(Gp-4) TEST REPORT

XB-70A

FLIGHT 1-14

(No. 1 Air Vehicle, No. 14 Flight)

1 July 1965

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XB-70 JOINT TEST FORCE (FTTB)

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I. SUMMARY:

1. The fourteenth flight (1-14) of the XB-70, No. 62-001, was successfully completed on 1 July 1965. This same mission was aborted after lining up on the runway the previous day because of a problem with a landing gear wheel spider. Programmed tests were conducted and apparent improved performance resulted from a new climb schedule and from operating the inlet at higher recovery positions. After landing, two areas of honeycomb face sheet were found to be missing along with other face sheet separations.

2. The flight crew was Mr. Al White, North American Aviation, Inc, Pilot, and Mr. Van Shepard, NAA, Copilot. Takeoff occurred at 0649 PDT from Edwards AFB runway 04 at a gross weight of approximately 522,100 pounds. Landing on Edwards runway 04 at a weight of 295,000 pounds was at 0833 PDT. Total flight time was one hour and forty-four minutes (1+44), total supersonic 1+19, total Mach 2.0 or greater 0+50, and total Mach 2.5 or greater 0+12.

3. Preflight inspection, engine start, and pre-taxi checks were routine. Taxi out and remaining preflight checks were completed in sufficient time to allow takeoff eleven minutes ahead of schedule.

4. Power was advanced to minimum afterburner for takeoff. Afterburner instability was experienced on engines No. 3 and 4. Maximum afterburner was selected after brake release and the pilot reported rotation at 190 knots. Askania range reported lift-off at 225 knots after a ground roll of 9,875 feet. Gear, flap, windshield, and wing tip operations were normal. Loud noises and buffeting in the aircraft was again apparent around 390 knots during the climb.

5. Acceleration to supersonic speeds at 32,000 feet was slow, until the pilot discovered that he had not again advanced the throttles to maximum power after retarding them to investigate aircraft buffeting. Flutter data was obtained at 32,000 and 36,000 feet. Acceleration was to 575 knots, 25 knots above Flight 1-13 climb speed. A climb to 50,000 feet was made, at which altitude, indicated airspeed was supposed to have been bled off gradually to 524 knots at 66,000 feet. However, an inadvertent unstart of the left inlet occurred at about 50,000 feet, at which time, the copilot was attempting to hold a top of the yellow shock position in accordance with the flight card. The unstart was probably caused by the aircraft being in a right turn at the time. In restarting the inlet, the pilot reported a significant effect in pitch when the bypass doors opened, causing the aircraft to climb. As a result, the

climb schedule above 50,000 feet was not followed. At this same time a planned manual sequencing of tank No. 1 was missed resulting in tank No. 1 being emptied. Fuel in tank No. 7 was used to maintain cg.

6. The bobweight was released at 2.6 Mach during the climb. After leveling at 66,000 feet, inlet performance was obtained with the shock position indicated at mid yellow and top green. When going to the higher inlet recovery, mid yellow shock position, a very definite aircraft pitch down was reported. (Pilot's accelero-meter showed .8g). Throttles were retarded to stabilize the air-craft speed and data obtained at 66,000 feet, 2.845 Mach, 535 knots at an indicated total temperature of 508°F. Dynamic maneuvering and stability data were also obtained for combinations of bobweight free and locked and flight augmentation control system (FACS) on and off conditions. Dynamic and stability maneuvers were repeated between 2.7 and 2.6 Mach.

7. A cabin purge test was conducted at 2.5 Mach, 66,000 feet and during a 400 knot descent to below 40,000 feet. Maximum cabin altitude reported was 38,000 feet at initiation of the purge. Both altitude tape indicators locked up at about 65,000 feet upon cabin depressurization.

8. The copilot landed the aircraft. The landing was long but touchdown smooth. The drag chutes (2 chute configuration) were fully blossomed long before nose wheel touchdown. No control problems were reported. After landing the pilot reported that his rear side window fogged up during descent and at some time during flight a light haze covered the outside of the inner windshield. After the flight, as noted previously, two pieces of face sheet were found to be missing and several face sheet bonding separations from the honeycomb core had occurred.

II. CONFIGURATION CHANGES PRIOR TO FLIGHT 14:

1. Air Induction Control System:

a. Throat ramps scheduling revised to decrease rate during transition from NORMAL to LOW performance and vice versa (L.H. side only).

b. Bypass door open lights repaired.

2. Propulsion:

a. Engine No. 6 vibration - data showed 520 cps. Use definite throttle detent.

b. All main engine fuel filters changed from 40 micron to 17 micron.

c. Throttle No. 3 rerigged at fuel control. Was out of rig and caused afterburner lite problem.

3. Hydraulics and Landing Gear:

a. Leak in P_2 system - end plate on No. 6 pump - repaired.

b. Leaks repaired at No. 3 P_1 pump end plate and No. 3 P_1 EDV.

c. Re-checked left hand main landing gear down indicator light. Nothing found.

d. Brake instrumentation installed for 11 slot rotor tests.

e. Left hand main landing gear door open checks made to confirm that doors would not open with momentary loss of electrical power with gear de-pressurized.

4. Avionics:

a. Master caution lite repaired.

b. Instrument panel vibrators checked (sticky indicators). One vibrator mis-oriented 90°. Engineering investigating larger vibrators.

c. Compass swung and compensated.

5. Structures:

a. Windshield checked for tape and rivulets of fluid.

b. Pilot's side window - replaced desiccant and checked fan.

c. Windshield fabric seal patched.

d. Fuel leak repaired at tank No. 6 left lower door.

e. Left hand duct roof damage repaired and precussion pins added at BLC truss lands.

6. Flight Controls:

a. Flap P_1 pressure malfunction corrected by removing 1 GPM flow regulator from pressure line.

7. Miscellaneous:

a. Pilots' tape recorder revised to obtain power from air vehicle system with battery back-up.

b. Auxiliary landing light removed and replaced with sheet metal. (Foreign object damage (FOD) potential).

c. Water service 2,000 pounds (in lieu of 4,400 pounds).

III. TEST LOG:

	Throats biased from 2.46 Mach left and 2.43 Mach right to 2.40 Mach.
0553	Begin engine start - All manual starts.
	Start No. 3 engine; O.K.; EGT 520°.
0554	Start No. 1 engine; O.K.; EGT 450°.
0555	Start No. 2 engine; O.K.; EGT 500°.
0556:30	Start No. 4 engine; O.K.; EGT 570°.
0557:30	Start No. 6 engine; O.K.; EGT 500°.
0559	Start No. 5 engine; O.K.; EGT 550°.
0601	Servicing hydraulics.
0612	Flight controls check; Data C/N 1234; Off C/N 1279.
0616	Alternate throat check. Tower Temp 59°F; Wind 240° at 4 Kts.
0619	Electrical and hydraulic GPU's disconnected.
0624	Disconnect ground air conditioning.
0627	30 second MIL run on all 6 engines; Data On C/N 2202; Off C/N 2212); (No. 2 ADS 40% to 50% vibe).
0628	Taxi.
0630	C/N 2394 Data On; turn left; Data Off C/N 2424.
0631	C/N 2465 Data On; turn right; Data Off C/N 2497.
0642	Inspect tires and brakes - O.K.; check for trim.
0644	Reset counter.
0645	Water 2,000 lbs; NH_3 485 lbs.
0647	249.5 total fuel; LN_2 7/8.
0648	Data On C/N 328; engines to 85% then light afterburners 3 and 4; 2 and 5; 1 and 6.
0649	Brake release - Maximum afterburner; 150 KIAS in 35 sec.
0650	Takeoff.
0651	Data Off C/N 475; gear cameras on; gear up.
0651:30	Flaps up.
0652	Cabin recorder on.
0653	Tank No. 1 On; tanks No. 2, 4 and 7 Off; getting a loud noise; Data On C/N 640; seems to be function of speed-getting buffet at 390 knots; pulling up to 350 knots.
0654	C/N 686 Data Off; tips to one-half.
0658	Windshield up; 370 KIAS; .9 Mach; 28,000 ft; north of Trona.
0701	Bypass 400 square inches; Data On; accel supersonic aug. on B-70 1.02; chase .961 Mach.
0707	No. 2 ADS 60% to 65% (not lighting the light).
0712	1.18 Mach at 32K.
0714	Wing tips to 65° (left down 4 seconds before right); tank No. 6 Off; FACS Off; Data On; flutter pulses; FACS On; 575 Kts; Data On; flutter pulses; Data Off C/N 2059; throat to AUTO; 1.6 Mach at 35,000 feet; B-58 reported smooth flight conditions; XB-70 and B-58 heading and TACAN agrees.

Test Log (Cont'd)

0719	1.83 Mach at 43,000 feet.
0720	Total fuel 142,000 pounds; tank No. 2 starting to feed.
0721	1.95 Mach (throat 1.9 left; 1.935 right) (Feeling vibration in aircraft; not turbulence) (Turbulence in turn).
0722	Mach 2.
0724	Tank No. 1 9,200 lbs; total 130,000 lbs; left throat unstart light (transmission interference) throat to Mach 2.0.
0726	On schedule at 2.2 Mach; rpm lock-up; maximum afterburner; dive to gain speed; throat on schedule in AUTO. (shock in low yellow).
0728	Tank No. 1 Off; tanks No. 2, 4 & 7 AUTO; shock is in low yellow.
0730	2.55 Mach at 58,000 feet (total temp 377°); bypass 490 square inches; shock in mid yellow.
0731	Total fuel 112,000 lbs; tank No. 7 1,600 pounds; shock in low yellow.
0732	2.58 Mach; 535 Kts; 61,600 feet; total temperature 410° at 2.60 Mach; throats 2.565 left, 2.560 right.
0733	Update 6; bobweight is free; 100 nm from Malad.
0734	Total fuel 106,000 lbs; holding top of green 370 square inches left and 390 square inches right Open bypass.
0734:30	525 bypass; top green .6 P/R needle ± 10° movement.
0735	.6 P/R; slight rumble in air vehicle 410 square inches left and 380 square inches right bypass.
0736	64,300 feet; 530 knots; total temperature 468°; Mach 2.71 throats left 2.665, right 2.655; 100,000 pounds total fuel; 40 nm from Malad City.
0737	65,000 feet; 2.75 Mach (turn right - shock to bottom of green).
0738	66,000 feet; some pitch-up in air vehicle with shock at bottom green; rumbling in air vehicle.
0739	2.76 Mach; total temperature 484; rumbling in aircraft; 510 KIAS.
0740	67,500 feet; Mach 2.7; 92,000 lbs total fuel; No. 2 ADS 60%; bypass 460 holding in white; fuel 92,000 lbs.
0741	1,700 lbs water; EE temp 42; NH_3 480.
0742	Hydraulics U_2 185; rest 200; closing bypass doors; ADS vibe back down again.
0743	66,000 feet went to 2.64 Mach in turn.
0744	84,000 lbs total fuel; .6 shock position ratio 18° bank angle; U_2 - 185; holding top green at 2.64 Mach.

Test Log (Cont'd)

0747	79,000 lbs total fuel; 462° total temperature. (slight smell in cockpit of paint burning; 2.73 Mach; bypass 370 left, 380 right; .65 shock position; 1.75 P/R.
0749	Tank No. 4 Off at 400 lbs; 73,000 lbs total fuel; 2.8 Mach; 65,300 feet.
0750	C/N 3935 Data On; closing bypass at 2.82 Mach and 66,000 feet accel to 2.85; accelerometer indicates .8g; back on throttles, 290 right, 260 left and mid yellow-stab for 10 seconds; 2.845 Mach; 66,000 feet; 534 knots; 508° total temperature. Data C/N 3984 coming to top green 320 left, 340 right; 2.84 Mach; throats are 2.85 Mach left and 2.795 Mach right.
0751	Bobweight free; shock bottom green; dynamic maneuver (card 3 point 1) Data C/N 4065; repeat FACS Off.
0752	Total temperature 490; Data C/N 4178 Off.
0754	2.82 Mach; 66,000 feet; 95° throttles to 90° lock bobweight; FACS Off repeat dynamic maneuver.
0756	Bobweight free and FACS On; got heavy buffet when closing bypass. Duct performance to low; shock aft to crosshatch; FACS Off; 2.83 Mach at 65,000 feet.
0757	Stability maneuvers; Data C/N 4390.
0758:30	Data Off C/N 4470; tank No. 2 is feeding.
0759	2.8 Mach; 67,300 feet; wind-up turn to left 1.45g.
0800	68,000 feet; 51,000 lbs total fuel; 485° total temperature; engines good; water 1,300 lbs.
0802	2.75 Mach; 66,000 feet; right wind-up turn; Data C/N 4626; 1.45g.
0803	630 square inches right bypass; 45° bank; tank No. 2 Off; 46,000 lbs total fuel.
0805	66,000 feet; 2.6 Mach; rolling out of turn (Data 4863) pullup and release C/N 4685.
0806	2.64 Mach; FACS Off; dynamic maneuver bobweight free.
0807	2.69 Mach; repeat with bobweight locked.
0808	Tank No. 7 Off; 39,000 lbs total fuel; to 40° throttle; decel; water 1,200.
0808:30	2.5 Mach; 65,700 feet.
0809	PURGE (38 K cabin pressure).
0811	37,000 pounds total fuel (37 K cabin pressure).
0812	Utility hydraulic pump status No. 3 - orange; quantity and pressure good (no telemetering to verify).
0813	Altitude tapes locked up 60 and 65 K. at Mt. Whitney; 56,000 feet.

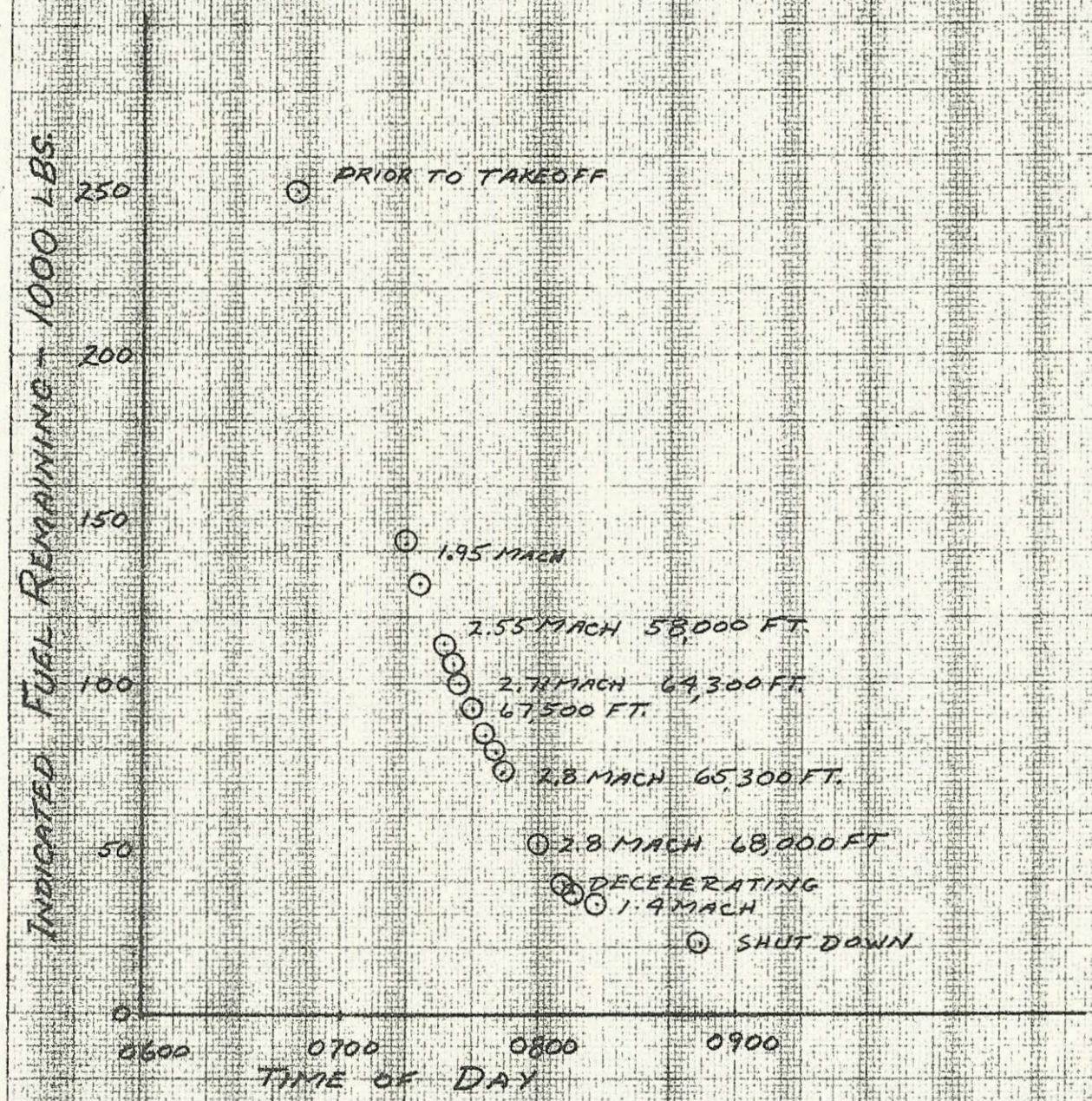
Test Log (Cont'd)

0814	25,000 lbs fuel in sump. Bypasses to 700 square inches; cabin is 36,500 feet; pump status still flickering but green most of the time.
0815:30	Throat secured; data off; 50,000 feet; 400 KIAS; throttle 40° (33,000 feet cabin altitude).
0818	1.4 Mach; bypass 400 square inches; wing tips to one-half; 22,000 lbs fuel in sump; total fuel 33,000 lbs; 13/16 LN_2, rpm release.
0819	Sump fuel low level light came on; getting some turbulence; No. 3 Utility pump O.K. now; 42,000 ft.
0820	Data On C/N 5767; 40,000 feet; repressure; cabin pressure 24,000 lbs; nose ramp down.
0821:30	No. 1 2, 5 and 6 engines to idle; 3 and 4 to 90%; cabin altitude 11,000 feet; 35,000 feet; through Mach jump; Data Off C/N 5863; LN_2 three-fourths; bypass closed.
0823	Nose ramp down; wing tips up; water 600 lbs; NH_3 440.
0825	High "Q" noise in aircraft.
0827	310 KIAS; 10,000 feet.
0828	260 KIAS; gear coming down.
0829	Gear lights green; flaps down; tank No. 6 on for 2 minutes; final approach Tank No. 3 17,000 lbs.
0833	Touchdown.
0833:30	Data Off; 78° EE; overheat light.
0834	Shud down engines No. 1 & 6, flaps up.
0835	Brake test, left aft wheels slid about 12 feet during test but right aft wheels did not slide. Data On C/N 6666; Off C/N 6687.
0836	Taxi in; outer surface of inside windshield is smoked up or haze (not moisture); inside of rear window on pilot side fogged up about half way down descent. LN_2 5/16; water 600 lbs; NH_3 440; EE 69°; O_2 14.4. Inlet Data On C/N 7137; Off C/N 7155 to full closed on C/N 7205; Off C/N 7220; rain removal checks.
0847	Air vehicle taxied to hangar.
0849	Shut down engines No. 2 and 5; and 3 and 4; Tank No. 3 11,100 lbs.

IV. FUEL LOG:

FLIGHT 1-14

TOTAL FUEL REMAINING VS TIME



INDICATED FUEL QUANTITIES

TANK	PRIOR TO TAKEOFF	AT ENGINE SHUTDOWN
1	34,300 lbs.	1,200 lbs.
2	28,800	300
3	22,200	11,100
4	36,600	100
6L	38,000	2,500
6R	38,000	1,100
7L	10,600	1,700
7R	10,600	1,200
8L	13,400	400
8R	13,400	200
TOTAL	299,500	20,500

V. ENGINEERING COMMENTS:

1. Structural Failures:

a. Two structural failures occurred where large areas of honeycomb face sheet were lost in flight and other failures of face sheet separation on one or both sides of the core occurred. An analysis of the failures is being made by NAA. A brief description of the failures and type of fix being made is as follows:

(1) Left wing starting at station 1449 outboard of the wing weld, an area approximately 3x4 feet of face sheet was missing. Other smaller areas were apparently damaged by the loose face sheet. Damaged core was removed from an area 9x40 inches, doublers spot brazed to the .008 inch inner face sheet to allow attaching T's to support the external skin. In the remaining areas, cluster pins were spot welded to the good core cell walls for attachment of outer face sheet. Inner face sheet of this panel, which is part of wing fuel tank No. 6, was damaged in the process of brazing on doublers and was sealed externally with Viton.

(2) Right side of fuselage station 1049 just above the upper wing surface, an area 10x30 inches of face sheet was lost in flight. A cluster pin and doubler type repair was made. Inner face sheet of this panel, fuel tank No. 1, was not damaged.

(3) Right duct roof void at station 1533 approximately 1x6 inches resulted in .060 inch protrusion. Face sheet was removed and pin cluster and doubler repair was made.

(4) Wing spearhead void at station 961 approximately 6x30 inches. This is aft of the wing apex repair made after Flight 1-12. Face sheet was removed and pin cluster and doubler repair made.

(5) Underside right wing station 1471 void 3x8 inches. Face sheet was removed and cluster pin and doubler repair made. In the process of making this repair, two holes were accidentally burned into upper tank No. 6 when welding the cluster pins to the core, and had to be repaired with rivets and Viton sealed.

(6) Lower bottom left side of fuselage had a 33 inch protrusion with void areas forward and aft of frame station 1635. A 6 inch wide section of honeycomb panel was removed. Repair was made using doublers with T's to support the outer face sheet rather than a honeycomb plug.

b. During the down time for these repairs the aerodynamic filler "white lightning" was removed from the lower wing surface and lower fuselage to allow close inspection. A number of other repairs such as doublers over dents and creases, loose spot brazes were made.

2. Windshield:

a. During taxi in, the pilot reported that the outer surface of the inside windshield was smoked up or covered with a haze which did not appear to be moisture. The windshield area was opened up and an oily film was removed from the windshield. Laboratory samples were taken; also, the inlet air filter and the air gap desiccant were removed for analysis. The film was first suspected of being Oronite 70 hydraulic fluid and the windshield ramp actuator and forward fuselage to which the air-gap is vented was inspected and no evidence of hydraulic leakage was found.

b. Two small gaps in the attachment of the metal bellows at the corners of the windshield were found which would allow unfiltered air to enter; however, this did not explain the problem.

c. On this flight, as well as Flight 1-13, the pilot's rear side window fogged up during descent. The cause of this problem is also as yet unknown. Following Flight 1-13 tears in the fabric were found along the left side and were repaired. It is not too likely that this was the source of the moisture since the rear side window air-gap is not recirculated. This air-gap is not directly connected to the rest of the windshield air-gap except for a vent line from the blower.

3. Drag Chute:

The two 28 foot drag chutes were again used as on Flight 1-13. After initial contact with the runway the aircraft ballooned and was off the ground for about 2,000 feet. The pilot chute was deployed before the tires again touched the runway and the main chute were fully blossomed just after main gear touchdown. The nose gear did not touchdown until four seconds and 383 feet after the main chutes had blossomed. Photo coverage did not indicate any pitching effect on the aircraft as a result of the nose gear being off the runway during chute deployment and the pilots commented that there were no control problems.

4. Brakes:

Tests were made of the 11 slot rotor brake after this flight while stopping, using rear brakes only. Skidding of the left rear wheels occurred for approximately 12 feet on the second stop.

5. Altitude Indicator:

The failures of both the pilot's and copilot's altitude tape indicators were caused by internal shorts which occurred during cabin depressurization. After the flight, bench checks of the indicators revealed that one failed at an 18,000 foot pressure altitude and the second at a 33,000 foot pressure altitude. Spare units were also checked, and they passed the over 40,000 foot test. The spare altitude indicators will be installed in the air vehicle prior to the next flight. This failure has been experienced on previous flights when the cabin was depressurized.

6. Landing Gear Wheel Spider:

a. Flight 1-14 was aborted 30 June 1965 after the aircraft had been taxied to the end of the runway. The abort was a result of inspection of the landing gear just prior to the scheduled takeoff. It was found that the No. 6 wheel spider teeth were disengaged from the wheel teeth. This condition would most likely result in no braking of that wheel. The wheel was damaged because of the spider slippage and had to be replaced.

b. An item on excessive gap had been written up the previous day in the aircraft inspection records and was supposedly corrected. This failure was apparently a result of not following established procedures for torquing the wheel spider retaining nut. These procedures call for the nut to be torqued with the axle jacked and then rechecked with the wheels on the ground.

7. NASA Supersonic Transport Tests and Instrumentation:

a. Landing Gear Instrumentation and Cameras:

NAA again requested that the landing gear cameras be used to record the lift-off with color film. Rate of sink data at landing was recorded for the nose gear and the right main gear. The left main gear rate of sink arm remained up and locked. A check of the arm after the flight showed that it was improperly rigged.

b. Cabin and Ballast Bay Microphones:

Data recorded during the acceleration from .95 Mach number to 1.4 indicated sound levels of 131 db in the pressurized and insulated cockpit area and 133 db in the unpressurized and non-insulated ballast bay area during subsonic flight. These levels were reduced to 125 db in the cockpit and 123 db in the ballast bay at supersonic flight conditions.

c. Velocity Acceleration and Altitude (VGH) Recorder:

Good VGH records were obtained for both the XB-70 and the B-58. There was no appreciable turbulence during the flight so there is no significant data to compare between the two airplanes.

d. Sonic Boom:

A sonic boom was recorded at two different measurement stations located north of Edwards AFB as the XB-70 flew over at Mach 2.6 and 65,000 feet. The airplane's ground track passed between the two stations one-half mile from one and 6.1 miles from the other. The data is being analyzed by NASA and will be forwarded to the XB-70 SPO as soon as possible.

8. Maintenance Discrepancies:

a. Auxiliary drive system (ADS) vibration on No. 2 engine 60-65 (no caution light) periodically throughout flight.

b. Copilots right hand buzz light on twice during flight.

c. Inside of outside windshield hazy.

d. Pilots aft side window (inner surface) fogged up.

e. Trim for takeoff (TTO) light very difficult to get with button.

f. Utility pump status on engine No. 3 yellow during latter part of flight while supersonic.

g. Tape altimeters locked up during purge at 65,000.

VI. CONCLUSIONS:

1. This flight was completed in accordance with the test plan. Improved performance was seen as a result of a new climb schedule and operating the duct at higher recovery positions. Maximum speed and altitude were Mach 2.85, 585 KIAS, 68,000 feet. Maximum indicated total temperature observed by the flight crew was 508°F.

2. Honeycomb panel failures resulted in external face sheet being lost in two areas.

3. Systems which gave overall satisfactory performance were:

Engines	ECS
Fuel	Radios
Landing Gear	Hydraulics
Nose Wheel Steering	Oxygen
Brakes	Flight Controls
Flaps	Wing Fold
Instrumentation	TACAN
Electrical	AICS
Communications	Drag Chute
Fire Detector (ADS & Eng)	Nose Ramp
IFF	

4. The copilot's preoccupation with operation of the inlet resulted in him missing a key manual control point in fuel sequencing.

5 Aircraft pitch change results from fairly small move-ment of the bypass doors.

6. Glare caused by reflections on the pressure suit face plate severely restricted instrument panel and forward visibility when flying into the sun.

7. Altitude tape indicators failed and locked up during cabin depressurization.

8. The nose wheel steering does not respond as well to right rudder pedal movements as it does to the left.

VII. RECOMMENDATIONS:

1. In regard to honeycomb panel and structural failures:

a. All failures be analyzed to determine cause and relation to other failures.

b. To the extent practical, make structural modifications to minimize damage and prevent it in critical areas such as the inlet and flight controls.

c. Plan future flight progression to higher temperatures and dynamic pressures (q) in a conservative manner in an attempt to cause unknown weak areas to become identifiable without causing extensive damage. If temperature and "q" are factors, this could reduce down time for repair as well as provide a greater margin of safety.

2. Continue removal of "white lightning" to allow thorough inspection of the external skin after each flight.

3. The cause of haze on the windshield and fogging of the pilot's aft side window should be determined and eliminated.

4. Fuel sequencing should be made automatic to reduce the copilot's work load.

5. Provide fuel tank empty caution lights to reduce copilot work load and protect fuel pumps from prolonged dry tank operations.

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