,020	-10°

GROUND EFFECT TEST: The airplane was established on the final approach in the landing configuration at an indicated speed of approximately 245 knots. The power was set to give approximately 600 feet per minute rate of descent. The angle of attack was approximately 5 degrees and as the airplane entered the ground effect area, the angle of attack was held as constant as possible. The airplane had decelerated to 217 knots and the wheels were within two feet of the ground when power was advanced. The ground effect definitely cushioned the airplane and a very gentle touchdown would have occurred if the throttles had not been advanced.

APPROACH AND LANDING: Following the ground effect test, the airplane remained in the pattern and was landed with FACS on and about 25,000 pounds of fuel remaining. All three chutes fully deployed. The airplane was braked to a stop on the runway and one small brake chatter occurred when decelerating below approximately 30 knots. A slight brake fade was noted just before stopping the airplane. As the airplane moved forward after the stop, the #7 tire blew out. The airplane was taxied slowly from the runway and shut down.

CONCLUSIONS:

1. There was a slight directional trim change between 1.0 Mach and 1.3 Mach.

2. The airplane had excellent natural lateral directional dynamic stability from 2.0 Mach thru 2.5 Mach.

3. The pilot can overcontrol the ailerons and induce lateral directional oscillations which reduce the apparent stability to an unsatisfactory level. Pilot experience and practice can overcome the overcontrolling tendency, although, it could reappear under conditions of emergency or strain.

4. The standby roll trim should be used for lateral trimming when the flight plan calls for turning the FACS on and off.

5. The longitudinal static stability curve is very flat from 2.5 Mach down to 2.0 Mach.

6. A slight brake fade was noted near the end of the landing roll.

MAINTENANCE DISCREPANCIES:

1. Both main landing gear slow to retract.

2. Left #2 unstart light blinked on and off at 2.28 Mach.

3. Roll augmentation disengaged and would stay engaged only 5 seconds for each re-engagement.

4. Pilot and copilot rate of climb jumped intermittently while flying at 50,000 feet.

5. The #7 tire blew out as the airplane began to move forward following a stop on the runway.

RECOMMENDATIONS:

1. Correct the maintenance discrepancies noted.

2. Continue to investigate the airplane's handling qualities at high speed.

3. Insure that each XB-70 pilot has the opportunity to practice "augmentation off" flying.

4. Use the standby roll trim for lateral trimming when the FACS is scheduled to be turned off and on.

5. Investigate the brake fade that was noted on this flight and has been noted several times in the past.

HANDLING QUALITIES: A handling qualities questionnaire is attached.

Fitzhugh L. Fulton

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Pilot

XB-70A No. 001

HANDLING QUALITIES QUESTIONNAIRE

LIGHT 1-46 PILOT Fulton CONFIGURATION Tips at 65°

LONGITUDINAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Airspeed, Altitude, Attitude	2.0/50,000 2.0/60,000 2.4/60,000 2.5/62,000	FACS ON	5	Much effort is required to hold desired altitude. The longitudinal static stability is essentially neutral in this speed range. The lack of adequate instruments for controlling pitch add to this problem
		FACS OFF	--	
MANEUVERABILITY - Ability to change: Airspeed, Altitude, Load Factor		FACS ON	4	Longitudinal forces too high cause pilot effort to be high during turns and during transition from level acceleration into a constant IAS climb schedule
		FACS OFF		
RESPONSE TO TURBULENCE		FACS ON	3	This flight encountered high altitude turbulence and the airplane responded fairly well
RESPONSE TO CONFIGURATION CHANGES		N/A		
OVERALL LONGITUDINAL RATING			4	

LATERAL-DIRECTIONAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY -	2.0/50,000	FACS ON	4	Lateral trim causes excessive directional change. At high speed the heading remains fairly constant. The airplane requires considerable attention to maintain a constant bank angle
Ability to hold: Heading Bank Angle	2.0/60,000 2.4/60,000 2.5/62,000	FACS OFF	4.5	
MANEUVERABILITY -		FACS ON	4	The airplane has good maneuverability; however, it is very easy to couple with the airplane laterally and with the pilot in the loop the airplane can have divergent stability due to the yaw from aileron control input
Ability to change: Heading Bank Angle		FACS OFF	5	
RESPONSE TO TURBULENCE		FACS ON	3	The airplane responds well in moderate turbulence
		FACS OFF	3	
OVERALL LATERAL-DIRECTIONAL RATING			4	
CONTROL HARMONY			4	Lateral forces too light and longitudinal forces too heavy

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #1 (001) PILOT Lt. Col. F. L. Fulton

FLT. NO. 1-46 COPILOT V. H. Shepard

DATE OF TEST 25 April 1966 FLT. TIME 2:07

CHASE AIRCRAFT AND PILOTS

Chase 1 - T38 - 600 Lt. Col. Sorlie/ Col. Cotton

Chase 2 - F4C - 743 Capt. Gentry/Capt. Hoag

Chase 3 - T38 - 194 Major Cuthill

PURPOSE OF FLIGHT

1. Directional Dynamic -2.0, 2.4, and 2.5 Mn
2. Longitudinal Static Stability - 2.0-2.5 Mn
3. Air Start - 1.1 Mn, 30,000 ft.
4. Air Speed Calibration - Pacer Method

1.0 ENGINE START

Engines were started with 265,500 pounds of fuel aboard. All engines started normally in 5.5 minutes.

2.0 TAKEOFF

The brakes were released with 256,000 pounds of fuel remaining and 36 seconds later using maximum after-burner power, 155 KIAS was observed on instrumentation air speed. This acceleration was excellent as the handbook quoted 150 KCAS (151 KIAS) after 36 seconds. The actual temperature was 3° below that used in the handbook computation.

3.0 DIRECTIONAL DYNAMIC

The directional oscillations for the dynamic damping data were induced with the ailerons with roll and yaw augmentation off. Majority of the tests were started from two degrees of sideslip. Data were obtained at 2.4 Mn, 60,000 feet, 2.5 Mn, 62,000 feet, 2.0 Mn, 50,000 and 60,000 feet. The directional damping was satisfactory - damping to less than 1/10 amplitude within three to four cycles. The damping appeared better at Mach 2 than at the higher Mach numbers. Furthermore, the damping also appeared better at 50,000 feet as compared to 60,000 feet, however, the pilot complained that it was harder for him to fly the airplane at 50,000 feet than 60,000 feet at a constant Mach 2.

4.0 STATIC DIRECTIONAL STABILITY - 2.5 Mn, 62,000 Feet

A full rudder sideslip was accomplished where 1-1/2° of sideslip was observed and 10° of right aileron was required to maintain wings level with the right rudder sideslip.

5.0 LONGITUDINAL STATIC STABILITY - 62,000 Feet

The airplane was trimmed up with hands off at 2.5 Mn with the inlet normal by holding a constant shock at .65 SPR. Data was obtained at 2.4 Mn and 2.08 Mn where zero force was required to stabilize the Mn. The same shock position and throttle angle were used at all Mach numbers.

6.0 AIR START - 1.1 Mn, 30,000 Feet

The #1 engine was air started at 1.08 Mn, 29,600 feet and the engines started immediately as the air start switch was turned on. The #1 engine throttle had been in idle for approximately one minute prior to the air start switch ON.

7.0 AIRSPEED CALIBRATIONS - Wing tips 1/2, nose ramp down

The following pacer airspeed points were obtained in near level flight:

AIRSPEED KIAS				ALTITUDE - FT.		B-70 Mn
VSI	INST.	C/N	PACER	VSI	PACER	
373.5	376	5550	361	31,860	30,480	1.0
371	373	5661	357	31,900	30,520	.991
365	367	5853	353	31,970	30,780	.982
359.5	360.5	5976	348	32,100	30,900	.97
356.5	357.5	6068	345	32,010	30,890	.96
350	350	6365	339	32,070	31,020	.947

8.0 CONCLUSIONS

1. Directional damping was satisfactory at 2.5 Mn, with roll and augmentation off - damping to 1/10 amplitude within 3-4 cycles.

2. Longitudinal static (stick free) stability was essentially neutral from 2.0 to 2.5 Mn at 62,000 feet.

3. The pilot remarked that the airplane was easier to fly at Mach 2 (lateral directionally) 60,000 feet than Mach 2, 50,000 feet, even though the directional damping appeared better at 50,000 feet.

4. Airstart on #1 engine was satisfactory at 1.08 Mn, 30,000 feet.

9.0 DISCREPANCIES

1. Both main landing gear slow to retract.

2. LH #2 unstart light blinked on and off at 2.28 Mn.

3. Roll augmentation disengaged and would stay engaged only five seconds for each reengagement.

4. Pilot and copilot rate of climb jumped intermittently around 50,000 feet altitude.

V. H. Shepard
Copilot

PILOT COMMENTS

XB-70A FLIGHT 2-36 26 APRIL 1966

INTRODUCTION: The flight was rescheduled for 1130 hours after slipping from 0900 because of mechanical problems. Brake release occurred at 1128. Flight objectives were essentially the same as those flown on Flight 1-46 and were to allow a comparison of high speed handling qualities between airplane #1 and airplane #2. The tests scheduled were lateral directional stability at 2.0 Mach, 2.4 Mach and 2.6 Mach, longitudinal static stability from 2.6 Mach down to 2.0 Mach, and airspeed calibrations with a T-38 pacer airplane. All tests were completed except one stability run at 2.0 Mach, 50,000 feet, which was canceled after the #2 ADS low oil pressure warning light came on and the windmill brake was applied to that engine. The maximum speed and altitude attained was 2.65 Mach and 65,500 feet. Flight time was two hours and five minutes.

PREFLIGHT AND TAXI: All engine starts were normal except that the initial EGT peaks on engines #2 and #5 were 610 to 620 degrees C. After stopping near the runway, the left brake did not release completely when forward motion was started again. It seemed to hang up momentarily and produced a slight chatter. Runway 22 was selected for takeoff because of a strong wind from 290 degrees at approximately 20 knots velocity.

TAKEOFF AND CLIMB: Total fuel remaining at brake release was 262,000. The brake release was very rough and shook the airplane considerably. The takeoff was made using max A/B and overspeed RPM since the temperature was 85°F. The acceleration time check was computed as 19.5 seconds from 70 to 150 knots. The speed was 3 knots low, but still within the allowable tolerances. The lift off came at approximately 215 knots. FACS was engaged prior to brake release and improved the handling qualities in the moderate turbulence encountered immediately after takeoff and during the initial climb. After retracting the landing gear and flaps and lowering the wing tips to 25 degrees, a normal 425 knot/.95 Mach climb to 32,000 was completed.

ACCELERATION AND CLIMB: The airplane was accelerated level at 32,000 feet to 575 knots and then accelerated and climbed to the first test condition of 2.0 Mach, 50,000 feet. The windshield ramp was raised near 1.0 Mach and the tips were lowered to 65 degrees at 1.35 Mach. The AICS operated normally with bypass opening occurring between 1.4 and 1.45 Mach. The openings were 575 square inches left and 535 right.

DIRECTIONAL STABILITY AT 2.0, 2.4 AND 2.6 MACH: The airplane exhibited excellent natural lateral directional dynamic stability with the roll and yaw augmentation off at 2.0 Mach, 50,000 feet; at 2.0 Mach, 60,000 feet; at 2.4 Mach, 60,000 feet and at 2.6 Mach, 65,000 feet. There appeared to be no appreciable difference in the stability characteristics from 2.0 Mach to 2.6 Mach. The characteristics appeared, from a qualitative standpoint, to be much the same as those found on airplane #1 although this airplane may have slightly better damping characteristics since it appeared that a larger control input was required to produce the same size yaw excursions. This airplane was also noted to have a slightly greater rolling tendency than did airplane #1 when released after a lateral directional disturbance. Aileron pulses were used to excite lateral directional oscillations. At all the conditions tested, positive directional dynamic stability was noted and the airplane would damp out when the controls were released. The oscillations were under one-half amplitude within two cycles. It was easy to couple with the oscillations and by feeding the oscillations arrive at a neutral or possibly slightly divergent condition. As on airplane #1, this appeared to be most prevalent when the wings were near level. A properly timed quick rudder input would reduce the magnitude of the yaw oscillation to almost zero. The airplane was flown for seven minutes continuous at approximately 2.4 Mach with the yaw and roll augmentation off. The yaw excursions were easily kept within $\pm \frac{1}{4}$ degree even during a 90 degree turn at 25 to 30 degrees of bank.

The airplane showed negative dyhedral effect during a FACS on sideslip at 2.6 Mach, 65,000 feet. The yaw angle was 1.2 degrees right with $\frac{1}{2}$ right rudder and about 5 degrees of right aileron. A release from sideslip with all FACS on had almost deadbeat damping.

The standby roll trim was used for lateral trim to prevent an out of trim condition when the FACS was turned on or off. Trim transients were negligible and this method is recommended when FACS is scheduled to be cycled on and off.

At 2.6 Mach, 65,000 feet an audible rumble was heard and felt when the yaw angle reached $\frac{1}{2}$ degree or more. This was thought to emanate from the inlet area.

LONGITUDINAL STATIC STABILITY FROM 2.0 TO 2.6 MACH: With FACS on, the airplane was trimmed at 2.6 Mach, 65,000 feet, and then decelerated to 2.25 Mach, 2.19 Mach and 1.99 Mach. The airplane was retrimmed at each speed and a data shot taken. The curve was very flat as the trim change was small. The elevator pull force required to stabilize at each point prior to retrimming was only 3 to 5 pounds.

TURBULENCE: Turbulence was light to moderate for more than 30 minutes during the climb and acceleration. The turbulence began around 42,000 feet and continued until the airplane was above 63,000 feet. For several minutes around 60,000 feet, the turbulence was continuously moderate and occasionally heavy. This turbulence slowed the acceleration rate and was uncomfortable in the cockpit. At one time near 62,000 feet, the airplane encountered a very sharp disturbance which momentarily buffeted the airplane and caused the speed to jump immediately from 2.51 Mach to 2.56 Mach and then rapidly drop back to 2.51 Mach. This was probably some type of strong vertical shear in the air mass. Its affect on the airplane was very pronounced.

ADS WARNING LIGHT ON ENGINE #2: While attempting to set up for the 2.0 Mach, 50,000 feet, stability tests, the ADS warning light and the #2 engine warning light illuminated. The #2 throttle was retarded and after completing the emergency procedures, the engine was shutdown. It was quickly apparent that the airplane could not be decelerated rapidly enough to get the engine RPM below 22% within five minutes, therefore, the engine windmill brake was applied at 1.63 Mach, 51,000 feet. The engine speed decelerated from 68% windmill RPM at 1.63 Mach to zero RPM at 1.40 Mach in approximately 75 seconds.

AIRSPEED CALIBRATION WITH T-38 PACER: A T-38 pacer airplane was flown in formation with the XB-70 to calibrate the airspeed system. The points were all flown with the gear and flaps up and the wing tips at 25 degrees. They are listed below:

Mach Pilot/Copilot	VSI Airspeed Pilot/Copilot	Standby Airspeed	VSI Altitude Pilot/Copilot	Pacer Airspeed	Pacer Altitude	Pacer OAT-Degrees C
1.08/1.075	408/407	410	31,950/31,960	405	31,140	+3
- /1.055	399/398	402.5	31,820/31,840	395	30,950	-1
.952/ .95	353.5/352	354	31,970/31,980	353	30,930	-10
.94/ .94	347.5/346.5	348	32,120/32,130	343	31,100	-12
.92/ .92	339.5/338	338.5	32,100/32,120	330	31,220	-13
.895/.895	329/328	327.5	32,070/32,080	320.5	31,250	-14

APPROACH AND LANDING: The wind direction was reported as being 80 degrees from the right on runway 22 with a velocity of 20 knots gusting to 26 knots. With 25,000 pounds of fuel remaining, the flare speed was computed as 186 knots. During the last portion of the final, the crab angle appeared to be 6-8 degrees. The wing down method of cross-wind landing was used. About $\frac{1}{4}$ right aileron and 1/3 left rudder was required. A smooth touchdown resulted and the right landing gear touched down first, as planned. It had been planned to engage the nose wheel steering prior to chute deployment because of the strong cross-wind. The nose

The nose gear was lowered and steering engagement attempted, however, it was very slow to engage. Therefore, the chute was deployed prior to nose steering engagement. The steering finally engaged and the airplane was braked to a stop. A slight skid occurred at 25 knots on the right brake and even after the pedals were released it continued to chatter for a few seconds.

SYSTEMS:

1. The hydraulic system performed satisfactorily, however, the hydraulic warning system was almost valueless since 4 of the 6 utility pump warning lights were illuminated during most of the flight.

2. The AGPS compass heading seemed to lag behind during turns and made it difficult to stay on the desired track.

3. The AICS operated satisfactorily throughout the flight. The left inlet automatically started at 2.03 Mach and the right started at 2.13 Mach.

4. The environmental control system provided satisfactory cooling to equipment and to crew members. Excessive water was exhausted out the #4 and #7 drain holes underneath the fuselage just forward of the inlets. This water formed large ice buildups which fell from the airplane at lower altitudes. Some of the ice entered the inlets and could cause engine damage.

CONCLUSIONS:

1. The airplane had excellent natural lateral directional dynamic stability from 2.0 Mach thru 2.6 Mach with the roll and yaw augmentation off.

2. Overcontrol of the ailerons can induce lateral directional oscillations which reduce the apparent stability to an unsatisfactory level. Experience and practice can overcome the overcontrolling tendency.

3. This airplane had similar lateral directional stability characteristics to airplane #1 in the speed range from 2.0 Mach to 2.6 Mach. This airplane probably has slightly better directional damping and slightly less roll damping than does airplane #1.

4. The airplane experienced continuous light to moderate turbulence at high altitude for more than 30 minutes.

5. The airplane's cross-wind landing characteristics were very good.

6. The utility hydraulic warning light system should be made more reliable.

7. The ice buildup under the fuselage should be eliminated to prevent possible engine damage.

MAINTENANCE DISCREPANCIES:

1. The #2 engine warning light stayed on after a warning light test.

2. The left brake didn't release immediately on takeoff.

3. Pilot's clock inoperative.

4. The windshield ramp was slow to extend in flight.

5. TACAN would not lock on Channel 92 or Channel 94.

6. The #1 UHF radio reception and side tone were intermittent.

7. Yaw #1 augmentation kicked off numerous times.

8. AGPS heading lags following a turn.

9. ADS #2 light came on at 2.0 Mach, 50,000 feet.

10. The #2 engine windmill brake was applied at 1.63 Mach, 51,000 feet.

11. Nose wheel steering slow to engage after landing.

12. The #1 engine had 7 mils turbine vibration at 98% RPM.

13. APX-46 (IFF) had partial output.

14. The #5 utility hydraulic pump status light stayed on during flight.

15. Right brake slow to release during taxi.

16. Holding brake released two times without pilot depressing pedals.

17. Ice formed aft of holes 4 and 7 under fuselage.

RECOMMENDATION:

1. Correct the maintenance discrepancies noted.

2. Continue to investigate the airplane's high speed handling qualities.

3. Redesign the utility hydraulic warning light system to be more reliable.

4. Discontinue exhausting water in an area that can cause ice to build-up ahead of the inlets.

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Pilot

COPILOT COMMENTS

XB-70A FLIGHT 1-47 27 APRIL 1966

INTRODUCTION: The flight was airborne at 1310 hours. Flight objectives were a flutter point at 1.54 Mach (620 KIAS), 3,000 feet; lateral directional stability at 2.0, 2.4 and 2.6 Mach; engine power modulations at 2.6 Mach, airstarts at .8, .9 and 2.4 Mach and subsonic airspeed calibration with a T-38 pacer at 15,000 feet. None of the original flight objectives were accomplished because the #6 ADS low oil pressure warning light illuminated around 1.5 Mach and the engine was shut down and the windmill brake applied. Alternate tests were accomplished which included Cooper ratings of subsonic maneuvers and stability at subsonic speeds. The maximum speed and altitude was 1.5 Mach and 31,000 feet. Flight time was 2 hours and 41 minutes.

PREFLIGHT AND TAXI: All engine starts were normal except #3 which failed to rotate using the normal start method and on the first soft start attempt. On the second soft start attempt, the engine rotated and was started satisfactorily. The ambient temperature was around 80 degrees and during taxi out the cockpit was uncomfortable since no cabin cooling is available from the "aux cool" system. Both attitude indicators were in a one degree right wing down position during the taxi out, but righted themselves prior to takeoff.

TAKEOFF AND CLIMB: Total fuel remaining four minutes prior to brake release was 255,500 pounds. The brake release was smooth and the acceleration check was good using max A/B and overspeed RPM. The speed was 3 knots lower than aim speed but still within allowable tolerances. The lift off was at approximately 215 knots and FACS were engaged for the takeoff. The pilot commented that FACS improved the handling characteristics in the light to moderate turbulence that was encountered at low altitude. After retracting the gear and flaps, the tips were lowered to 25 degrees and a normal 425/.95 climb established.

ACCELERATION: After leveling at 30,000 feet, an acceleration to 1.54 Mach (620 Knots) was started to obtain a flutter point. The acceleration time appeared slow and about 5 minutes were required to go from 1.0 Mach to 1.5 Mach. Just as the aim speed was approached, the #6 engine warning light and the ADS warning light illuminated.

ADS WARNING AND OPERATION OF #6 WINDMILL BRAKE:

When the #6 ADS warning occurred, the right bypass was opened to 700, RPM lockup released and the #6 throttle retarded to idle and then cut off. All other throttles were reduced to military power or slightly less to slow down. The #6 engine windmill speed was initially 66% RPM and slowly decreased as the airplane speed decreased. It was apparent that the RPM could not be lowered to 22% within 5 minutes but Data Control advised that the windmill brake should not be applied since the engine speed was decreasing at a satisfactory rate. It was down to 32% in four minutes and down to 23% in six minutes. The engine RPM had been slowed to 19.5% at 300 knots, 18,000 feet after approximately 10 minutes. Data Control then advised to apply the windmill brake and the engine RPM versus time was as follows: 19.5% when brake applied, 16% in 30 seconds, 12% in 38 seconds, 7% in 49 seconds, 2% in 60 seconds and stopped in 63 seconds.

The airplane encountered light to moderate airframe buffet as it was slowed to subsonic speed at around 30,000 feet. A slight descent was required during the turn toward Edwards after the ADS warning light illuminated. The gross weight was apparently too high for subsonic speed at 30,000 feet with less than afterburner power.

MANEUVERS - COOPER RATED:

A series of maneuvers were accomplished at .8 Mach, 20,000 feet and than a Cooper rating was assigned to each maneuver. The maneuvers accomplished and the techniques used were:

Climb and Descent

1. Trim on speed and altitude.

2. Climb 5,000 feet at constant Mach, then level off.

3. Descend to original altitude and level off.

Coordinated Turn:

1. Trim on speed and altitude.

2. Bank 30 degrees and turn 30 degrees.

3. Roll out and stabilize.

4. Return to original heading in same manner.

Aileron Turn: Use same procedure as Coordinated Turn except do not use rudder.

Run #	Maneuver	Wing Tips	FACS	Rating	Comments
C-1	Climb & Descent	Up	Off	3.5	
C-2	Coordinated Turn	Up	Off	4	
C-3	Aileron Turn	Up	Off	4	1 Degree Yaw
D-1	Climb & Descent	Up	On	3	
D-2	Coordinated Turn	Up	On	3	$\frac{1}{2}$ Degree Yaw Max
D-3	Aileron Turn	Up	On	3	1 Degree Yaw Max
F-1	Climb and Descent	25°	On	2	Easy to do
F-2	Coordinated Turn	25°	On	3	
F-3	Aileron Turn	25°	On	3	
E-1	Climb & Descent	25°	Off	3	
E-2	Coordinated Turn	25°	Off	3	
E-3	Aileron Turn	25°	Off	3	

The run numbers shown above correspond to those on the test card.

STABILITY TESTS AT 25,000 FEET:

The airplane was stabilized at .80 Mach for longitudinal stability tests with FACS on and the speed stability switch on. When the speed was increased to .90 Mach, approximately 3 pounds push force was required to stabilize. After decelerating to .70 Mach, the force required to stabilize was approximately 3 pounds of pull.

With the FACS off, the airplane was stabilized again at .80 Mach. After increasing speed to .90 Mach, the airplane was stabilized hands off without changing the trim. The trim change was within the friction band. The stabilized point at .70 Mach was almost within the friction band and only a very light pull force was required. A light hum was noted in the noise level when the speed dropped below 300 knots.

A wind up turn at .8 Mach with FACS off required about 15 pounds of pull force at 1.4 "g". With FACS on, the pull force was near the same or slightly less.

A stick fixed longitudinal dynamic pulse at .8 Mach with FACS on was deadbeat. With FACS off, the airplane damped in one cycle.

With FACS on at .8 Mach, a $\frac{1}{4}$ aileron roll to the right without using the rudder produced 2 degrees of left yaw. With FACS off, another $\frac{1}{4}$ right aileron roll produced 2 degrees left yaw during the roll and 2 degrees right yaw in the recovery.

FORMATION FLYING: During the return to the field, the XB-70 was flown on the wing of the B-58 for the first time. Speed during the formation flying was 300 to 350 knots. The airplane controllability was good and no adverse characteristics were noted except when the ailerons were used excessively. Power response was excellent. Visibility was marginal when flying from across the cockpit and there was an excessive amount of windshield structure in the way at either position. The nose ramp was raised for a few moments while the left seat pilot was flying the left wing position. When the nose ramp was extended $\frac{1}{2}$ or more, the formation visibility was completely lost. The nose ramp was then lowered and the two airplanes were flown over the field in formation with the B-58 in the lead position.

APPROACH AND LANDING: Two low approaches (one for each pilot) were made and then were followed by a full stop landing. The landing fuel was 38,000 pounds and the flare was computed as 190 knots. Touchdown was at 173 knots on the tape indicator. Two chutes opened completely and one was about $\frac{1}{2}$ inflated. The left landing gear strut was flat and the airplane felt rough when rolling down the runway.

CONCLUSIONS:

1. Primary mission objectives could not be accomplished.

2. The windmill brake worked excellently.

3. The airplane has reasonably good formation characteristics.

4. The cockpit was very warm during taxi out.

MAINTENANCE DISCREPANCIES:

1. The #6 ADS oil lite came on in flight.

2. The #6 windmill brake was applied at 21% engine RPM.

3. The #4 A/B would not lite in flight.

4. Flap pressure lite on for 2-3 minutes after flaps were extended.

5. Left hand landing gear strut went flat on landing.

6. Utility #1 gauge read approximately 400 psi high (4600 when T/M showed 4200).

RECOMMENDATIONS:

1. Correct the maintenance discrepancies noted.

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Copilot

COPILOT REPORT

XB-70A No. 62-207 30 April 1966

Flight 2-37

INTRODUCTION

The objective of this flight was to sustain Mach 3 for 30 minutes. The flight was delayed one day because the local Mach transducer for the left inlet failed causing the throat to drive to minimum width, and the discovery of two cracks in the left forward main wheel brake housing.

Pilot - Mr. Al White	Takeoff Time - 0806
Copilot - Colonel Joseph Cotton	Total Flight Time - 2+16

SUMMARY

Failure of the nose gear to retract properly required a complete cancellation of the mission objective. A shorted wire in a junction box, on top of the right main gear bogie, blew control circuit breakers and prevented gear retraction. The nose gear door and wheel mechanical jam was due to the loss of hydraulic pressure in the gear system and airloads on both gear and door. The shorted wire had been lodged between the junction box lid and the edge of the box, probably for many removals. An overlapping bracket prevents direct visual inspection and makes it necessary to slide the lid in place. The design invites installation error.

The nose gear extension procedure was developed by a great supporting team of engineers and technicians. In this particular case there was plenty of fuel, thus more than ample time to devise the emergency plan. System changes, emergency equipment, and plans should be made to handle equally serious gear or wing fold emergencies in less than half the time. A portable television camera in the cockpit and a viewing capability in the control room would have been ideal. The present nose gear emergency extension system is not sufficiently positive and independent to provide adequate extension insurance.

PROPOSAL ?

Two landing gear control circuit breakers located in the electronics bay were found blown on postflight. They were probably blown when the electrical short occurred. Concern for the nose gear extension and discussions on lake bed vs runway landing occupied time and attentions and neglected thought to resetting these breakers. This should have been attempted and must be a check in such future emergencies. Brake pressure application, preventing wheel and tire spin-up, has been very costly and now occurred twice --- now is the time to add mechanical return springs to the actuators to more positively insure the brakes are off when the brake pedals are not depressed.

PREFLIGHT, ENGINE START AND TAXI

The four new brakes, axles, and brake housings were coated with a new dry lubricant. The four rear tires were new.

The pilots were strapped in at 0650, fuel totalizer 276,500 lbs. The first five engines started normally but No. 2 engine failed to motor properly. By jumping the speed switch and holding the start switch engaged during initial rotation the engine was successfully started. Engine start required an unusual 22 minutes. The hydraulic systems were serviced to near 165% fluid levels.

We initiated taxi for runway 04 at 0740 with a fuel totalizer of 268,000 lbs and a surface wind from 200° at 2 knots. The toe operated automatic brakes were nearly as smooth and chatter proof as the hand operated manual brakes on 001. I was greatly impressed with the ease and comfort of the stop made for the pre-takeoff inspection. The ground crew inspection revealed no abnormal conditions. Prior to lineup the fuel total was 264,000 lbs. Predicted takeoff for 65°F was 19.5 sec acceleration (70 to 150 KIAS), rotation 182, takeoff 212 in 9,300 ft. Heading was 44° when aligned with the runway.

TAKEOFF AND CLIMB

The FACS on takeoff was made without use of engine overspeed. Brake release at 0806 in minimum afterburner, was symmetric and comfortable. Brake release fuel totalizer was 260,000 lbs. Al called 70 KIAS on his CADS airspeed, I called out a stopwatch time after 19-1/2 secs and he called 154 KIAS. Rotation airspeed on the standby indicator was 185 with an estimated takeoff speed of 202 KIAS.

NOSE GEAR MALFUNCTION

Approximately 16 seconds after breaking ground, with utility system pressures and quantities normal, I raised the gear handle. Some 5 to 7 seconds after raising the handle we heard a muffled bang and felt a thump in the airframe. I put the gear handle down at counter number 358. The main gear indicators were green, the nose gear green light was out, and the red light was illuminated in the gear handle. Major Pete Knight in T-38 chase reported the nose gear door did not open far enough and when the nose gear retracted the door was jammed between the two nose gear wheels. He reported the nose gear was about half way retracted and the left nose gear tire blown (See attached photo).

Fitz and Shep pulled in closer with the heavy TB-58 and reported both main gear doors open and not pressurized. Both bogies were in their proper nose up position. The utility systems were normal. The

main objective was to get the nose wheel door out of the way so the gear could be extended. While the systems engineers devised their plan we established maximum endurance with flaps down, in military power near 260 KIAS and 9,000 ft. Chase reported some vapor coming from the nose wheel well, the fluid levels were holding near normal.

While the electrical plan was being devised speed was reduced to 225 KIAS at 9,000 ft, to reduce airloads and the gear electrical emergency extend switch was placed from NORMAL to ALL GEAR DOWN. This uses the utility #2 system. The nose gear moved down about 3 inches and stopped, again indicating to chase that the door was the mechanical restraint. The main gear doors appeared to be powered and held firmly in place. The flaps were raised, speed increased to 285 KIAS and the airplane was yawed out to 4° left but there was no change in the door or gear position. The electrical emergency switch was returned to NORMAL, the gear moved up 6 inches and again came down 3 inches when the same switch was placed down again. A 3° yaw right was also ineffective. It was becoming more apparent that the door and gear were being held in the mechanical interlock condition by airloads and the only way to get the gear down was by either forcibly removing it or in some way fooling the system into believing the door was in fact open. Of course, the latter appeared less hazardous and was preferred by all.

The eventual successful plan was to enter an electrical panel in the aft right of the pressurized compartment, remove a plug-in relay, short across two terminal points in its receptacle to bypass the nose gear door down switches, provide power to the nose gear extend solenoid, and obtain hydraulic pressure on the nose gear down cylinder without the door being open.

With the obvious motivation I hardly noticed I was wearing a pressure suit as I unstrapped, left the capsule and went to the aft of the crew compartment. Thanks to foresight, Jerry Pakes had provided an extension cord which I connected to my capsule communications lead and was able to listen to intercom and command conversation while in the rear of the compartment --- some 12 ft from the pilot seat. My personal briefcase contained a screwdriver, pliers, diagonal cutters and the all essential flashlight so I had all the tools necessary to do the job. Tools could have been improvised but the job could not have been completed in the existing darkness of the compartment without a flashlight (See attached photo for equipment used).

The relay panel cover was easily removed. There was some delay insuring the correct relay (1K17) was being removed but assurance came when the gear handle red light went out as the relay was pulled. Positive identification of the correct two terminals (diagram Nos. 27 and 29) required several minutes. Positive identification and satisfaction of both pilots was possible only after a checkerboard

display was drawn and compared with instructions from the ground.

I designed a jumper wire from a paper clip and since I was sweating considerably cut a piece of leather from my lap belt for an insulator. We were both concerned about the situation Al would be facing should I get knocked out from an electrical shock. I held the jumper on terminals 27 and 29 while Al selected the emergency electrical gear switch from the previously selected down position back to normal. Chase reported the nose gear extending, the green light came on and the nose gear door closed. I removed the jumper, we sighed a great relief and congratulated the boys in the control room for a great piece of work.

After replacing the relay the gear handle red light remained out so the relay covers were reinstalled.

LANDING

After considerable discussion and review of the management ground rules, the decision was made to land on the unfoamed runway. It was expected that nose wheel steering would be operable and the tendency would be to pull right. For this reason the runway would not be foamed. Decision against a dry lake bed landing was in fear of the right nose gear tire blowing and resulting in the axle and strut digging in.

Two practice low approaches were made to runway 04 with 62,000 and 52,000 lbs of fuel remaining. The wind was calm. The final approach was made with a fuel totalizer of 44,000 lbs (tank 1 - 2.5; 2 - 1.1; 3 - 29.7, and 5 - 8.9). Best flare speed was 183 KIAS. Yaw augmentation was turned off and nose wheel steering in takeoff and land and engaged. Final approach airspeed was 200 KIAS at 9-1/2° angle of attack. The landing speed on the standby indicator was 172 KIAS. Chute deploy speed was at an estimated 160 KIAS. Very soon after the smooth touchdown we heard and felt some tires blow. Chase reported the main wheel tires on fire and just prior to Al lowering the nose gear I felt a vibration and heard noises like some more tires blowing. Soon after the nose wheel contacted the runway violent side-to-side and vertical cockpit vibrations were experienced. The nose airspeed boom was whipping directionally and eventually broke and hung down.

After shaking, rattling, rolling, and sliding some 7,000 ft we came to a stop. Al had cut engines 1 and 6. Reports from ground and chase were few and not too reassuring so I cut off some switches, unstrapped and went aft to get the escape ropes (Sky Genies) out and prepare our exit. In our haste and concern for the fire we did not jettison the drag chutes. Engines No. 2 and 5 were cut prior to the ground crew coming on intercom. I had cut COOL CIRC and AUX COOL and with a further delay in shutdown the EE temperature reached 90°F before engines No. 3 and 4 were cut.

The fire fighters responded immediately and soon after stopping all flame was extinguished. We exited the aircraft via the rescue vehicle mounted escape ladder. Both main bogies were damaged extensively, six of the eight main tires were blown, the left nose gear tire was blown, gear doors were damaged and the pitot static boom was broken (See attached photos).

FLIGHT SQUAWKS

1. No. 5 engine EGT cutback to 820°C at Max A/B just after takeoff.

2. No. 2 engine EDV would not pressurize at engine start.

3. Telemetry frequency 235.5 weak.

4. Correlation counter and flashing instrumentation lights inoperative after landing.

5. On gear retraction the nose gear jammed against the main door blowing the left nose gear tire. Gear handle was returned to down before the gear cycle was completed.

6. Left aft and both right brakes locked on landing causing all six tires to blow out.

7. Vibration caused by imbalance on nose gear broke the pitot static boom.

SYSTEMS SUMMARY

Landing Gear: Needless to say it was the cause for the big panic. Nothing but unsatisfactory can be said for the safety design of a system which allows a single failure to prevent emergency extension of the nose gear in a reasonable period of time. The emergency extension procedure used in this case required far too much time --- 1 hour and 15 minutes.

Brakes: All four brakes were new and were coated by a dry lubricant. Taxiing out they were very smooth and did not chatter. Hydraulic system head pressure held the brake actuators out of detent and prevented 6 of the 8 wheels from spinning up on landing. The extensive damage to the bogies and their components dictates a change in the brake system in the hydraulic power off mode.

Communications: The radios were satisfactory. The gear emergency generated a need for a crewman to converse directly with the ground from the aft crew compartment. The capability now exists to converse on intercom but we need to go one step further and provide the ability to talk on command.

Engines: No. 5 EGT cutback to 820°C in maximum afterburner shortly after takeoff and was operated in military power for the remainder of the flight.

Instrumentation Package: During the very rough landing roll the correlation counter and flashing "data on" green lights became inoperative. It's a wonder more systems didn't fail as a result of the extreme roughness caused by the nose wheel shimmy.

Drag Chutes: Two chutes fully developed, the third one was about half inflated.

Hydraulics: Utility systems status lights were on continually for pumps No. 1, 3, and 4. This is a very undesirable condition.

Operation of the following systems was satisfactory:

Nose Wheel Steering	Hydraulics
Flaps	Fire Detection
Fuel	Flight Controls
Electrical	Oxygen
IFF	Environmental
TACAN	Wing Fold
Flight Instruments	

Systems not used: AICS, ILS, and Nose Ramp.

RECOMMENDATIONS

1. An emergency trouble-shooting kit containing tools, flashlight, jumper wires, etc. be taken on every flight.

2. Adequate lighting be provided for the right aft pressurized compartment.

3. Capability be provided to transmit and receive on the command radios from any place in the forward pressurized compartment.

4. Eliminate nuisance illumination of utility hydraulic pump status lights.

5. Add mechanical return springs to the brake actuators to insure they are off when the brake pedals are not depressed.

6. Correct wiring deficiency in the bogie junction boxes, insulate between terminals and cover and remove obstructing bracket.

7. Provide a more positive and independent nose gear emergency extension system.

8. Require copilot check circuit breakers in electronic bay before landing when system malfunctions are suspected that, if not corrected, would prevent a safe landing.

9. Prototype aircraft should have a fire detection and deluge or extinguishing system for the wheel wells.

Joseph F. Cotton

JOSEPH F. COTTON, Colonel, USAF
XB-70A Test Director - Copilot

HANDLING QUALITIES QUESTIONNAIRE

FLIGHT 2-42 PILOT V. H. Shepard CONFIGURATION Wingtips - One-half

LONGITUDINAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Airspeed, Altitude, Attitude	.85/20K	FACS ON	$2\frac{1}{2}$	Near limit aft CG 24.7%
		FACS OFF	$4\frac{1}{2}$	
MANEUVERABILITY - Ability to change: Airspeed, Altitude, Load Factor		FACS ON	3	
		FACS OFF	5	Longitudinal stick force/G was near 12 lbs/G and excessive attention was required to prevent exceeding G limits.
RESPONSE TO TURBULENCE			5	
RESPONSE TO CONFIGURATION CHANGES			-	
OVERALL LONGITUDINAL RATING		FACS OFF	5	

HANDLING QUALITIES QUESTIONNAIRE

FLIGHT 2-42 PILOT V. H. Shepard CONFIGURATION Wingtips - Up

LONGITUDINAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Airspeed, Altitude, Attitude	.95/35K	FACS ON	+-1/2	
		FACS OFF	4	
MANEUVERABILITY - Ability to change: Airspeed, Altitude, Load Factor		FACS ON	-	Overpowering adverse yaw due to ailerons coupled with very strong dihedral effect could cause serious problems because it is so natural for one to use small amounts of aileron to maintain wings level during small initial yaws.
		FACS OFF	6	
RESPONSE TO TURBULENCE			-	
RESPONSE TO CONFIGURATION CHANGES			6	
OVERALL LONGITUDINAL RATING			6	

HANDLING QUALITIES QUESTIONNAIRE

FLIGHT 2-42 PILOT V. H. Shepard CONFIGURATION Wingtips - One-half; Windshield - Down

LONGITUDINAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Airspeed, Altitude, Attitude	.95/35K	FACS ON	2	Near 23.5% CG.
		FACS OFF	3	
MANEUVERABILITY - Ability to change: Airspeed, Altitude, Load Factor		FACS ON	$2\frac{1}{2}$	
		FACS OFF	$3\frac{1}{2}$	
RESPONSE TO TURBULENCE				
RESPONSE TO CONFIGURATION CHANGES				
OVERALL LONGITUDINAL RATING				

HANDLING QUALITIES QUESTIONNAIRE

FLIGHT 2-42 PILOT V. H. Shepard CONFIGURATION Wingtips - Full Down; Windshield - Up

LATERAL-DIRECTIONAL	MACH/ALT.	RATING		COMMENTS
TRIMMABILITY - Ability to hold: Heading, Bank Angle	2.4/60K	FACS ON	3	With FACS, the airplane was significantly better than #1 airplane because there was less roll-yaw coupling due to aileron overcontrol. Resultant yaw oscillations were neutral and of lower peak-to-peak amplitude than #1. Negative dihedr effect was less than that observed on #1.
		FACS OFF	4	
MANEUVERABILITY - Ability to change: Heading, Bank Angle		FACS ON	$3\frac{1}{2}$	
		FACS OFF	4	
RESPONSE TO TURBULENCE				
OVERALL LATERAL-DIRECTIONAL RATING				
CONTROL HARMONY				

COPILOT COMMENTS

XB-70A FLIGHT 1-48 3 MAY 1966

INTRODUCTION: The flight was airborne at 1243 hours. Flight objectives were the same as those on Flight 1-47 and were a flutter point at 1.54 Mach, 30,000 feet; lateral directional stability at 2.0, 2.4 and 2.6 Mach; engine power modulations at 2.6 Mach; airstarts at .8, .9 and 2.4 Mach and subsonic airspeed calibrations with a T-38 pacer at 15,000 feet. The landing gear failed to give satisfactory operation after takeoff and had to be left down for the remainder of the flight. All primary mission objectives were canceled and gear down alternate tests were flown. Tests accomplished were power modulations at 260 knots, 18,000 feet and AGPS tests. The flight was terminated early because of a hydraulic leak. Maximum speed and altitude was 275 knots and 23,000 feet. Flight duration was one hour and 22 minutes.

PREFLIGHT AND TAXI: All engine starts were normal and were completed within 5 minutes. The airplane was taxied to runway 04 but after reaching the runway area, the takeoff was delayed to allow the tires to cool for 22 minutes because of the long taxi distance and the high ambient temperature (91°F).

TAKEOFF AND CLIMB: Total fuel six minutes prior to brake release was 248,000 pounds. When the throttles were advanced for takeoff, the #6 engine vibration went to 70%. After manipulating the throttle, the vibration was reduced to 40% at military power. Overspeed RPM was used for takeoff, however, at the acceleration check of 21 seconds, the speed was only 141 knots instead of the expected 151 knots. The takeoff was continued since all cockpit indications were normal and the airplane seemed to be accelerating normally. After lift off, the landing gear handle was placed up and the landing gear retracted. The red light in the gear handle went out for a moment and then came back on. The landing gear was re-extended normally and then the landing gear handle was raised again? The nose gear came up and locked, however, both main landing gear folded and rotated only. The main landing gear struts made no movements toward retracting. The gear handle was then placed down, the gear went down and locked normally and it was left down for the remainder of the flight. Gear down alternate tests were then accomplished.

ENGINE POWER MODULATIONS: The airplane was climbed to 18,000 feet and stabilized at 260 knots for engine accelerations and decelerations. The following tests were accomplished:

ENGINE #	THROTTLE MOVEMENT	RATE OF MOVEMENT	COMMENTS
3	Mil to Max A/B	Fast	Momentary Peak 1000° EGT
3	Max A/B to Mil	Fast	800° EGT then 900° EGT
3	Mil to Min A/B	Fast	Momentary Peak 980° EGT
3	Min A/B to Mil	Fast	810° EGT then 900° EGT
1,2,3	Mil to Max A/B	Fast	Average Peak 970° EGT
1,2,3	Max A/B to Mil	Fast	750° EGT then 900° EGT
3	Idle to Max A/B	Fast	Momentary Peaks of 950°, 900°, 1000°, 950° and stabilized at 900° EGT
3	Max A/B to Idle	Fast	Normal Deceleration
1,2,3	Idle to Max A/B	Fast	Peak EGT Approx 1000°
1,2,3	Max A/B to Idle	Fast	Normal Deceleration-61% Idle RPM
6	Idle to Max A/B	Fast	Momentary High Vibration-950-1000° EGT
6	Max A/B to Idle	Fast	Normal Deceleration-61% Idle RPM
1,2,3,4,5,6	Idle to Max A/B	Fast	Peak EGT's Approx 1000°
1,2,3,4,5,6	Max A/B to Idle	Fast	Normal Deceleration

All engines responded well to throttle movements. There were no excessive EGT's or any indications of other than normal operation.

AIRFRAME BUFFET: A slightly different airframe buffet was noted at around 20,000 feet altitude at an indicated speed of 260 knots. The total fuel was around 145,000 pounds (410,000 gross weight). This was probably the result of the slow speed at moderately high altitude. An attempt was made to retract the flaps at this altitude but they only partially retracted and were returned to full down and remained there for the remainder of the flight.

AGPS TEST: The airplane was held in a continuous bank of 10 degrees or more for 12 minutes after selecting "standby ADI" to slave the copilot's instruments to the standby gyro. The airplane was then rolled out of the bank and the wings leveled by visual reference. A comparison was made between the pilot and copilot instruments and produced the following indications:

Heading	Bank Angle	Pitch Attitude
Pilot 80°	3° Left Wing Down	4° Nose Up
Copilot 80°	8° Left Wing Down	2° Nose Up

The "standby gyro fast erect" was then selected and the AGPS switch placed to the "derated mag" position. Within 10 seconds, the copilot attitude indicator went to a wings level indication. The pilot and copilot readings with the wings visually leveled were:

	Heading	Bank Angle	Pitch Attitude
Pilot	78°	1° Left Wing Down	6° Nose Up
Copilot	78°	Wings Level	2° Nose Up

This test proved that the precession was excessive on both the primary and the standby attitude indicators.

HYDRAULIC LEAK AND REPLENISHING SYSTEM: Shortly after completing the AGPS tests, a leak was noted in U_2 hydraulic system. The quantity gauge was down to 4.1 gallons instead of the expected 10 to 12 gallons and the head pressure was at 160 psi. A momentary flicker on the #5 utility pump was also noted. The U_2 hydraulic replenishing system was turned on and powered from the essential electrical bus. The leak rate and the replenishing system transfer rate were apparently almost equal since the quantity indication did not change for 15 minutes. The quantity indication versus time was as follows:

Time	U_2 Quantity	U_2 Head Press	Comments
1342	4.1 Gallons	160 PSI	Leak detected - replenishing on
1344	4.1	164	
1348	3.8	167	Descending
1352	4.0	180	Holding around 15,000 feet
1357	4.1	188	Descending
1359	4.5 to 5.0		In traffic pattern
1400	7.0		In traffic pattern
1404	7.5 to 8.0		Turning off runway - replenishing off
1406	6.4		Stopped on Taxiway
1408	5.9		Leak found to be in Bay #6
1409	5.3		Engine #6 cut off

After the #6 engine was cut off, the U_2 quantity remained around 5.3 gallons until all engines were cut off approximately 30 minutes later.

APPROACH AND LANDING: After the hydraulic leak was detected, the airplane was descended toward the traffic pattern. The airplane was leveled for approximately three minutes while I left the copilot seat to check the circuit breakers in the EE bay. All circuit breakers were found to be in their normal positions and I returned to the seat and refastened all straps

and fittings. With 75,000 pounds of fuel remaining, the flare speed was computed as 200 knots. The touchdown speed was approximately 185 knots. Two of the three chutes inflated properly and one was only partially inflated. The flaps failed to retract after landing.

AFTER LANDING: In order to reduce the gross weight to allow the airplane to be jacked without defueling, the engines were run at high power while still on the taxiway. Two engines were run in afterburner and the other three engines were run near military power for approximately 20 minutes to burn 30,000 pounds of fuel. The #6 engine had been shutdown earlier.

SYSTEMS:

1. Environmental System: The cabin temperature remained very comfortable during this slow speed flight at 15,000 to 20,000 feet. The temperature rheostat was set at position 3.

2. Fuel System: The system gave satisfactory operation, however, the total quantity indicator jumped from 199,500 pounds to 204,500 pounds. The indications were all normal after that sudden change.

CONCLUSIONS:

1. The hydraulic quantity replenishing system probably more than paid for itself on this flight by saving the 3 pumps in Utility #2 hydraulic system.

2. The landing gear system gave unsatisfactory operation and prevented accomplishment of the primary mission.

3. The AGPS system had excessive errors.

4. Engine operation was excellent during acceleration and deceleration tests.

5. Running engines at high power settings after landing is not a satisfactory method of reducing the airplane gross weight.

MAINTENANCE DISCREPANCIES:

1. High vibration on #6 engine at 85% RPM prior to takeoff.

2. Red light came on in gear handle after gear retraction. Chase reported up and locked. Gear was extended normally. On second retraction attempt the main gear folded and rotated but did not retract. Nose gear operation was normal. All landing gear were then re-extended normally.

3. Total fuel quantity indication increased 5,000 pounds when near the 200,000 pound level.

4. U_2 hydraulic fluid level decreased during flight. Leak appeared to be from #6 ADS bay area. Hydraulic replenishing system was used for 21.5 minutes.

RECOMMENDATIONS:

1. Correct the maintenance discrepancies noted.

2. Rework the landing gear to give satisfactory operation.

3. Devote maximum efforts to correcting the AGPS errors to allow more important testing to be accomplished without heading and attitude distractions.

4. Do not run at high engine power on the ground to reduce airplane gross weight.

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Copilot

COPILOT COMMENTS

XB-70A FLIGHT 1-49 9 MAY 1966

INTRODUCTION: The flight was scheduled for 1100 hours and brake release was at that time. Flight objectives were the same as those scheduled for Flights 1-47 and 1-48, but not accomplished due to inflight malfunctions. The scheduled tests were a flutter point at 1.54 Mach, 30,000 feet; lateral directional stability at 2.0, 2.4 and 2.6 Mach; engine power modulations at 2.6 Mach; airstarts at .8, .9 and 2.4 Mach and subsonic airspeed calibrations with a T-38 pacer at 15,000 feet. One gear cycle was scheduled immediately after takeoff due to the landing gear malfunction on the previous flight. Satisfactory gear operation was not obtained, therefore, none of the scheduled tests were completed. Gear down tests were then accomplished and consisted of AICS airflow tests at 10,000 feet and maneuvers - Cooper rated. The maximum speed and altitude was 240 knots and 15,000 feet. Flight time was two hours and 16 minutes.

PREFLIGHT AND TAXI: All engine starts were normal with 520° the maximum EGT encountered on first peaks. The airplane was taxied to Runway 22 since the wind was from 220 degrees at 12 to 20 knots velocity. Light brake chatter was encountered on the left gear during a pedal application at slow speed.

TAKEOFF AND CLIMB: Total fuel remaining at brake release was 255,500 pounds. Max A/B power was used and the acceleration was satisfactory. Computed lift off was 215 knots and actual lift off was 213 knots. The gear handle was placed up and the gear retracted normally. A gear cycle was scheduled because of the gear problem on the previous flight, therefore, the gear handle was placed down. All gear doors opened normally and the nose gear extended and locked down. The main gear remained up and locked with the doors open. The original flight plan was, therefore, canceled.

The refrigeration package did not operate and when the aux cool switch was turned off, the EE temperature started to increase. The aux cool was reselected to on and remained on for the remainder of the flight. There was an "oil fume" type of odor in the cockpit which remained for quite a while.

LANDING GEAR EMERGENCY: The airplane was climbed to approximately 12,000 feet, power set at military, and the speed established at 260 knots for maximum endurance, while the gear problem was being investigated. After the personnel in Data Control discussed the problem, I was advised to proceed to the EE bay and check the circuit breakers. I installed my seat pin, disconnected all fittings, left the seat and checked the circuit breakers.

All circuit breakers were normal and I returned to the forward part of the airplane. The extension cord carried in the flight information box under the throttle quadrant was connected to the copilot position to provide radio reception and two way interphone communication while out of the copilot seat. Data Control advised to turn off the liquid cool pump switch because of a glycol leak noted by chase. After that, I proceeded again to the EE bay with the communication cord strung from the copilot seat through the EE bay entry door and into the bay. The door was closed on the cord. After thoroughly checking and rechecking all circuit breakers I attempted to leave the EE bay but the communication cord had jammed the door and it could not be opened. I passed on this bit of news over the interphone and made a quick check to determine if the door was being held closed by anything other than the cord. Part of the difficulty in opening the door was caused by having to release the small pressure door with the left hand and then trying to simultaneously open the entry door with the right hand. The cord was found to be the only thing jamming the door but the internal air pressure on the door added to the difficulty. I finally was able to pull the door so hard that the lower part of the door cut the communication cord and allowed the door to open. I returned to my seat and refastened all fittings. The landing gear electrical emergency switch was then selected to the down position and the main gear extended and locked. All landing gear doors remained open. The three landing gear green lights were on and the red light in the handle was out.

GROUND EFFECT STUDY: One low approach was made in an attempt to get ground effect data since the flight plan had to be modified to a gear down flight. The turbulence was found to be excessive and the airplane was climbed to 10,000 feet.

AICS THROAT AND BYPASS AIRFLOW AT 250 KNOTS, 10,000 FEET: With the left throat set at 2.15 Mach, the left bypass doors were set with the manual wheel at closed (30), 200, 400, 800, 1000, 1600, 2250 (full open), 1600, 1000, 800, 400, 200 and closed (30). The left throat was then fully opened and the same bypass settings established. No unusual engine indications were noted. The throttle angle was approximately 40 degrees with the throat set at 2.15 and approximately 37 degrees when set at 1.69 (full open).

MANEUVERS - COOPER RATED: A series of maneuvers were accomplished at 240 knots, 8500 feet, and than a Cooper rating was assigned to each maneuver. The maneuvers accomplished and the techniques used were:

Climb and Descent:

1. Trim on speed and altitude.

2. Climb 5,000 feet at constant speed, then level off.

3. Descend to original altitude and level off.

Run #	Maneuver	Wing Tips	FACS	Rating	Comments
B-1	Climb & Descent	Up	On	$2\frac{1}{2}$	Held within $\pm$ 3 knots
A-1	Climb & Descent	Up	Off	$2\frac{1}{2}$	

The run numbers correspond to those on the test card.

APPROACH AND LANDING: Data Control advised that the lakebed should be used for landing as a precaution since the landing gear operation had been abnormal earlier in the flight. One low pass was made to check lakebed runway 23. The ammonia quantity appeared to be decreasing rapidly, therefore, it was decided to land immediately. I went to the EE bay and checked all circuit breakers in and returned to my seat. With a headwind of approximately 15 knots, the approach was established. Flare speed was computed as 192 knots and the touchdown was approximately 180 knots. Only two of the three chutes fully inflated, however, the airplane decelerated easily due to the increased rolling friction on the lakebed. The airplane was taxied in and the ammonia quantity was down to 60 at engine shutdown.

SYSTEMS:

1. The environmental control system leaves much to be desired when the refrigeration package is inoperative as it was on this flight. Cabin temperature was very hot and opening the crew air shut off valve only increased the flow of warm air.

2. All other system operation was generally satisfactory except the landing gear.

CONCLUSIONS:

1. Landing gear operation must be improved.

2. The cockpit can become very uncomfortable when the refrigeration package does not operate.

3. The EE bay door is too difficult to open.

MAINTENANCE DISCREPANCIES:

1. Main gear remained in wheel well on extend cycle. Nose gear came down and locked. All doors came open, remained open and appeared to be powered open.

2. Refrigeration package inoperative.

3. Glycol leak on nose gear door.

4. Aux intercom cord broken.

5. Pitch aug disengaged several times during flight.

6. The #2 radio operation erratic.

7. Ammonia consumption rate appeared excessive during latter part of flight.

RECOMMENDATIONS:

1. Correct the maintenance discrepancies listed.

2. Modify the EE bay to make it easier to open.

3. Accomplish all engineering and maintenance work that is needed to obtain reliable landing gear operation.

Fitzhugh L. Fulton

FITZHUGH L. FULTON, JR., Lt Colonel, USAF
XB-70A Copilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT V. H. Shepard

FLIGHT NO. 2-41 CO-PILOT Col. J. Cotton

DATE OF TEST 25 May 1966 FLIGHT TIME 2:23

CHASE AIRCRAFT AND PILOTS

Chase 1	-	F-104D #316	-	Maj. Parsons/Lt.Col.Fulton
Chase 2	-	F-104D #316	-	Capt. Gentry/Lt.Col.Fulton
Pacer	-	F-104A #748	-	Lt.Col.Sorlie
Pacer	-	F-104A #748	-	Lt.Col.Sorlie
Support	-	C-130A #132	-	Capt. Stroup/Maj.Doryland
Helicopter		H-21B #389	-	Capt. Thomas

PURPOSE OF FLIGHT

1. Five-engine climb performance at takeoff speed
2. Flutter test at 1.54 Mn, 30,000 ft.
3. Directional static and dynamic stability at 1.6 Mn, 41,000 ft.
4. Airspeed pacer calibration at .78-.98 Mn
5. Longitudinal dynamic stability at .81 Mn, 25,000 ft.

1.0 ENGINE START

All engines started satisfactorily, except #2 engine would not start using normal ignition and airstart ignition had to be utilized. Fuel prior to engine start was 272,500 pounds.

2.0 TAKEOFF AND FIVE-ENGINE CLIMB

Six minutes prior to brake release, the total fuel was 261,500 pounds.

The nose was lightened with slight aft force near 185 KIAS, and definite rotation was started at 195 KIAS. The airplane was airborne near 210 KIAS--8 knots low--but acceleration appeared good, considering the 81°F temperature. OVERSPEED was used, and #5 engine was in T_S reset (825-830°C) for test purposes. Acceleration was four knots low after being timed from 69 to 147 KIAS.

At 3800 ft. pressure altitude, the #2 engine was retarded to Military Power and the airspeed stabilized at 218 KIAS (round dial). Then #2 engine was retarded to IDLE. With the other five engines in MAX A/B out of overspeed, data were obtained of a constant speed climb. Turbulence was causing some airspeed variation; however, it was believed that 30-40 seconds of marginal stabilized data were obtained near 218 KIAS ± 2 knots. The airplane did not appear to climb, and may have been descending. Gear, flaps, and windshield were down and the wingtips were up. This test should be repeated in smooth air, for it appeared

that the five-engine climb performance was nil or marginal at published take-off speed.

3.0 FLUTTER TEST

This test was not accomplished because of conflicting commercial traffic at the test altitude and because the aft cooling door on #4 engine did not close, requiring the #4 throttle to be placed at the 40-degree position. This decreased thrust extended the calculated track further north and perhaps led to part of the conflicting traffic problem. Further high-speed tests were also aborted due to the left inlet being inoperable in the AUTO mode; STANDBY mode functioned satisfactorily.

4.0 DIRECTIONAL DYNAMIC AND STATIC STABILITY - 1.6 MN, 41,000 FT.

Data were obtained of a directional dynamic oscillation induced with the ailerons with augmentation OFF. The resulting oscillation damped to near one-tenth amplitude in two and one-half cycles. Then a right rudder sideslip was accomplished with augmentation ON, and full rudder produced only 1.3 degrees of sideslip. A release from one degree resulted in a deadbeat oscillation.

5.0 AIRSPEED CALIBRATION (PACER METHOD) .9 MN

The following stabilized points were obtained with wingtips at one-half and the windshield down:

	XB-70					PACER		
Run No.	Mn	Airspeed Inst.	Airspeed VSI	Alt. VSI	Temp. °F	Airspeed KIAS	Alt. Ft.	Temp. °C
1.	.955	367.5	366	30,520	22	354.5	29,550	0
2.	.935	360	359	30,230	19.5	348	29,340	-2
3.	.91	351.5	350	30,100	17	341	29,295	-3
4.	.873	336.5	335.5	29,880	12	328	29,140	-6
5.	.862	325	325	30,670	6	318	29,970	-9
6.	.837	314.5	315.5	30,620	3	310	30,150	-10
7.	.817	305	307.5	30,450	2	301.5	29,920	-11
8.	.778	291.5	293	30,260	-	288	29,760	-14

6.0 LONGITUDINAL DYNAMIC - .81 MN, 25,000 FT.

Data were obtained of a pull-up and release and a pull-up and a return of the control rapidly to neutral. Wingtips were positioned at one-half on all runs. Damping was essentially deadbeat with augmentation ON, and at least one cycle was required for the oscillations to damp to one-tenth amplitude with augmentation OFF. One return-to-neutral run had to be repeated for the final G was oscillating around 0.8G. Center of

gravity appeared aft on all of the runs (approximately 23.5 per cent with 29,000 pounds in the sump) as the return was slow and sluggish on the releases which gave the appearance of a low restoring moment. Damping was satisfactory for all conditions.

7.0 CONCLUSIONS

1. Five-engine rate of climb with gear and flaps down at published take-off speed using maximum afterburner power appeared nil at 3,800 ft. pressure altitude.

2. Flutter test had to be discontinued because of conflicting commercial traffic.

8.0 RECOMMENDATIONS

1. That the five-engine take-off climb deficiency be investigated at low altitude in smooth air and that the take-off weight be limited at certain temperatures until conclusive data is obtained.

2. That large block altitudes (25,000 to 40,000 ft.) be reserved during the ETE for test work just north of ALPHA area.

9.0 DISCREPANCIES

1. Windshield failed to go down on first attempt on ground hydraulic power.
2. No. 1 tach sticky at 0-5 per cent.
3. Nosewheel steering pulls to right.
4. No. 4 engine 105 per cent in OVERSPEED for one minute 38 seconds.
5. LH AICS inoperative in AUTO.
6. YAW AUG No. 1 disengaged when STBY roll trim was actuated.
7. Pencil lost in copilot's capsule.
8. Flap pressure light came on after flaps retracted on ground.
9. No. 2 engine required airstart ignition to start.
10. Nosewheel steering light blinked during mid part of landing roll.
11. VIBRATION HIGH light on during landing--all indicators below 2 mils.
12. No. 4 engine cooling door (aft) open above Mn 1.0.

V H Shepard

V. H. Shepard
Pilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT V. H. Shepard

FLIGHT NO. 2-42 COPILOT Col. J. Cotton

DATE OF TEST 27 May 1966 FLIGHT TIME 2:08

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #314 - Lt. Col. Sorlie/Lt. Col. Fulton
Chase 2 - F-104 #755 - Capt. Hoag
Chase 3 - F-104 #316 - Capt. Livingston/Capt. Smith
Chase 4 - F-104 #314 - Lt. Col. Sorlie/Lt. Col. Fulton

PURPOSE OF FLIGHT

1. Level flight acceleration, 1.12-1.37 Mn.
2. Flutter point, 1.54 Mn, 30,000 ft.
3. Directional stability at 2.4, 2.5, and 2.0 Mn, 60,000 ft.; and 2.0 Mn, 50,000 ft.
4. IDLE power descent.
5. Stability and control set, .95 Mn, 35,000 ft., wingtips one-half.
6. Longitudinal static stability, 2.4 to 2.0 Mn.
7. Aileron roll, .95 Mn, 35,000 ft.
8. Directional stability, .95 Mn, 35,000 ft., wingtips UP.

1.0 LEVEL FLIGHT ACCELERATION

Data were obtained of an acceleration at 32,000 ft. from 1.12 to 1.37 Mn with the windshield down, the wingtips at one-half, and all engines in maximum afterburner power; however, #6 engine was in T_5 for the entire run. Data were considered good.

Near 1.36 Mn something started yawing the airplane slowly to the right; and near three-quarters degree of yaw, left rudder was applied. Then dihedral caused the right aileron to be applied to instinctively hold the wings level, which immediately yawed the airplane left to near three degrees. Near full right rudder was applied with no apparent affect, still not realizing the aileron was producing the yaw. The airplane yawed back to the right and the ailerons were released, which caused the airplane to roll rapidly to a 40-degree bank angle. The bank angle was recovered slowly and the wingtips were lowered to full down. The airplane ended up near 35,000 ft. It was believed some external force produced the initial yaw, and not the aileron, because as the ailerons were released, the yaw continued.

2.0 FLUTTER POINT - 1.54 MN, 620 KIAS

The speed was obtained with all augmentation off; however, the control raps were not applied because of light turbulence in thin cirrus clouds. No problem was encountered in flying the airplane; however, if ailerons were not handled carefully, the airplane would oscillate ± 1 degree in yaw from aileron overcontrol near center due to yaw-roll dihedral effect. Frequency of the oscillation was definitely higher than previously experienced at higher altitudes and lower dynamic pressures.

3.0 DIRECTIONAL STABILITY - 2.0, 2.4, 2.5 MN

Data were obtained of directional oscillations with roll and yaw augmentation off. All oscillations damped to within one-tenth amplitude in two to three cycles and were excellent considering the high Mach numbers. All data obtained at 60,000 ft., except the 2.5 Mn point was obtained at 62,000 ft.

At 2.5 Mn the dihedral was almost neutral, but slightly negative and full rudder produced only 1.8 degrees of sideslip. Turns also were accomplished with roll and yaw augmentation off, and the airplane handled significantly better than No. 1 airplane in that there appeared to be less yaw-roll coupling, and misuse of the ailerons did not cause lateral over-controlling or divergent yawing oscillations.

4.0 DIRECTIONAL STABILITY - 2.0 MN, 50,000 FT.

A set of data was obtained with roll and yaw augmentation off and the resultant oscillations were within one-tenth amplitude in less than three cycles. Lateral-directionally, the airplane flew worse when compared with 60,000 ft. handling qualities. The roll-yaw coupling appeared to be more pronounced at the lower altitude, also the frequency of the yaw oscillation appeared higher. The dihedral effect was more negative than that observed at higher Mach Nos.

5.0 LONGITUDINAL STATIC STABILITY - 2.5 - 2.0 MN, 62,000 FT.

A hands-off trim shot was obtained at 2.5 Mn, 62,000 ft., with all throttles at the 100-degree position and the inlet in NORMAL performance. Then at 2.4 Mn, difficulty was encountered in obtaining a stabilized point because of more and more forward force required to hold a stabilized speed. All fuel tanks were then turned off and the stabilized point was obtained which required near ten pounds of push force. This same force was required at 2.2 and 2.0 Mn. Then the force was trimmed out and a hands-off trim shot was obtained at C/N 4398. All points were marked when the force and speed had stabilized. The data will have to be corrected for the apparent CG change.

7.0 DIRECTIONAL STABILITY - .95 MN, 35,000 FT., WINGTIPS ONE-HALF

With augmentation on and off, directional static and dynamic tests were accomplished. The airplane demonstrated neutral dihedral effect during the directional static test with augmentation on, but was slightly positive with augmentation off. Full rudder sideslips could not be accomplished because of exceeding the sideslip limits (3.7 degrees) near seven-eights rudder deflection. Rudder deflections in excess of three-quarters travel were not linear in that a small increase in rudder deflection produced a large sideslip angle change. Dynamic releases resulted in a 20 per cent overshoot with augmentation on and damped to one-tenth amplitude within three cycles with augmentation off.

8.0 AILERON ROLL - .95 MN, 35,000 FT., WINGTIPS ONE-HALF

One-quarter aileron deflection roll to the left was attempted with augmentation on from a stabilized right 30-degree bank angle. The roll was discontinued after 20-degree bank angle change due to rapidly increasing sideslip angle near three degrees.

9.0 LONGITUDINAL ACCELERATED AND DYNAMIC STABILITY - .95 MN, 35,000 FT., WINGTIPS ONE-HALF

With augmentation on, the damping was excellent exhibiting only a 20-per cent overshoot. Damping was good with augmentation off with only a 60-per cent overshoot on the first cycle and damping out within two cycles. Control stick return data was superior to the release data because of the aft CG.

A wind-up turn with augmentation on was accomplished to 1.58G and the gradient was moderate and positive. The longitudinal accelerated data was not obtained with augmentation off because of clouds.

10.0 DIRECTIONAL STATIC AND DYNAMIC STABILITY - .95 MN, 35,000 FT., WINGTIPS UP

With the wingtips up, a wings-level sideslip with augmentation off was accomplished out to six degrees. The airplane was touchy lateral-directionally and as more rudder was applied, more aileron was required to compensate for the strong positive dihedral. This required a reversal of the rudder in order to stabilize the sideslip since the aileron was so powerful a yaw device. A mild pitch-up moment was observed as the initial controls were applied. Finally a stabilized point was obtained near five and one-half degrees with less than one-quarter rudder and one-third aileron. This was an unacceptable situation, and the airplane should not be flown at this speed in this configuration except for test purposes.

Data were also obtained of a release from near two degrees, but the controls were disturbed before two cycles were completed because of roll-off to near 40 degrees.

11.0 CONCLUSIONS

1. Overpowering yaw due to ailerons coupled with positive dihedral effect in the transonic speed range was unacceptable and leads one into dangerously large sideslip angles with small amounts of aileron required to instinctly maintain wings level.
2. No. 2 airplane was significantly better lateral-directional-wise than No. 1 airplane from 2.0 to 2.5 Mn with augmentation off. The yaw-roll coupling frequency due to ailerons and negative dihedral effect did not produce divergent directional oscillations. The oscillations were there, but were neutral, and the amplitude was less than that observed on No. 1 airplane.
3. No. 2 airplane exhibited less negative dihedral than No. 1 airplane from 2.0 to 2.5 Mach number.
4. One-quarter aileron rolls were not possible to obtain at .95 Mn, 35,000 ft., with wingtips at one-half due to exceeding the yaw limits after 15 to 20 degrees of bank angle change.
5. Rudder power was inadequate to cope with yaw produced by ailerons.
6. Roll augmentation was adding aileron in the transonic speed range making an unsatisfactory situation worse.

12.0 RECOMMENDATIONS

1. Reduce the overpowering yaw due to aileron deflection in the transonic speed range.
2. Increase the roll mechanical advantage around center.
3. Disable the augmentation electrical roll input in the transonic speed range.
4. Increase rudder power so that full rudder may approach the yaw limits.
5. Until aileron yaw is reduced, lower the wingtips from one-half to full down near 1.1 Mn instead of 1.4 Mn.

13.0 DISCREPANCIES

1. Nosewheel steering pulls right upon engagement.
2. Left-hand brake hung up after stopping during taxi out.
3. Repaint throat marks in the inlets for pilot walkaround.
4. Safety wire broken on both ventilation suit outflow valves.

V. H. Shepard
Pilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT V. H. Shepard

FLIGHT NO. 2-43 COPILOT Lt. Col. F. Fulton

DATE OF TEST 31 May 1966 FLIGHT TIME 2:02

CHASE AIRCRAFT AND PILOTS

Chase 1 - T-38 #600 - Col. Sorlie/Col. Cotton
Chase 2 - F-104 #748 - Col. Rushworth
Chase 3 - T-38 #600 - Col. Sorlie/Col. Cotton

PURPOSE OF FLIGHT

1. Level flight performance - 2.18 and 1.95 Mn, 55,000 ft.
2. Longitudinal accelerated and dynamic stability - 2.15, 1.95, and 1.8 Mn, 55,000 ft., and .8 Mn, 25,000 ft.
3. Nose ramp noise study, .95 and .7 Mn

1.0 ENGINE START

At engine start the following quantities were noted: 19.9 liters of oxygen, 1,900 pounds of water, 550 pounds of ammonia, and 273,500 pounds of fuel. All engines were started normally, except for #2 which was airstarted because of 4-joule ignition being inoperative. After #3 engine was started, it was observed by the ground crew that the secondary nozzle appeared farther closed than the other nozzles.

2.0 TAKEOFF AND CLIMB

Fuel was observed at 265,500 pounds four minutes prior to brake release. The takeoff was satisfactory; however, the acceleration check was missed because of excessive time spent in monitoring engines after reaching MAX A/B.

During the climb the chase reported that the #3 engine tailpipe had a redder color than the other engines, and the throttle was reduced to MIL power on that engine. Power was returned back to MAX A/B on #3 engine after going supersonic. Chase still reported that the tailpipe had increased to a much redder color than the other engines. Throttles were retarded to the 100-degree angle, and chase reported a cooler color. The remainder of the flight was then flown with the throttle at 90 degrees when afterburner was required.

The 575-knot constant airspeed climb from 30,000 ft. was accomplished almost entirely by flying the new test vernier ADI attitude tape, and the ability to maintain the 575 knots was much improved over previous flights. Attitude was not constant during this portion of the climb

and appeared to increase. Small adjustments ± .2 degree could be accomplished and flown. Excessive longitudinal forces and lag in response were observed in making these very small pitch changes.

3.0 LEVEL FLIGHT PERFORMANCE - 55,000FT.

Two minutes of level flight stabilized data were obtained with the windshield up at 2.18 Mn and with the inlet started in NORMAL performance. At 2.17 Mn the throats and the shock positions were observed at 2.085 and 2.095 and .61 and .62, left and right respectively.

Level flight performance at 1.95 and 1.8 Mn at this altitude was not attempted because of light-moderate turbulence throughout the flight at 55,000 ft. from Salt Lake City to Edwards via Peach Springs.

4.0 LONGITUDINAL ACCELERATED AND DYNAMIC STABILITY

At 2.18 Mn, with augmentation OFF, dynamic releases and returns were accomplished and near four cycles were required for the oscillations to reduce to one-tenth amplitude. Then while trimming during the first part of the recording, which began at C/N 2997, a constant Mn wind-up turn to 1.6 G was obtained. The gradient was positive with moderate stick forces.

At 1.95 Mn, pull-ups, returns, and releases were accomplished with essentially the same damping as described above. The pull-up and control-stick-return-to-neutral data were definitely better because it appeared on the release that the elevators did not return to trim. Then with the data still running, the airplane was retrimmed after C/N 3850 and a wind-up turn to the right up to 1.6 G was accomplished at a constant 1.96 Mn.

A pull-up, return, and release were then accomplished at 1.75 Mn, 53,000 ft., and qualitatively no difference in damping as described above could be detected. Then a wind-up turn to the right was attempted; however, the data was discontinued because of increasing Mn. The wind-up turn was then repeated at C/N 4603 where good data were obtained up to 1.55 G at 53,700 ft.

With the wingtips at one-half at .8 Mn, 25,000 ft., with an aft CG near 24.5 per cent, a wind-up turn was accomplished with augmentation OFF. The force required at 1.6 G was near 20 pounds. This maneuver was repeated, FACS ON, with a turn to the left, and the gradient appeared to be essentially the same.

With the CG near 25 per cent, a wind-up turn to the right with augmentation OFF was repeated where the gradient was definitely shallower and only approximately twelve pounds were required to pull 1.6 G.

5.0 NOSE RAMP NOISE STUDY

Data were obtained of actuating the nose ramp at .9 Mn, 25,000 ft., in level flight with the cabin recorder on. The nose ramp was placed up at C/N 5538 and the switch was placed in the DOWN position at C/N 5580.

At .7 Mn, 15,000 ft., the nose ramp switch was placed UP at C/N 6875 and the windshield was observed fully up at C/N 6915, requiring 40 seconds for the up cycle. Then at C/N 6930 the switch was placed in the DOWN position and the windshield was observed full down at C/N 6939, requiring nine seconds for the down operation.

6.0 NO. 2 ENGINE NOZZLE PROBLEMS

While advancing all engines from 40 degrees to afterburner near 1.3 Mn for an FAA/NASA boom test, the #2 engine did not respond and hung up near 70 per cent rpm. The throttle was retarded to IDLE immediately. The copilot then advanced the throttle toward MIL and the EGT increased to over 950°C without proper rpm response. The engine was then shut off.

Later, at .8 Mn, 20,000 ft., the #2 engine was restarted and the light-off occurred approximately thirty seconds after the AIRSTART switch was turned ON. The engine was advanced toward MIL power, but the rpm would not increase above 72 per cent and the nozzle appeared to be hung up at 20 per cent. The remainder of the flight was flown with the #2 engine in IDLE.

7.0 CONCLUSIONS

1. Satisfactory level flight performance data were obtained at 2.18 Mn with the inlet started.
2. Airstart was marginal at .8 Mn, 20,000 ft., requiring at least thirty seconds for light-off.
3. The new sensitive vernier attitude tape was a significant improvement and enabled one to maintain a reasonably constant airspeed during climb from 32,000 to 50,000 ft.
4. Excessive longitudinal forces required to make very small (± .2 degree) adjustments in pitch attitude and this, coupled with excessive longitudinal lag, increased the pilot's workload in maintaining climb schedule.

8.0 DISCREPANCIES

1. Pilot's ADI ball one-half left in level flight.
2. No. 2 engine would not start on normal ignition; had to use airstart.
3. No. 2 engine hung up at 70 per cent rpm on acceleration and nozzle stuck at 20 per cent.
4. A-9 nozzle #3 engine too far closed.

5. No. 3 engine throttle ramp missing when going from MIN A/B to MIL.
6. VIBRATION HIGH light on during landing roll with all engines reading near one mil.
7. No. 1 utility hydraulic pump pressure low - 3100 psi.
8. Nosewheel steering pulls right during taxi and engagement with rudder trim neutral.
9. Excessive smoke left brake near 140 knots and left brake grabs at 10 knots.

V. H. Shepard

V. H. Shepard
Pilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT V. H. Shepard

FLIGHT NO. 2-44 COPILOT Col. J. Cotton

DATE OF TEST 4 June 1966 FLIGHT TIME 2:05

CHASE AIRCRAFT AND PILOTS

Chase 1 - T-38 #600 - Capt. Hoag/Lt. Col. Fulton
Chase 2 - F-104 #755 - Capt. Marrett
Chase 3 - F-104 #314 - Lt. Col. Sorlie
Chase 4 - F-104 #316 - Capt. Hoag/Lt. Col. Fulton

PURPOSE OF FLIGHT

1. Level flight performance - 2.9 and 3.0 Mn.
2. Ram purge - 3.0 to 2.3 Mn, 72,000 ft.
3. Cooper Ratings - .8 Mn, 20,000 ft.

1.0 ENGINE START

At engine start the following quantities were observed: 19.8 liters of oxygen, 2,020 pounds of water, 545 pounds of ammonia, and 274,500 pounds of fuel. All engines started normally; however, airstart ignition was used to start No. 1 engine because of inoperative four-joule ignition. The following maximum EGT's were observed in the first ten seconds after light-off: No. 5 - 530°, No. 4 - 520°, No. 6 - 535°, No. 3 - 525°, No. 1 - 555°, and No. 2 - 540°. Engines were started in order listed; No. 5 was out of place because of having a history of being a hot starter.

2.0 TAKEOFF

Fuel at brake release was 263,000 pounds. Acceleration was good to 150 KIAS with 20 seconds required from 70 to 149 KCAS; however, the wind was variable near 15 knots from 240 degrees. Rotation was started at 185 KIAS, and liftoff occurred very near the target 213 KIAS.

3.0 CLIMB

All engine cooling doors were observed by chase to be closed at .73 Mn. Near 1.1 Mn, while accelerating in level flight near 32,000 ft., something started yawing the airplane (observed by yaw needle and supported by the new Lear-Siegler ADI inclinometer ball--three-quarters ball width deflection at one degree yaw). This yaw was not felt or observed visually on the horizon and was not corrected with rudder.

This yaw produced very little rolling moment. The yaw disappeared at 1.27 Mn in which the inclinometer ball confirmed as the ball was centered. The bypasses were not operating during this time; however, throats were scheduling.

Erratic heading was observed shortly after starting the supersonic climb. The heading had been accurate at 323 degrees when checked with the chase. Near 1.7 Mn, the heading was observed to drift left to 316 degrees in approximately three seconds. (Later the ground track indicated that the airplane had been turning slowly left for several minutes, but it appeared the airplane's compass did not indicate same.) Previously the platform was slewed to 223 degrees on the runway; and after landing, the platform indicated 222 degrees.

The following EGT's were observed during the climb after T_2 reset commenced:

		ENGINES - °C					
Mn	T_o-°F	1	2	3	4	5	6*
1.9	210	860	870	845	860	858	820
2.0	240	840	851	825	840	838	821
2.1	270	828	840	812	825	822	820
2.2	320	815	825	810	822	813	822
2.3	335	819	827	809	821	815	822
2.5	405	819	829	812	821	816	820
2.7	467	818	832	812	820	815	820
2.8	517	819	832	810	822	815	820
2.88	550	818	836	810	821	818	820

Inlets started at 2.05 and 2.11 Mach numbers, left and right respectively. Throats maintained fairly good schedule until 2.6 Mn where both were leading closed, reading 2.6 and 2.59. Both were opened to keep read-out Mach numbers at least .05 Mn less than airplane Mach. This opening definitely increased airframe buffet from very light (commenced near 2.3 Mn) to light. HIGH PERFORMANCE was selected at 2.72 Mn, and essentially all of the buffet disappeared. Throats were now leading properly, in the closed direction, by .07 Mn; but near 2.8 Mn, had to be further closed because of lagging excessively. Shortly thereafter, right throat again had to be closed further because of lagging the schedule excessively. At 2.91 Mn, both throats were reading 2.97 Mn. Performance in the climb above 2.7 Mn was excellent compared to the acceleration from 2.3 to 2.7 Mn. As the airplane was leveled off at 70,000 ft. for the level flight performance run at 2.9 Mn, four degrees of left-wing-down trim was required for hands-off flight.

4.0 LEVEL FLIGHT PERFORMANCE - 2.9 MN

Just as proper power, trim, and altitude were fairly well stabilized, ground requested the turn toward home. This turn negated the data.

*No. 6 engine in T_2 reset entire flight for G.E. test purposes.

Shortly after stabilizing near 17-degree bank angle, the copilot reported the right inlet unstarted. (Later data revealed that the inlet went through a restart cycle and did not unstart.) The engines were checked immediately, and no abnormalties were observed. As the copilot reported the right inlet stabilized in a restart condition, the No. 6 engine was observed (most likely from the blinking EGT light) in a stalled, over-temperature condition. The throttle was pulled to Military Power immediately. A glance revealed no change, and throttle was reduced to IDLE and EGT immediately decreased.

In the restart condition, near one-third to one-half rudder and ten pounds of aileron were required for level flight at 2.82 Mn. Right bypass was reading 1,440 sq. in. The right inlet was reset; and at 2.72 Mn with engine No. 6 at IDLE, other engines in MAX A/B, the following readings were observed on engine No. 6: EGT - 380°, Nozzle - 67 per cent, RPM - 90 per cent, throats and bypasses - 2.65 and 2.64 Mn, and 550 and 630 sq. in., left and right. Prior to this, near 2.8 Mn, the right bypass was generally running fifty sq. in. farther closed than the left. Taking this into account, approximately 130 sq. in. of bypass were required to compensate for engine No. 6 at 90 per cent RPM rather than 100 per cent. Engine RPM lockup was not connected on this flight, which probably saved an engine as this step was eliminated in the emergency procedure. (Later data revealed that the engine did not exceed temperature-time limits.)

With engine No. 6 at IDLE, others in MAX A/B, 60,000 ft. was reached with 2.35 Mn. Seven or eight minutes later the airplane had accelerated to 2.55 Mn in level flight. The ram purge test was aborted because of not being able to accelerate to Mach 3 on five engines in the space and fuel remaining.

5.0 SONIC BOOM - 1.8 MN

The boom was accomplished in descent using full power on five engines at 1.8 Mn, 54,300 ft., with 42,500 pounds of fuel remaining. Shortly after that, the data was marked at C/N 5321 for airspeed calibration purposes.

6.0 COOPER RATINGS - .8 MN, 20,000 FT.

With augmentation on, wingtips at one-half, a climb and descent was accomplished through 2,500 ft. (because No. 1 and No. 6 throttles were in IDLE, the climb was not accomplished to 25,000 ft.). The maneuver was easy to perform and was rated -2. With augmentation off, it was rated a 4½ because of low gradients and low restoring moments causing excessive overcontrol. The CG was aft at 24 per cent with 18,000 pounds total fuel remaining. Thirty-degree bank angle turns with and without rudder coordination and with and without augmentation were accomplished. All four maneuvers were given a rating of 4 due to aileron sensitivity and yaw due to aileron or excessive rudder required to compensate for yaw on the initial roll-in.

7.0 EXPANDED SCALE ATTITUDE INSTRUMENT

The expanded scale attitude tape definitely improved the writer's ability to maintain a constant 575 KIAS up to 50,000; however, above this altitude where climb speed varies with altitude, more difficulty was encountered. It was intended to find a near constant attitude that hopefully would approximate the climb schedule, but this was never found. The expanded scale tape did help, but airspeed still varied excessively. It was felt that at least one parameter should be constant in order to obtain the most benefit from the attitude tape. The tape sensitivity and damping appeared satisfactory. This instrument, along with an equivalent airspeed indicator, may solve the climb schedule problems. Once while flying the round dial airspeed, it was observed that the VSI readout airspeed did not move while the round dial airspeed increased nine knots. Then all of a sudden the VSI airspeed "broke out" and increased very rapidly to exactly what the round dial was indicating. This VSI instrumentation, I believe, causes some of the longitudinal problems at high Mach and high altitude.

8.0 ERRATIC NOSEWHEEL STEERING

After stopping on the runway at the end of the landing roll, near full right rudder was applied in order to make a ninety degree turn. The turn seemed slow, and rightly so, because the steering was in takeoff and landing mode. The rudder was released somewhat and taxi mode was selected, then full rudder was applied wherein the airplane turned moderately fast. As the rudder was released, toward neutral, to stop the turn, the airplane kept turning and full left rudder was applied with apparently negative results. Just prior to applying full emergency brakes to prevent running off the taxiway, a lessening of the turn was observed. As the airplane straightened out, some right rudder was applied and response was normal. Then to stop the slight right turning, full left rudder was required to straighten the airplane again. The airplane was stopped. It appeared that the authority to the left was almost nil and normal or slightly high to the right. Later, the steering was checked and found to have corrected itself, for the authority was now equal left and right

9.0 CONSUMABLES REMAINING

Just prior to shutdown, the following quantities were observed:

FUEL - LBS.		NH_3-LBS.	H_2O-LBS.	O_2-LITERS	LN_2 - %
1 - 200	6L - 0	320	1,450	12.1	42
2 - 100	6R - 300				
3 - 9,500	7L - 0				
4 - 400	7R - 0				
5 - 400	8L - 0				
	8R - 0				
Total:	11,000				

10.0 CONCLUSIONS

1. AGPS heading was lagging actual airplane heading at medium speeds.
2. Flight track deviations should be allowed in order to obtain performance data.
3. The expanded scale attitude tape was a significant improvement and enabled one to maintain much better longitudinal control during the climb.
4. Considerable difficulty still encountered in maintaining climb schedule above 50,000 ft., even with the new attitude indicator. It appeared that some constant parameter was needed, along with the sensitive attitude, in order to perform a satisfactory job.
5. Fifteen hundred pounds of trapped fuel at shutdown--less than one per cent was considered satisfactory.

11.0 DISCREPANCIES

1. Pilot's left-hand buzz caution light cycles off and on during engine start.
2. Right-hand inlet went through a restart cycle at 2.9 Mn without an unstart.
3. Nosewheel steering went hard right with half rudder upon switching from T/O LDG to TAXI, then left steering was insensitive.
4. UTL STATUS #5 on most of flight.
5. No. 2 EGT cycles 835-845°C above 80-degree throttle angle and sluggish to return below 918° on selecting MIL.
6. No. 6 engine above 980°C for unknown time.
7. Pilot's VSI airspeed hanging up near 570 knots, 2.3 Mn.

V H Shepard

V. H. Shepard
Pilot

PILOT'S FLIGHT REPORT

AIR VEHICLE XB-70A #2 (207) PILOT V. Shepard

FLIGHT NO. 2-45 COPILOT Col. J. Cotton

DATE OF TEST 6 June 1966 FLIGHT TIME 2:00

CHASE AIRCRAFT AND PILOTS

Chase 1 - F-104 #316 - Major Knight/Lt. Col. Fulton
Chase 2 - F-104 #748 - Capt. Curtis
Chase 3 - F-104 #817 - Capt. Hoag
Chase 4 - F-104 #316 - Lt. Col. Sorlie/Lt. Col. Fulton

PURPOSE OF FLIGHT

1. Level flight performance - 2.9 and 3.0 Mn.
2. Ram purge - 3.0 and 2.3 Mn.

1.0 ENGINE START AND TAKEOFF

Prior to engine start the following were observed: 272,500 pounds of fuel, 565 pounds of ammonia, 14.8 liters of oxygen, 2,100 pounds of water, and both the OAT and the EE temperature were reading 68°F.

The takeoff was normal with a slow rotation starting at 185 KIAS. The airplane became airborne slightly above 210 KIAS, three knots below target takeoff airspeed. The airplane flew off between ten and eleven degrees of pitch attitude and accelerated normally. The timed acceleration was good from 69 knots, as 156 knots was reached after twenty seconds; however, the wind was blowing at 18 knots, variable.

2.0 CLIMB/ACCELERATION

The climb was uneventful to 2.28 Mn where light airframe buffet commenced. No difficulty was encountered in holding the 575-knot constant climb speed to 50,000 ft. using the test attitude indicator. The test vernier attitude tape was erratic and generally rotated the entire flight. From 50,000 ft. the airplane was generally climbed ten to fifteen knots below the envelope limit speed in order to prevent exceeding limit speeds during the climb at high Mach numbers. Difficulty was still encountered in controlling the airspeed within plus or minus fifteen knots due to poor airplane response longitudinally, and nothing was constant during the climb and vernier tape was useless.

At 2.7 Mn, HIGH inlet performance was selected, and almost all the airframe buffet disappeared. The airplane appeared to perform much

better in HIGH performance, and it readily went to 2.9 Mn even in seventeen to twenty degree bank angle turns. The copilot made considerable changes with the throat deviation knobs during the climb in order to keep the throat within the required limits. The airplane was leveled out at 2.9 Mn, 70,000 ft., with 78,000 pounds of fuel remaining.

3.0 LEVEL FLIGHT PERFORMANCE - 2.9 MN

At level out, throttles #3 and #4 were pulled back near 90 degrees. The airspeed tended to increase and the two throttles were further reduced to 85 degrees. Excellent altitude control was maintained with almost no attitude change. It appeared that the airplane was luckily at the proper attitude and trimmed out. Angle of attack was reading four degrees at 70,020 ft., 487 knots, 551° total temperature. The data was turned on immediately at C/N 3750 with the Mach number reading 2.89, throats reading 2.95 and 2.91, and the bypass reading 340 and 310 sq. in., left and right respectively. For more than one minute nothing changed until the altitude started to climb slightly and the airspeed fell off to 486 knots. A very slight pitch attitude correction was made which started a very mild, medium-period (four to six seconds) longitudinal overcontrol in attempting to maintain a constant altitude. The altitude oscillated plus or minus 60 or 70 ft. around 70,080 ft. During one minute of this continual hunting and never being able to settle out because of poor altitude information and longitudinal selectivity around center, the airspeed only changed one knot to 485. For a supersonic point this was considered excellently stabilized data, especially the first minute.

4.0 CLIMB TO MACH 3, 72,000 FT.

The CHUTE OVERHEAT caution light came on at C/N 3940. As the airplane was climbed toward 72,000 ft., continuous data commenced at C/N 4020. As the airplane was rolled out of a turn on a 210-degree heading, the attitude gyro indicated seven degrees left wing down. Derated mag was selected. This had no effect on the roll angle with the airplane in level flight; however, the heading returned to 200 degrees instead of 210 degrees. As the airplane reached 72,000 ft., 619 degrees total temperature was observed at 3.025 Mn. At this Mach number the right inlet was running behind schedule, reading only 3.01, and the deviation knob was increased from 005 to 015. Shortly after this, throats and bypasses were observed at 3.06 and 3.07 and 260 and 290 sq. in. respectively.

5.0 RAM PURGE - 72, 000 FT.

After stabilizing at Mach 3, for a minute or so, the copilot selected NORMAL performance and reported the left inlet lagging .08 to .09 Mn

with 995 set in the deviation windows. The right inlet was lagging .05 Mn with 015 deviation setting. Then the following data were observed: Cabin altitude, 8,000 ft.; ammonia quantity, 500 pounds; water quantity, 1,650 pounds; EE temperature reading 44°F; and 609 degrees total temperature at indicated 3.0 Mn, 72,000 ft. No. 3 and 4 throttles were observed at 94 degrees; other throttles, of course, were at MAX A/B. At this time the left inlet unstarted. This was considered a mild unstart, even milder than the bypass unstarts observed on previous tests at 2.4 Mn. The only transient noticed in the airplane was a slight roll to the left which required only five pounds of aileron force to maintain wings level. Very little yaw was observed, and since the airplane did not require any special attention, the engines were checked immediately and were found to be normal. The left three throttles were pulled back slightly while checking the engines. The copilot observed the left inlet in a restart condition and reported the left bypass at 1,300 sq. in. At this time the airplane was trimmed laterally for hands-off flying. Then the copilot pushed the RESET button and the throttles were advanced to MAX A/B to maintain the Mach number. Above Mach 3 was maintained during the entire unstart and restart cycle, even though the three left throttles were slightly retarded in anticipation of engine stall problems.

The airplane was trimmed out at 70,500 ft. and PURGE was finally selected at C/N 4647. (The airplane was not climbed to 72,000 ft. as the card called for because of running out of air space and not wanting to remain at such high Mach number with the drag CHUTE OVERHEAT light illuminated.) The cabin altitude ascended moderately fast, reaching 30,000 ft. in thirteen seconds and 35,000 ft. in approximately thirty-four seconds. No trim change was observed with scoop operation. After one minute, the Mach number was 3.02 with the cabin altitude reading 35,000 ft.; ammonia, 500 pounds; water, 1,550 pounds; EE temperature, 42° at an altitude of 70,700 ft. LOW PERFORMANCE was then selected on the inlet. As the copilot retarded the throttles to MIL power, the airplane was observed to pitch up slightly. Altitude was held level near 70,000 ft. for the deceleration to 400 KIAS. At 2.7 airplane Mach number the throats were reading 2.54 and 2.63 and the bypasses were reading 1160 and 980 sq. in., left and right. Right-hand deviation was set at 000. As the airplane reached 410 knots, 70,000 ft., REPRESSURE was selected C/N 4918 with the cabin stabilized at 36,000 ft. Mach number was near 2.3, the ammonia quantity was 410 pounds, and water was 1,600 pounds. EE temperature was reading 39 degrees. The EE OVERHEAT light came on for five or ten seconds after repressure was selected, then extinguished itself as the cabin decreased toward 8,000 ft. The remaining part of the letdown was satisfactory, being in the neighborhood of 400 knots.

6.0 AIRSPEED AND SONIC BOOM DATA

Just after the deceleration was commenced, the data was marked at C/N 4760, 2.99 Mn, 70,400 ft., at ground command in order to correlate sonic boom and space-positioning data.

7.0 LATERAL TRIM CHANGE

As the wingtips were selected to one-half near 1.3 Mn, the airplane became left wing heavy. It was observed that most of the left wing down trim (three to four degrees) that had been utilized for most of the flight was now eliminated after retrimming laterally. The lateral trim change was mild and was most probably the result of the changing wingtips configuration.

8.0 CONCLUSIONS

1. Impossible to fly the limit climb schedule without exceeding airspeed limits.
2. Excellent level flight performance run obtained at 2.89 Mn.
3. Inlet throats open excessively when shifting from HIGH to NORMAL performance, reducing maneuvering margin.
4. Airplane transients and trim changes resulting from a throat unstart at Mach 3 were mild. Trim change was primarily in roll--five pounds.
5. The flood flow ram scoop operated satisfactorily at 3.0 Mn, 70,000 ft., and recovery during the level deceleration at 70,000 ft. to 400 KIAS (2.3 Mn) also was satisfactory, maintaining the cabin at 35,000 to 36,000 ft.
6. No problems were encountered in flying the airplane lateral-directional wise at Mach 3, even during a throat unstart. Let's give it a Cooper Rating of 3.
7. Longitudinally at Mach 3 the airplane was more difficult to fly because of excessive time and work required to hold altitude.

9.0 DISCREPANCIES

1. Pilot's radio lead has loose connection on A/P side of pressure suit connector.
2. Fuel totalizer erratic.
3. ADI vernier attitude tape erratic.
4. Drag CHUTE OVERHEAT came on at 555°TT, went off at .9 Mn.
5. Thump in right rudder at 2.7 to 2.8 Mn.
6. Ice formed on fuselage drain hole #7.

V. H. Shepard
Pilot

V. Shepard

FTTP 66-8-7

Date · 11 August 1966 (Revised)

TO · Roy Ferren
Address · Dept. 186, Bldg. 2
Los Angeles

FROM · A. S. White
Address · Dept. 186, Bldg. 2
Los Angeles

Phone · 3548

Subject · Pilot's Summary Report - XB-70A

The purpose of this report is to summarize pilot opinion of flying the XB-70A. In reading this report, consideration should be given to the fact that the combination of this airplane's size, weight, and speed ranges compares to no other airplane in existence; and that the program is primarily a research program in which, to this point in time, the ground rules have allowed only those changes which were necessary to safely accomplish the objectives. In the normal sequence of development of an operational airplane, many of the opinions and recommendations expressed herein would have been made after the initial airworthiness flights. They are presented now, for the record, and for consideration if improvements can be made for the follow-on program.

In general terms, the XB-70A is an interesting airplane to fly. It has some peculiarities due to the size, weight, and configuration that are different from most other airplanes. The movable wingtips introduce some new characteristics in this airplane that have not been experienced before, such as the wide variations in directional stability, roll power, and dihedral effect.

The airplane has a tremendous performance capability and is a thrill to fly from that standpoint, but this capability combined with the fact that the airplane is climbed and cruised very near the boundary of the allowable flight envelope make it possible for the airplane to get out of the envelope quicker and easier than any other airplane this pilot has flown. The duct pressure limits and the low allowable G aggravate the recovery. All this adds to the pressure on the pilot by requiring greater concentration on his part. This is acceptable in a research program of this nature, but would certainly not be acceptable in an operational vehicle. The potential for a great airplane is here, but some refinements are required.

More specifically, the pilot's opinions and recommendations are as follows:

GROUND HANDLING

Taxiing the airplane is not a difficult operation. Turns from one narrow taxiway to another narrow taxiway can be made with acceptable accuracy. However, parking the airplane in a precise location is difficult because of the restricted visibility, configuration of the airplane, and lack of repeatability of the nosewheel steering system; i.e., the nosewheel steering rate varies with the load on the nosewheel so that full rudder pedal application does not consistently give the same turning rate. Ground observers are required for parking, but their inputs are sometimes valueless due to the steering system's inability to follow their directions. Cooper Rating of 3.5.

Originally, the braking system was unsatisfactory at very low speeds. With development, the system has become marginally satisfactory. The airplane can be stopped without brake chatter as long as the pilot anticipates far enough in advance and applies the very light braking to make the stop. If an abrupt stop is required at low speeds, heavy brake chatter will result. Cooper Rating of 4.5.

IN-FLIGHT HANDLING QUALITIES

Low Speed

The pitch control in low-speed flight regime is very good. Some lack in airplane response can be detected during abrupt pitch maneuvers; however, the response is satisfactory in all of the normal maneuvers used in flying the airplane. The long period of the short-period oscillation is different from most other airplanes, but does not cause difficulty in controlling the airplane. The damping in pitch is good in the subsonic flight regime. Cooper Rating of 2.5.

The main difficulty in flying the XB-70 arises from a combination of characteristics in the lateral-directional sense. These characteristics are: First, that the period of the short-period oscillation is very long as compared to most other airplanes. Secondly, the side force per degree of sideslip is low in this airplane. This combination makes it difficult for the pilot to sense inadvertent sideslips. In addition to these characteristics, the airplane has a marked positive dihedral effect (particularly Ship No. 2) and it has excessive adverse yaw due to aileron. Considering these four characteristics together, it can be seen that an inadvertent sideslip can occur without the pilot being aware of it if, for instance, he is busy with other systems' operations. When this sideslip occurs, the airplane rolls due to the dihedral effect. Instinctive reaction of the pilot is to counteract the roll with aileron; however, the aileron input tends to increase the sideslip because of the high adverse yaw due to aileron. This increased sideslip causes more roll away from the aileron input and aggravates the situation. The solution is that the pilot must fly the sideslip or yaw indicator religiously throughout the flight regime. This general characteristic of the XB-70 is most predominant with the wingtips up. Cooper Rating of 4.5.

Placing the wingtips in the one-half position reduces the tendency for the situation explained in the previous paragraph to occur. The tendency is reduced because lowering the wingtips reduces the roll power by approximately fifty per cent, therefore reducing the yaw due to aileron. In addition, the tips-down configuration reduces the positive dihedral effect. Cooper Rating of 4.

The longitudinal trim system is very good. Cooper Rating of 2.

The lateral trim system is also very good, except that the primary lateral trim control is difficult to operate with a high degree of accuracy when the pilot is wearing heavy gloves. Cooper Rating of 3.

The directional trim system is very good after the gear has been retracted. It is too sensitive with the gear down, which causes the pilot to overcontrol when attempting to trim out directionally. Occasionally a pilot will encounter some difficulty when engaging the nosewheel steering system due to his inability to find the neutral directional trim position. For instance, the pilot may trim out directionally prior to putting the gear down; however, the trim system may not be exactly centered at this time. When the gear is lowered, this minor out-of-trim condition is amplified by a ratio of four to one, but still might not be detectable by feel to the pilot in turbulence. After landing, when the rudders are released and the nosewheel steering is engaged, an abrupt transient in the steering system may be encountered. It is recommended that consideration be given to reducing the directional trim rate and incorporating a rudder position indicator. Cooper Rating of 3.

The compatibility of the roll and pitch force gradients is satisfactory in this pilot's opinion; however, due to the large differences in the moments of inertia, the airplane responds much quicker in roll than it does in pitch or yaw. This is not considered to be a discrepancy against the airplane, but a characteristic of a very long, narrow configuration. It requires some getting used to by the pilots in order not to overcontrol in roll, particularly with tips up. This pilot does not believe that a change should be made in the response characteristics, but would like to see something done to reduce the adverse yaw due to aileron. This would eliminate the primary objectionable characteristic in the airplane. If the pilots did not have to be concerned about generating yaw with the aileron inputs, the fighter-like roll response of this airplane would not be objectionable. Control force compatibility--Cooper Rating of 3.

The trim change while operating the landing gear is negligible. The trim change while operating the wingtips is small and occurs at such a slow rate that it is hardly noticeable to the pilot since he takes care of it in the normal trimming of the airplane. The trim change due to operation of the flaps is large, but easily manageable with the trim system. Although the trim system will take care of the trim change, when the flaps are lowered the control column moves very near the forward end of its travel leaving very little usable down elevon for maneuvering, go-around, or flying in turbulent air. This could be extremely hazardous in the instance where the CG was farther aft than normal. It is recommended that design change be made whereby more down elevon control is made available with flaps down.

The airplane experiences moderate buffet at low speeds with the gear and flaps down. There is a minor change in the buffet level as the gear and flaps are raised. Some buffet persists and a high aerodynamic noise level exists until the airplane accelerates to .87 Mn or above, at which time the buffet completely disappears and the noise level is reduced to at least half of the low-speed level.

High Speed

Pitch control during the transonic accelerations and low supersonic speed ranges is very good. Above Mach 2 it becomes evident that there is some deterioration in the effectiveness of the pitch control. At speeds above 2.5 Mn, the force level required to maneuver the airplane is excessive due to the deterioration of effectiveness and due to the action of the "q" bellows. Cooper Rating of 3.5.

The directional control is adequate to take care of three engines out on one side condition, but is much less effective in producing yaw than the ailerons. Considering the capability of the rudders alone, they are considered adequate. Cooper Rating of 3. However, the powerful capability of the ailerons in producing yaw is considered the most objectionable characteristic in the airplane. Cooper Rating of 4.5.

The roll response of the airplane in the supersonic flight regime is good. The roll response does not seem to deteriorate at the same rate as pitch response, and therefore there is less compatibility in the response of the airplane between Mach 2 and 2.7 than in other areas. As the airplane approaches Mach 3, the roll response deteriorates somewhat and the yaw due to aileron input is reduced; therefore the handling qualities of the airplane in roll are better at Mach 3 than at any other supersonic speed. Cooper Rating for the roll control system is 3.5.

Although there are minor differences in the flight characteristics between 1.4 and Mach 3 with all augmentation off, the general characteristics are the same. The short-period oscillations in pitch and yaw are four to six seconds in length and the damping in pitch and yaw is relatively poor. The airplane can be flown at all speeds with the augmentation off, except that extreme care must be used in the use of ailerons because of the strong tendency to excite lateral-directional oscillations with the ailerons. This is due to a high roll rate in the unaugmented case and due to the excessive level of yaw due to aileron. When the pilots leave the ailerons alone, the yawing oscillations will damp. Unaugmented supersonic flight--Cooper Rating of 5.

VISIBILITY

The visibility is satisfactory with the windshield down. Although some forward visibility is lost after the rotation for takeoff and during the initial part of the climbout, the remainder of the subsonic flight is satisfactory. The visibility for landing is considered good. This pilot is not aware of any loss of runway visibility during the approach, flare, and touchdown. Cooper Rating of 3.

Visibility with the windshield in the up position is unsatisfactory. The pilot cannot see the horizon ahead and must make the flight almost entirely with reference to the instruments. Considering the poor quality of the pitch attitude indicating system and the poor quality of the heading information, precise heading, climb schedule, and altitude flying are extremely difficult. In addition, images of light-colored ground such as snow and sandy desert areas reflect badly in the windshield during turns, at times causing vertigo. Cooper Rating with the windshield up--5.

UNSTARTS

The inadvertent inlet unstarts encountered in the flight test program have varied in intensity from mild to severe. They are breath-taking, to say the least. In the case of a severe unstart, they jar the airplane rather violently and are followed by heavy buffeting, intense aerodynamic noise, and minor trim changes. At Mach 3, the primary trim change is in roll, but usually does not persist since the other inlet will normally unstart within a few seconds. If the inlet system does not effect an immediate restart, the inlet will go into buzz. The buzz cycle is immediately recognizable to the pilot since it is an almost purely lateral oscillation at about the natural frequency of the fuselage. If it is not corrected, it builds up in intensity to a very disturbing--if not destructive--magnitude. In spite of the severity of the transients caused by inlet unstarts, airplane control is considered good.

LANDING

The XB-70 is not a difficult airplane to land. Some care must be used due to the distance between the pilot and the main gear and due to the crew station height above the main gear at touchdown. Because of these dimensions, it is not hard to undershoot the runway; but after some practice, all the pilots are able to make satisfactory landings without external assistance from the chase aircraft.

The wing of the XB-70 experiences a strong ground effect in the proximity of the runway which helps considerably in making relatively smooth landings. The secret to a good landing, like in most airplanes, is a good stabilized approach using a rather low rate of descent (two to three degrees glide slope).

Crosswind landings in the XB-70 are not as difficult as was predicted. The relatively shallow bank angle per degree of sideslip makes the wing-down technique rather easy to use with the XB-70.

Landing in turbulent air requires additional pilot concentration, primarily due to the previously mentioned relationship between inadvertent sideslip, dihedral effect, and yaw due to aileron. The pilot is required to watch the yaw indicator very closely in making an approach so as not to get into this inadvertent sideslip condition close to the ground. Landing Cooper Rating--3.5.

COCKPIT CONTROLS, COCKPIT LAYOUT, AND SYSTEMS OPERATION

Capsule

The pressure seals in the capsule doors have been torn loose many times when the pilots enter the capsules. Entering the capsule, particularly when the pilot is wearing a pressure suit, is very difficult due to the lack of space. The seals should be guarded so that they are not damaged in this way.

The original installation of the capsule handgrip seat pins included a lanyard and a take-up reel which were installed behind the pilot's shoulder. A large percentage of the time the take-up reel did not operate; and when it did operate, the pin was extremely hard to reach to reinstall after flight. A temporary fix was made by cutting the lanyard, thereby eliminating the take-up reel. This works satisfactorily, except for the minor inconvenience of not having a place to stow the pin.

The emergency parachute and riser cutter handles and the hinge split handle are difficult to see when encapsulated. When the pilot raises his head to see these handles with his helmet on, he must raise his helmet with his hand in order to see past the brow of the helmet. This is particularly true when the pilot is wearing a pressure suit and would be aggravated under the dynamic conditions encountered after ejection.

The pressurization and capsule oxygen gages are particularly hard to see once in the capsule.

The safety belt is almost impossible to adjust after it has been fastened.

The seal deflate button is very difficult to actuate due to its location when the pilot is wearing a pressure suit.

The hot mike interphone capability during encapsulation is operable only after the capsule doors are closed. It appears wise after the recent ejection to actuate the hot mike in another way in addition to the door closure. It should be connected to the handgrips so when an encapsulation is made, the hot mike interphone is available even if the doors are not closed.

The manual impact attenuator inflation device is extremely difficult to get to while encapsulated. It is recommended that some thought be given to relocating this device between the pilot's knees for easier access.

The Secondary Nozzle Rheostat

This rheostat is in a poor location considering the number of times it is used during the flight. It would be desirable to move it forward in the area near the oxygen and visor heater switches.

Hydraulic Pump Status Indicators

The hydraulic pump status indicators have become almost useless in view of the number of times that the pump status indicators show yellow with the pump operating properly.

Nosewheel Steering System

The nosewheel steering engage button ideally should be mounted on the control wheel. Originally this was not done because of lack of space on the wheel. The pilots believed that the augmentation disengage switch should have the priority location on the control wheel. The experience gained in the flight test program indicates that it would now be satisfactory to move the augmentation disengage switch to the same area as the augmentation engage button on the console and put the nosewheel steering engage switch on the control wheel.

TACAN

The TACAN instrumentation on the XB-70 is only marginally satisfactory. Early in the program the pilots were requested to list the minimum equipment with which they could accomplish the mission, and one TACAN set was suggested for navigation. Experience has now shown that without radar tracking and the occasional assistance of the FAA centers, some of the missions would have been extremely difficult to complete satisfactorily due to the quality of this equipment and installation.

Attitude and Heading Information

The attitude and heading information presented to the pilot are marginally satisfactory. This adds to the pilot's difficulty in navigating the airplane. In view of the above two conditions, it is highly desirable to have a more reliable navigation system. An inertial platform is highly recommended.

AICS Controls

The AICS controls were satisfactory for the development stages, although the controls in Ship #1 are minimum satisfactory. It is highly recommended that this system be reviewed for future use.

Flaps

The flap system is marginally satisfactory. Because of a design problem, the flaps have to be raised for the taxi and lowered just prior to takeoff in order to ensure that they will retract in flight. Occasionally they have not extended for landing, and occasionally they will not retract after landing. The result is that the pilots have lost confidence in the flap system. It is recommended that a design change be made to eliminate the necessity of the intricate procedure that is now required to operate the flap system.

Map Case

The map case is almost inaccessible to the pilots. In most cases the pilot would have to get out of his seat to get the equipment out of the map case. Although the map case is of little use to the pilots, it is the only place in the cockpit that extra material can be stored. Check lists and pilots' data cards must be strapped to the pilots' legs to be of any use. Some consideration should be given to a more convenient stowage space for let-down charts, handbook, and additional maps--particularly if this airplane is to be used for cross-country work in the future.

Wingtip Selector Switch

If the flaps are lowered for the landing prior to raising the wingtips to the up position, it is possible to lose control of the airplane. It is recommended that a safety device be installed to prevent lowering the flaps when the tips are not in the up position.

SUMMARY

The XB-70 has proven itself to be a very remarkable airplane. It has accomplished every milestone that was set down for it. No aerodynamic changes were required in order to achieve the objectives; but in spite of its tremendous performance, the XB-70 is an unfinished airplane. It was operated in a completely new speed and altitude range, but with off-the-sheld navigation equipment and flight instrumentation that is obsolete for this type of flight operation. This pilot believes that with normal development, including some aerodynamic refinement, some system changes, and better instruments and navigational equipment, this would be a truly outstanding airplane.

A. S. White
Chief Test Pilot

ASW:jau

cc: Swanson, Stroh, Spivak, Stacey, Schoch, Shepard, Ince, Kemp, Rogerson, Peterson, Fero, Melton, Matteson

COPILOT'S FLIGHT REPORT

AIR VEHICLE XB-70 #1 (001) PILOT Col. J. Cotton

FLIGHT NO. 1-63 COPILOT V. H. Shepard

DATE OF TEST 2 June 1967 FLIGHT TIME 2:23

PURPOSE OF FLIGHT

1. Stability and control at .75 Mn, Mid C.G., 22.5%
2. Stability and control at 1.2 Mn, 40,000 feet, Forward C.G. 19.5%
3. Handling qualities at 1.2 Mn, 40,000 feet
4. Pacer airspeed calibration

ENGINE START

Weight at engine start was 553,000 pounds with 272,000 pounds of indicated fuel. The engines were started normally in approximately six minutes. Tank 1 was reduced from 45,700 to 35,400 pounds prior to taxi.

TAXI

The left turn out of the run pad could not be completed within the confines of the taxiway because of excessive turn radius with full left rudder. The turn was slow and no brake was used. The airplane was stopped halfway through this turn on a signal from the ground crew. With the engines running, the airplane was positioned with a tug before further taxiing was continued. The next turn was a right turn and no problems were encountered. Problems were then encountered on the next ninety degree left turn in front of Base Operations. This turn was accomplished by the copilot and was anticipated from a position to the right of the taxiway centerline. Left brake had to be used in order to prevent the wheels from leaving the taxiway and possibly running over taxi lights. The turn was not normal and further investigation revealed that the airplane was pulling moderately right with or without steering engaged on a level surface. Pulling to the right was not a strut problem as the left strut was slightly lower than the right strut.

TAKEOFF

Brake release fuel was 246,000 pounds with the airplane weighing 527,000 pounds at 21.9% C.G. Acceleration was normal, reaching 149 KIAS as read from the sensitive airspeed at 34 seconds. Temperature was 52° F.

Shortly after takeoff the landing gear was cycled one and a half times with no difficulties.

Stability and Control - .75 Mn, 15,000 Feet

With Tank 6 feeding and all other tanks off, longitudinal and lateral directional stability sets were accomplished with the wing tips up. All runs were completed except the wings level sideslip which was omitted because of having to climb to a preassigned altitude prior to departing the Edwards Special Operating Area.

Nose Ramp - .91 to .93 Mn, 32,000 Feet

The nose ramp was raised and stopped at intervals of 20, 50, 80 and 100 percent of travel, then lowered and stopped at intervals of 80, 50, 20 and zero percent of travel. Data was on continuously from 3084 to 3270 C/N. The operation was excellent and the horizon was obscured when the ramp exceeded 40% up travel with seats adjusted approximately two inches from the top.

Stability and Control - 1.2 Mn, 40,000 Feet

Longitudinal and lateral directional stability and handling qualities sets were accomplished at a constant forward C. G. of 19.3% ±.5% by maintaining the following fuel schedule after Tanks 4 and 6 were empty. Generally the damping and stability levels were rated excellent to satisfactory. Turns were rated 2 and 3, uncoordinated and coordinated, respectively. The uncoordinated turns were rated higher because the adverse yaw was mild with slow or fast turn entries. In other words, rudder was not required and when rudder was used in the coordinated turns, the pilot had to work harder in attempting to coordinate the turn.

Tank	Fuel, lbs.	ON	OFF
2	23,300	X	
2	16,500		X
7	10,000	X	
7	Ø		X
2	16,500	X	
2	10,000		X
8	27,000	X	
8	20,000		X
2	10,000	X	
2	Ø		X
8	20,000	X	
8	13,700		X

Stability and Control - .75 Mn, Wingtips Up

Longitudinal and lateral directional stability sets were accomplished at 24,000 and 25,000 feet respectively at a mid C.G. of 22.5 ±.5% per the following fuel schedule with Tanks 6, 4, 7, and 2 empty. During

the wings level sideslip, mild positive dihedral effect was observed with near 5° of left aileron required for 1/3 to 1/2 right rudder in a stabilized 2.1° of right yaw.

Tank	Fuel, lbs.	ON	OFF
1	10,500		X
8	13,700	X	
8	8,400		X
1	10,500	X	
1	5,900		X
8	8,400	X	
8	Ø		X
1	5,900	X	

Airspeed Pacer Calibration

The following pacer points were obtained utilizing an F-104 pacer:

Mn	Airspeed - KIAS Sensitive	VSI	Altitude -Ft.	Temperature-°F.	Configuration
.745	320	318	24200	24	Gear & Flaps Up
.75	321	319	24300	--	"
.80	341.5	339.5	25000	28	"
.60	249	245.5	25600	--	Gear & Flaps Dn
.55	231	228	25000	2	"
.51	216.5	214	24250	Pegged at 0°	"

Nose Wheel Steering

The pilot had difficulty engaging nose wheel steering during the landing rollout. After several futile attempts, the writer was instructed to accomplish the job. The switch was then moved from FAILSAFE to ENGAGE and the nose steering light illuminated within a few seconds. Then the switch was returned to FAILSAFE and steering remained engaged. The problem may have been that the nose gear switch was not actuated until the pilot applied more nose down force with two hands.

Position of the engage switch and "nose steering engaged" light were not located in optimum positions on this aircraft. This may have attributed to the problem as the pilot couldn't spend enough time looking at the light and/or switch in their present positions during the critical rollout phase of landing.

During taxi-in, the pilot again had difficulty engaging the steering while investigating a moderate pull to the right. The left two main tires were blown out while trying to keep the airplane on the taxiway with brake; and steering disengaged.

Unavailable Fuel

The following unavailable fuel was observed on taxi-in:

Tank	Lbs.
1	500
2	100
4	400
6L	2600
6R	1400
7L	2300
7R	1600
8L	400
8R	Ø
	9300 Total

Conclusions

1. Nose wheel steering switch and engaged light are both located in awkward positions.

2. Aileron only turns were preferred over coordinated turns at 1.2 Mn, 40,000 feet because of lower workload and adverse yaw was not bothersome.

3. Variable nose ramp operated excellently.

Recommendations

1. That the aircraft be positioned on the north side of the run pad to improve the chances of accomplishing the first left turn.

Malfunctions

1. Nosewheel steering does not have sufficient authority in left turns.

2. Utility hydraulic System No. 2 oscillated from 3500 to 4500 psi.

3. While checking nosewheel malfunctions, Tires 3 and 7 blew out.

4. Yaw No. 1 indicator inoperative for first part of flight.

5. Tank 3 high boost pump malfunctioned prior to flight, but operated during flight.

V H Shepard

V. H. Shepard
Sr. Engineering Test Pilot

INTRODUCTION

The general statistics of the flight are included in the following:

Total Flight Time = 2:23 Hrs:Min
Total Time Above Mach 1.0 = 0.42 Hrs:Min
Maximum Mach Number = 1.43
Liftoff Gross Weight = 518,355 pounds
Landing Gross Weight = 293,115 pounds

The primary test objectives for this flight were as follows:

(a) Stability and Control - preliminary aeroelastic evaluation.

Mach 0.75, Altitude = 15,000 feet
Mach 0.75, Altitude = 25,500 feet

(b) Handling Qualities - GPAS Validation

Mn = 1.2, Altitude = 40,000 feet
Sidestep approach maneuvers in landing approach.

(c) Airspeed Calibration

Mach 1.4 to 0.9 level deceleration at altitude = 40,000 feet
Pacer Calibration
Mach = 0.92, 0.89, 0.85, 0.80, 0.75 at altitude = 32,000 feet
Mach = 0.70, 0.65, 0.60, 0.55, 0.50 at altitude = 25,500 feet

(d) Boundary Layer Noise

Mach = 0.90, Altitude = 32,000 feet
Mach = 1.43, Altitude = 32,000 feet

(e) Systems Functional Check

Landing gear - cycle following takeoff
Wing Tips
V_i = 270 KIAS, Altitude = 6-8,000 feet
Mach 1.3, Altitude = 32,000 feet
Variable Nose Ramp
Mach = 0.90, Altitude = 37,000 feet
Mach = 1.2, Altitude = 40,000 feet

A major portion of these test objectives were accomplished as planned. Modifications of or deletions from the scheduled test plan are indicated

within the Engineering Summary.

During the preflight taxi operation from the run-up area to the runway, problems were encountered with the nose wheel steering. The initial left turn from the run-up area had to be completed with the assistance of a tug. While returning to the hangar after the flight the crew again checked the nose wheel steering. In the process of this check tires 3 and 7 blew out on the left-hand boggie. A portion of one of the tires struck and damaged approximately a one (1) foot square area at FS 1728. Further postflight inspection of the aricraft structure or engines did not reveal any problems that would significantly effect the schedule of the next flight.

ENGINEERING SUMMARY

Stability and Control - In an attempt to measure the aeroelastic effect on the measured stability and control derivatives, a standard set of static and dynamic longitudinal and lateral-directional maneuvers were performed at an indicated Mach number of 0.75 and at altitudes of 15,000 and 25,000 feet. During the test maneuvers, the respective mode of stability augmentation was turned off and the wing tips were set at zero degrees. An objective in acquiring this data was to cover a range of weight and dynamic pressure while maintaining a relatively constant angle of attack and center of gravity.

The first set of data was obtained at 15,000 feet with an average gross weight and center of gravity of 465,000 pounds and 22 percent MAC, respectively. For these conditions the dynamic pressure was approximately 465 psf, the trim angle of attack was 3.5 to 4.0, degrees and the pitch attitude was reported to be approximately 1-2 degrees nose up.

In the longitudinal mode, the wind-up turn was performed up to the maximum normal acceleration = 1.48 "g" and a loss of approximately 400 feet in altitude was experienced. The pilot reported that there did not appear to be much of a force change in acquiring these conditions. Following this maneuver a pull-up and release maneuver was executed. The resulting oscillation was well damped but it was reported that there was a tendency to overshoot the target normal acceleration in this region. The pilot had established 1.2 to 1.3 as a target and overshot to approximately 1.48.

In the lateral-directional mode a series of double aileron and rudder pulses were performed. The wings-level sideslip was eliminated to avoid interference with commercial traffic in the area. Following the double aileron pulse the pilot reported that the oscillation in yaw reached ±1.5 degrees in sideslip and that there was a tendency to roll

off to the left. Prior to performing the rudder pulse an attempt was made to trim out the apparent left wing heaviness condition. Also it was reported that there was some difficulty in maintaining longitudinal trim. Two double rudder pulse maneuvers were performed as the first rudder input to the right did not produce the desired airplane response. The second maneuver incorporated a rudder pulse to the left and the telemeter data indicated that the maneuver was satisfactory. It was reported that there was still an apparent wing heaviness condition at the conclusion of the maneuver and the lateral trim was reported to be approximately 7 degrees left wing down.

For this series of maneuvers, the crew did not indicate any interference from turbulence and from this standpoint the data should be acceptable.

The second series of maneuvers performed at Mach 0.75 were accomplished in the altitude range from 24,000 to 25,000 feet. The average gross weight and center of gravity was 330,000 pounds and 22 percent MAC. The dynamic pressure was approximately 320 psf and the trim angle of attack was 4.0 degrees. As mentioned previously stability augmentation was turned off during the test maneuvers.

Prior to performing the test maneuvers the pilot indicated that the lateral-directional handling appeared to be a bit "wormy" with the wing tips at zero degrees deflection. This same observation was noted during the similar tests run at this condition earlier in the flight.

The initial longitudinal maneuver was a wind-up turn to the right where it was indicated that the maximum normal acceleration was 1.52 "g" at a bank angle of 47 degrees. Prior to the pull-up and release maneuver there was some indication of light turbulence; however after a slight delay, the maneuver was performed satisfactorily. The peak acceleration following the pull-up was noted to be 1.6 "g"'s.

The lateral-directional maneuvers consisted of a double aileron and rudder pulses and a wings-level sideslip. Prior to performing these maneuvers the pilot reported difficulty in trimming laterally. The airplane tended to roll to the right and the standby roll trim was used to acquire the necessary left wing down trim. The double aileron pulse produced yaw angles up to ±2 degrees and the resulting oscillation appeared to be well damped. Prior to the rudder pulse it was noted that the normal accelerometer which has the sensor at the cg was oscillated between 0.9 and 1.1 "g" while there was no apparent feel of this oscillation in the cockpit. The double rudder pulse produced yaw excursions up to 2.2 degrees and as in the aileron maneuver the damping appeared good. In the wings-level sideslip approximately 40 percent of the rudder was

used in conjunction with five (5) degrees of aileron to produce 2.1 degrees of sideslip. The damping from the release was similar to that experienced in the two previous maneuvers with the airplane ending up in a slight climb.

The postflight "quick-look" data indicated that the data obtained during these series of maneuvers are satisfactorily conditioned for the intended data analysis.

Handling Qualities - At a Mach number of 1.4 and an altitude of 32,000 feet, the pilot made an assessment of the spiral stability characteristics during gradual turns in the left and right direction. Bank angles up to 15 degrees in each direction were established. With hands off of the controls it was reported that the stability was essentially neutral. There was no strong tendency for the airplane to come level or increase the bank angle. In the left direction there was a slight tendency for the bank angle to increase and in the right direction for the bank angle to decrease. The roll trim prior to the check was approximately 0.25 degrees right wing down.

At a Mach number of 1.2 and an altitude of 40,000 feet a series of longitudinal and lateral-directional maneuvers were performed to evaluate handling qualities pertinent to the General Purpose Airborne Simulator (GPAS). The gross weight ranged from 393,000 to 350,000 pounds and the cg was manually controlled to an average location of 19.5 percent MAC. For these tests the nose ramp was up, the wing tips were set at 25 degrees, and the augmentation, in the mode of primary concern, was turned off during test maneuvers.

Initially, in the lateral-directional mode, double aileron and rudder pulses and a wings-level sideslip were performed for an assessment of the basic aircraft characteristics. The pulses essentially produced an oscillation where the initial yaw excursions reached approximately ±2 degrees. Following the aileron pulse, which was repeated once, there was still a tendency to roll off to the left. This tendency was not evident following the rudder pulse. Also, after the first aileron pulse the pilot indicated that the airplane was real stiff and that the oscillation had damped in four (4) cycles. During these maneuvers lite turbulence was encountered and it was reported that the airplane response felt like a ripple beginning at the aft of the airplane and progressed forward to the cockpit. In the wings-level sideslip, the full rudder deflection produced about 2.2 degrees of sideslip while an aileron deflection and force of 2-3 degrees and 8 pounds, respectively were required to maintain wings level.

To evaluate the general lateral-directional handling qualities, heading changes from 155 degrees to a stabilized 175 degrees and a return to

a 155 degree heading were performed. The initial 20 degree entry, turn and recovery were performed with controls uncoordinated rolling into the turn at a normal rate and recoverying on a prescribed heading at a fast rate. A bank angle of 25 degrees with approximately 5 degrees of right aileron were used in the turn and on recovery it was noted that only 1 degree of yaw was generated. The pilot reported no significant problems and gave a rating of 3 to this portion of the task. The return to the original heading was accomplished with a slow coordinated control input and a rapid recovery to the prescribed 155 degree heading. It was reported that it was difficult to use a coordinated control for the small heading changes. Also, it was noted that an attempt was made to coordinate controls through the use of spirit ball on the flight director and when this proved unsuccessful the pilot reverted to using the yaw needle indication which appeared to be a more correct indication and tended to simplify the task. It was noted that the slow or fast control input did not significantly effect the handling qualities and the pilot rating of 4 was given to this latter portion of the task.

In the longitudinal mode a standard pull-up and release and wind-up turn were performed for the basic airplane response and handling assessment. Two pull-up and release maneuvers were performed when the maximum normal acceleration was noted to be 1.25 to 1.3 "g". In the wind-up turn a normal acceleration of 1.47 "g" was attained, and it was noted that there was no significant trim change.

The longitudinal handling qualities task was to simulate an ATC Command to change altitude by ±2000 feet. Initially, the altitude change was to 42,000 feet. Power was advanced to a throttle angle of 105 degrees to attain a rate of climb of 5000 fpm. A light amount of turbulence was experienced and there was a slight tendency for overshoot at the 42,000 foot level. The rating for this phase was 3.0. On the descent to the original altitude of 40,000 feet the power was retarded to a throttle angle of 60 degrees. There were no significant problems noted and a rating of 2.0 was given for this phase of the test.

In general, the pilot indicated the airplane handling in this region of the flight envelope was excellent. It was pointed out, however, that there was a lack of balance between the longitudinal and lateral control forces and the lack of positive centering on the ailerons presents a problem. Also, the pilot indicated that there is a problem in performing the described tests with the nose ramp up. For example, there is no appreciable side force noted in the cockpit during maneuvers such as a sideslip and the only cue is the change in noise level with changing sideslip angle.

Airspeed Calibrations - Additional radar and pacer data were to be obtained for the calibration of the MA-1 airspeed head. However, due to the aircraft location and the fuel remaining at the specified points in the flight, the data acquired were limited. As the Edwards FPS-16 was not operational the only radar data obtained during the deceleration from Mach 1.2 to 0.9 at an altitude of 40,000 feet was from the Tonapah site and from the range of the aircraft at this time the value of the data is questionable.

The landing gear and flaps were up while the wing tips were set at zero degrees during the initial pacer runs at M = 0.74, 0.73, and 0.80 at an altitude of 25,000 feet.

The remaining runs indicated in the following table were accomplished with the gear and flaps down.

Pacer			XB-70 Pilot			
Airspeed	Altitude	Free Air Temperature	Mach Number	Round Dial Airspeed	CADS Airspeed	Altitude
319	24,120	0°	0.745	320.0	318	24,200
320	24,200	0	0.73	321.0	319	24,300
341	24,970	+1	0.80	341.5	339.5	25,000
250	25,580	-10	0.60	249.0	245.5	25,600
230	24,930	-12	0.55	231.0	228.0	25,000
215	24,250	-13	0.50	216.5	214.0	24,250

In conjunction with the pacer point at M = 0.80 and at a point at V_i = 225 knots and at 5000 feet prior to landing, a series of pictures were taken from a photo chase in an attempt to determine the forward fuselage and associated nose boom deflection for various levels of dynamic pressure. Similar photographs are to be obtained on future flights.

Boundary Layer Noise - The primary purpose for acquiring boundary layer noise data on this flight was to checkout the data system and to perform a preliminary analysis of the data to establish analysis and data reduction procedures. Consequently, noise data were recorded at the following flight conditions:

Mach Number	Altitude
0.75	15,000
0.90	32,000
1.43	32,000

The data sampling requirements at Mn = 1.2 and an altitude of 40,000 feet was eliminated due to fuel limitations at this time in the flight. Also, a postflight inspection of the data indicated that the data sample obtained at Mn = 1.43 condition was insufficient for analysis.

Atmospheric Turbulence - Throughout the flight, the airplane penetrated patches of lite to moderate turbulence. However, most of the time when turbulence was encountered the data was on the short interval or by the time continuous data was turned on the airplane passed through the turbulent region. In spite of this problem, two segments of data were recorded during a 40 and 15 second time period at Mn = 1.2 at an altitude of 40,000 feet. During the first of these runs the maximum incremental pilot and cg normal acceleration were ±0.14 "g"s and 0.13 "g"s, respectively and on the second run these accelerations were ±0.075 "g"s and ±0.05 "g"s, respectively. From the data recorded in the gust loads package, the normal and lateral equivalent gust velocities will be calculated. In addition a preliminary power spectral density (PSD) analysis will be made of the airplane response using the accelerometers located at various positions on the airplane.

The level of and quality of this data does not satisfy any of the original objectives of the gust program but it will assist in a check of the related airborne data system measurements and associated data reduction procedures.

OPERATIONAL SUMMARY

General - With the exception of the previously noted nose gear steering problems this flight followed a standard operational routine with a minimum of problems and pilot's squawks listed at the conclusion of the flight. The following is only intended to summarize some of the operational highlights and the pilot's report, to be submitted at a later date, will include more details.

JP-5 fuel was used on this flight. Following the depletion of the fuel in tank No. 6 after takeoff, the copilot manually controlled the fuel tank sequencing to maintain desired cg limits during the various test conditions.

While setting up for a series of nose ramp cycles at Mn ≈ 0.93 and an altitude of 32,000 feet, engines no. 1 and 6 were pulled out of afterburners to maintain a constant speed. As power was retarded engine no. 1 approached an overtemperature condition. The throttle angle on no. 1 was reduced to approximately 40 degrees to bring the temperature in a normal range. Almost simultaneously with the event, an indication of minimum A/B instability became apparent on engines no. 2 and 5. After

power was advanced and the airplane began to accelerate out of this region of the flight envelope all three engines behaved normally. During a later portion of the flight under similar flight conditions, engines no. 2 and 5 exhibited the same tendency of minimum A/B instability. In this case, telemetering data indicate the engine vibration was in the range of 2-4 mils.

In general, all of the systems functioned normally during the flight and with the exception of the nose wheel steering problems, the pilot indicated that the airplane was in good condition at the conclusion of the flight. The problems encountered with the environmental system on flight 62, lack of cabin pressurization, did not reoccur and the system functioned normally.

Systems Functional Check - Following the takeoff at $V_i \approx 260$ knots and in the altitude range between 6000 feet and 8000 feet the landing gear was successfully cycled up twice and down once. After this functional check and following the canard flap retraction the wing tips were cycled to the 25 degree position and returned to a zero deflection. The wing tip functional check was repeated at a Mach number of 1.3 at an altitude of 32,000 feet where the tips were cycled between the 25 and 65 degree position.

In addition to the above functional tests, the variable windshield ramp was cycled at a Mach number of 0.9 and an altitude of 32,000 feet. The nose ramp check scheduled for 1.2 Mn at an altitude of 40,000 feet were deleted due to a shortage of fuel.

In general there were no particular problems noted in conjunction with these functional tests.

Pilot Squawks - The following are a list of the crew squawks which were entered on the Air Vehicle Flight and Maintenance record at the post-flight.

1 - Aircraft pulls right during taxi with or without nose wheel steering engaged.

2 - Nose wheel steering did not engage on four attempts during initial landing roll.

3 - Blew tires 3 and 7 during taxi-in while investigating nose wheel steering problems.

4 - Utility 2 hydraulic pressure gage oscillated between 3500-4000 psi.

5 - Yaw needle no. 1 inoperative during early part of the flight.

6 - No. 1 engine EGT spends excessive time above 950° C.

XB-70 NO. 001

CONFIGURATION STATUS PRIOR TO FLIGHT NO. 63

I. CONFIGURATION CHANGES AND SIGNIFICANT REWORK

1. REPLACED INOPERATIVE FUEL PUMP IN TANK NO. 8 RH.

2. REPLACED NO. 5 ENGINE THROTTLE QUADRANT SYNCHRO.

3. INSTALLED NEW ATTITUDE DIRECTOR INDICATORS FOR PILOT AND COPILOT WITH IMPROVED SIDESLIP INDICATORS.

4. REPLACED RH WING FOLD DRIVE MOTOR - PERIODIC INSPECTION REQUIREMENT.

5. REWORKED NLG ELECTRICAL SYSTEM TO PREVENT UNLOCKING OF STRUT UPLOCK DUE TO HYDRAULIC SURGES.

6. REPLACED BROKEN BELLCRANK IN NLG DOOR FORWARD UPLOCK HOOK LINKAGE. NEW BELLCRANK IS INSTRUMENTED FOR LOAD DATA.

7. RERIGGED MLG STRUT RETRACT ACTUATORS TO PREVENT PISTON BOTTOMING DURING TAKEOFF.

II. PILOT SQUAWKS

1. LANDING GEAR OPERATED NORMALLY ON FIRST RETRACTION, BUT ON THREE ADDITIONAL ATTEMPTS THE MAIN GEAR WOULD FOLD AND ROTATE BUT WOULD NOT RETRACT.

   - Found that the LH MLG fold actuator was rigged to extend too far causing the fold uplock switch not to be made. Rerigged LH MLG fold actuators and checked the rigging of RH actuator to assure proper operation of the uplock switch. Replaced the LH MLG fold uplock bungee as precautionary measure.

2. "CABIN-OVER-10,000 FEET" LIGHT CAME ON WHEN AIRPLANE WENT ABOVE 10,000 FEET. REPRESSURIZE SWITCH WOULD TEMPORARILY REDUCE CABIN ALTITUDE FOR 3 OR 4 MINUTES.

   - Replaced a relay which prevented electrical power from energizing makeup air valve solenoid.

3. NO. 1 ENGINE OIL PRESSURE CAUTION LIGHT WENT OUT SOONER THAN NORMAL AFTER INITIAL ENGINE ROTATION.

- Replaced oil pressure switch and two associated relays. Will ops check during engine runs.

4. NO. 1 ENGINE CAUTION LIGHT BLINKS ON AND OFF DURING INITIAL ROTATION.

   - Replaced a relay in circuit. Will ops check during engine runs.

5. TANK NO. 4 FAILED TO FEED IN AUTO.

   - Bench checked the module and found no discrepancy. Replaced a relay in the circuit and satisfactorily ops checked.

6. U-2 PRESSURE OSCILLATES ±100 PSI AT 2 CPS.

   - Process Specification LA0206-013 allows a peak-to-peak oscillation of 400 PSI.

7. DURING PULSES ON AILERON THERE WAS FEEDBACK TO RUDDER PEDALS (FACS ON).

   - The rudder control system is sensitive to high yaw rates and, since it is not an irreversible control, it will feed back a portion of these forces to the rudder pedals.

8. YAW NO. 1 INDICATOR MALFUNCTIONED EARLY IN FLIGHT, BUT WAS OK LATER.

   - Repaired a malfunction in the yaw system demodulator.

III. PILOT ADVISORIES

1. THE "CABIN DOOR LOCKED" INDICATING SYSTEM IS THE SAME AS FOR FLIGHT NO. 62. THE SWITCH HAS NOT BEEN RERIGGED. A NEW DESIGN HAS BEEN RELEASED AND PARTS ARE MADE, BUT INSTALLATION HAS NOT BEEN ACCOMPLISHED.

2. A LINE HAS BEEN PAINTED ON THE TAXIWAY AT THE EXIT FROM THE RUN PAD SO THAT MOBILCOM CAN ADVISE XB-70 PILOTS IN MAKING THE TURN SHARP ENOUGH TO AVOID RUNNING THE RH TIRES OFF THE TAXIWAY.

5 June 1967

Instrumentation Status

One hour and thirty minutes of data were recorded on flight 1-63. The following table summarizes the instrumentation status for flight 1-63.

Total parameters recorded	872
Inoperative parameters	31
Parameters with questionable preflight information	30
Parameters with open squawks	77

Parameters with Questionable Preflight Information

D3036	D3148	D3438	M110
D3091	D3153	D3443	M111
D3115	D3164	D3474	M112
D3136	D3206	D3533	M113
D3138	D3207	D3621	M124A
D3139	D3220	D3624	M124B
D3144	D3259		M126A
D3147	D3304		M126B

Inoperative Parameters

M116	T1082	T1504
M187	T1051	T1505
M188	T1086	T1514
M189	T1091	T1523
M193	T1133	T1524
S2517	T1143	T1528
D3079	T1467	T1529
D3149	T1473	T1530
D3161	T1502	T1531
D3570	T1503	T1532
		T1533

Parameters with Open Squawks

M12	M207	X577	X685	T1009	T1091
M42	A303	X578	S2177	T1010	T1133
M43	A901	X579	T1002	T1011	T1473
M44	X528	X580	T1006	T1034	T1514
M57	X566	X598	T1007	T1057	T1522
M177	X568	X677	T1008	T1082	T1525

Parameters with Open Squawks (continued)

D3034	D3474
D3035	D3520
D3036	D3521
D3079	D3537
D3091	D3570
D3103	D3572
D3106	D3577
D3115	D3580
D3144	D3582
D3207	D3596
D3218	D3602
D3294	D3604
D3306	D3605
D3391	D3606
D3393	D3614
D3409	D3616
D3423	D3617
D3443	D3618
D3468	D3619
D3473	D3636
	D3647

Figure 2

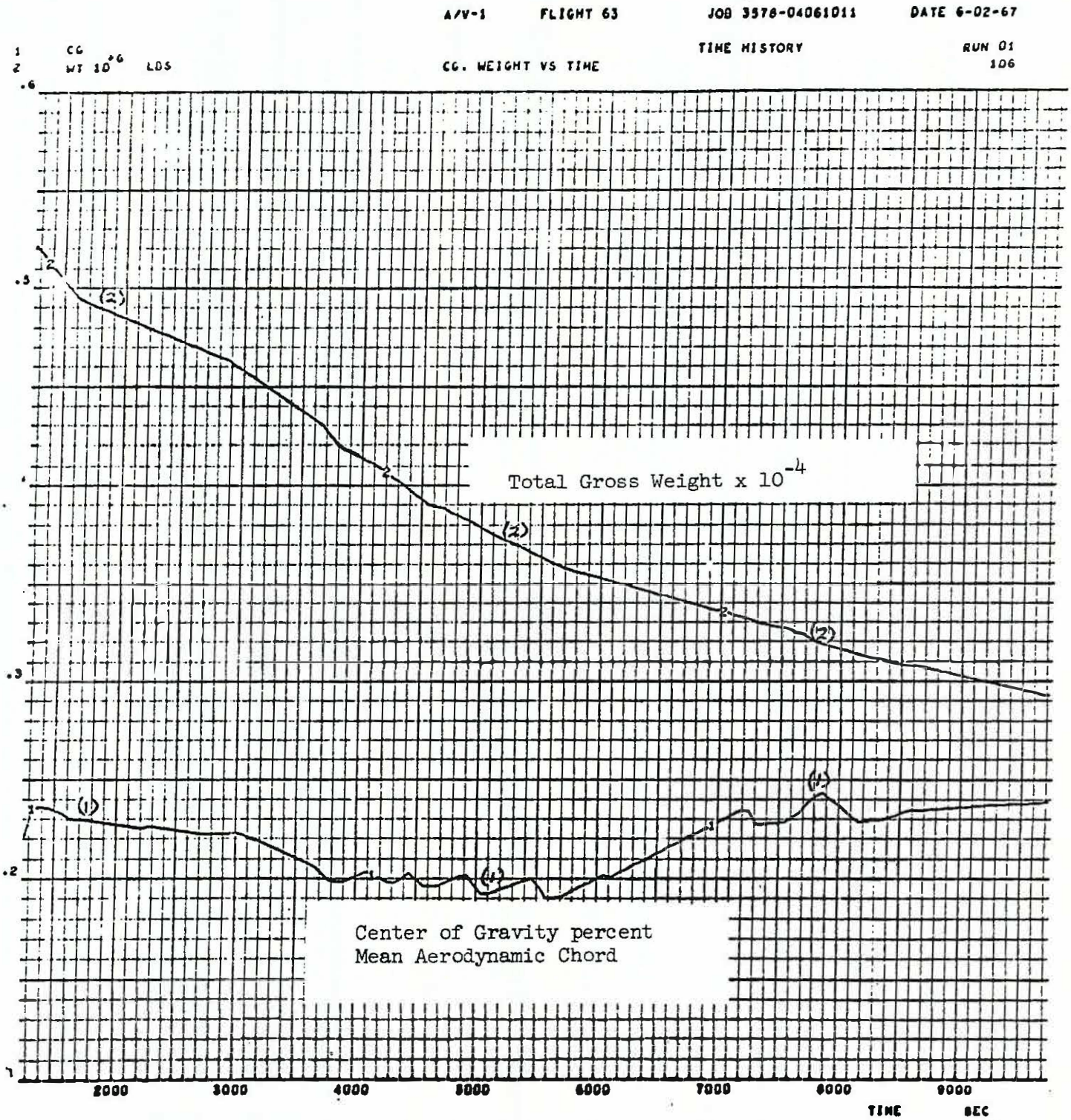

Figure 2.-XB-70 gross weight and center of gravity versus time.

Flight 1-63