(Gp-4) TEST REPORT

XB-70A

FLIGHT 1-11

(No. 1 Air Vehicle, No. 11 Flight)

28 April 1965

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XB-70 JOINT TEST FORCE (FTTB)

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I. SUMMARY:

1. The successful eleventh flight (Flight 1-11) of XB-70, No. 62-001, with Mr. Al White, North American Aviation, Inc (NAA), Pilot and Mr. Van Shepard, NAA, Copilot, was completed on 28 Apr 65. Takeoff from Edwards AFB runway 04, at a gross weight of approximately 518,000 pounds, occurred at 0914 PDST. Takeoff weight was the heaviest to date. Landing on Edwards runway 04 at a weight of 300,085 pounds, was at 1057 PDST. Total flight time was one hour forty-three minutes (1+43), total supersonic 1+16, and total Mach 2 or greater 0+57. Maximum speed and altitude was Mach 2.45 and 64,300 feet.

2. Preflight inspection, engine start, and pre-taxi checks were normal and routine. Severe brake chatter and tire skidding during brake application (automatic mode) became apparent upon leaving the run pad and continued during taxi to the takeoff position.

3. Takeoff power was advanced three times before a correct nozzle position indication was obtained on No. 1 engine. Indicator "spin" occurred on the first two power advances. All engine instruments were normal after the third power advance and during takeoff roll, rotation and climb. Acceleration between 100 KIAS and 170 KIAS was exactly as planned. Rotation was initiated at 195 KIAS and lift-off occurred at 215 KIAS. Gear and flap retraction and wing tip fold were normal.

4. Pitch, roll, and yaw pulses were accomplished at Mach 1.32, 32,000 feet, tips one-half and attempted at Mach 1.5, 35,000 feet, tips full down, but due to aircraft acceleration after the pitch pulse, roll and yaw pulses were not completed. Stability and control maneuvers at Mach 2.35, 55,000 feet were in progress when the fuel quantity indicating system malfunctioned. The individual tank readouts became inoperative and the fuel sequencing system would not work in AUTO. After a few moments it was discovered that the manual control was operative and the mission was continued.

5. Air inlet control system (AICS) tests at Mach 2.4, 60,000 feet, which consisted of shock position control and duct unstart tests, went more or less as planned, but not without shock position problems due to over-sensitivity of the indicators. Although the noise and vibration associated with an unstart was surprising when first encountered, the pilots were pleased with the positive indication of an unstart and with the lack of persisting aerodynamic transient due to unstart.

6. Following the AICS tests, a series of stability tests at Mach 2.3, 60,000 feet were attempted. The pitch augmentation switch was turned off in order to disengage the pitch damper.

Inadvertently the power switch was left off. The first maneuver performed was a pullup to 1.3G and release. Upon release of the controls and during the subsequent 5 to 10 seconds of control-free flight, the airplane slowly began to pitch nose up. When it was apparent that this was an abnormal situation, the wheel was pushed forward against the stop and an attempt was made to control the zoom-ing maneuver. Initially, the control had very little, if any, effect. At the same time, the copilot was attempting to close the bypass doors as far as possible to reduce any nose up pitching moment due to bypass door position. At approximately 63,000 feet controls began to take effect. The peak altitude reached in the maneuver was just over 64,000 feet and the Mach number was approximately 2.2. All engines were reduced to military for a very brief period during the recovery; but since this only increased the speed bleed-off, afterburner power was again immediately applied. During the recovery maneuver an indicated airspeed of 595 knots was obtained at approximately 52,000 feet. At this time it was decided to omit the remainder of the scheduled tests and return to base.

7. The descent, approach, and landing were accomplished without difficulty. For the first time all three drag chutes deployed during the landing roll, but the bottom chute collapsed shortly thereafter and only the usual two chutes remained inflated. Braking down to 30 knots was normal but was poor below 30 knots. After leaving the runway and during the postflight engine runs with full brakes applied, the aircraft skidded on the taxiway with all six engines in military power. During taxi in, manual braking tests were conducted which resulted in severe skid damage to rear main landing gear tires and the blowout of three tires.

8. An Air Force pilot was not on board for this mission therefore a copilot's report will not be included in this report. Due to the failure of the fuel quantity indicating system a fuel log is not available.

II. TEST LOG:

0754	Radio checks.
0800	Manifold P_1 for engine starts Manual starts all engines.
0801	Start No. 3 engine - got kick but no rotation.
0801:30	Start No. 3 engine (Soft start from 2,000 psi) EGT 500° EDV - pump status O.K. at idle.
0802:30	Start No. 1 engine - EGT 460° EDV - pump status O.K. at idle.
0803:30	Start No. 2 engine - EGT 510° EDV - pump status O.K. at idle.
0804:30	Start No. 4 engine - no ignition cycle ignition circuit breaker.
0806:30	Start No. 4 engine - EGT 550° EDV - pump status O.K. at idle.
0807:30	Start No. 6 engine - EGT 520° EDV @ 31% - U pump status light orange at idle - press high.
0808:30	Start No. 5 engine - EGT 510° EDV - pump status O.K. at idle.
0810	General checks.
0811	Service hydraulics.
0816	Emergency generator check - checking leak in No. 3 ADS bay.
0817	Flight controls checks.
0822:30	Data on 1498 - Control full throws for instrument cal. off 1539.
0823:30	Sump low level 29,000 pounds.
0824	Flaps down - U_6 pump status light went out - U_2 system pressure 4350 psi.
0825:30	Got a thump in aircraft - felt in rudder pedals.
0826	Alternate throttle check.
0827:30	EE bay check ADS Service No. 1 - 40%; No. 2 - 40%; No. 3 - 35%.
0833	Close cabin door - EE temperature holding 68°F. ADS oil leak O.K. now.
0836	Tank No. 1 29,000 and switch to off - using sump.
0839	Complete installation of external air condition door. Slow accelerations - single engines to MIL and STAB. No. 1 engine run nozzle indicator went ape - O.K. on second run idle - Mil - C/N 2517 - idle.
0840	No. 2 engine idle - Mil C/N 2562 - idle.
0841	No. 3 engine idle - Mil C/N 2605 - idle.
0841:30	No. 4 engine idle - Mil C/N 2649 - idle.
0842	No. 5 engine - Mil (99.2%) C/N 2693 kicking high vibe light on - 40 - 45% - idle.
0843	No. 6 engine idle - Mil C/N 2744 - idle.
0844	All engines idle - Mil C/N 2788 - idle.
0844:30	Check nose wheel steering.
0847:30	Taxi out - Temp 68° - Pressure altitude 2,113 - wind calm.
0855:30	Smoke from right rear wheels when turning onto west taxi-way. Skid and chatter on brake test - AUTO (Right rear wheels stop and skid momentarily) - Check left side - O.K. with a little chatter.

Test Log (Cont'd)

0859:30	Stop on taxiway for gear check - considerable chatter and some skidding - laid rubber on left side extending to rear of aircraft.
0904	Taxi on to runway.
0906	Much chatter both sides (auto brakes) - some skidding on left, more on right - pilot says terrible.
0907	Total fuel 240,500 pounds - waiting on check of runway - all fuel switches auto - tank No. 6 feeding.
0911	C/N 266 - up on power Engines No. 3 and 4 light afterburner Engines No. 2 and 5 light afterburner - No. 2 minimum afterburner instability Engines No. 1 and 6 light afterburner - No. 1 nozzle indicator spinning - all engines to idle Data on 345 - all to 85% - indicator spinning again Engines No. 1 and 6 light afterburner - O.K. now - 70° nozzle Engines No. 2 and 5 light afterburner - No. 2 minimum afterburner instability Engines No. 3 and 4 light afterburner.
0914	Brake release - 215 knots @ lift-off.
0915	250 knots - retract gear O.K.
0916	Flaps up - flap pressure light blinked - Data off 595 - cool doors still open - high vibe light No. 2 40-50%.
0918	Feel buzz come in at 385 knots just below 7,000 feet - disappeared 11,000 - 12,000 feet - bypass doors checked closed by chase - aerodynamic noise around cockpit building up at .8 M in climb.
0921	Tips to 25° - left indicator changes one-half second before right.
0922	Windshield up - 32,000 feet subsonic climb - B-58 360 knots - .955 Mach).
0923	Total fuel 200,000 pounds - No. 2 engine vibe 20% now.
0925	Mach jump 1.05 - bypass to 200 square inches.
0926	32,000 feet and accelerating.
0927	B-70 1.15 Mach - 435 knots on tape and pneumatic B-58 1.10 Mach.
0928	Tank No. 6 off - total 179,000 pounds.
0929	FACS off - Data on 1373 - flutter pulses - Data off 1402 - FACS on - wing tips to 65° - indicators together - bypass to 400 square inches - total fuel 167,000 pounds.
0932	35,000 feet - accelerating through 540 knots - Data on 1500 - FACS off - flutter pulses - went to 570 knots on pitch pulse and turned FACS on momentarily - master caution light - Data off - FACS on.
0933	39,500 feet - 1.7 Mach 565 knots - throat to auto - attitude gyro shows 2° left wing down.

Test Log (Cont'd)

0935 Mach 2 - engines cutting back - tank No. 4 is feeding.

0936 Mach 2.1 - 50,000 feet - 555 knots on tape - 557 knots on pneumatic - climbing in cross hatch at 780 square inches both sides - climbing through 54,000 feet - 2.2 Mach - forward to top of green - 640 left - 600 right.

0938 Right throat on schedule - left lagging .03 Mach - pilot and copilot Mach tapes running away - down to .4 Mach - throat is not following it - throat showing 2.3 - Mach tape back in at 2.3 Mach - tape ran away again - stuck at .4 Mach.

0940 55,000 feet - 556 knots - 2.3 M. (tape back again) - at 70° T/A - stabilizing. With shock at mid green shock moves around from middle white to top green.

0942 Pitch augmentation off - Data on 2108 - stability maneuvers - Data off 2182 - lost .02 Mach and 600 feet.

0944:30 Data on 2260 - wind up to 1.4g - Data off 2319.

0945:30 Total fuel 128,000 pounds.

0946:30 Total temperature 307°.

0947 55,000 feet - 562 knots - total temperature 314° - duct to low performance - now in turn.

0951 Data on 2575 - FACS off - stability maneuvers - Data off 2674 - C/N 2744 - FACS off for stability maneuvers. Lost all fuel quantity indication - Data off 2755 - FACS on - prepare to return - checking with quantity indicator test.

0954:30 Total 109,000 - strips appear to be working - Tank No. 7 now feeding - have to feed manually - does not appear to feed in auto.

0955 60,000 feet and leveling - sun in face and getting reflection from shield - hard to see panel.

0956 Total 104,000 pounds - Tank No. 7 half way down strip.

0956:30 At 60,000 feet - accelerating through 2.27 Mach -

	1	2	3	4	5	6
EGT	820	820	810	820	805	805
Nozzles	94	92	89	91	96	95

Attitude gyro now indicating 5° right bank with aircraft level. When going to normal duct performance cannot grab wheels fast enough to keep shock from bottoming out.

0958 Total fuel 100,000 pounds - no individual readout - Tank No. 7 going down by strip - Tank No. 7 appears to be stopped - turn No. 8 on to try to get high sump - turn tank No. 8 off and tank No. 1 on.

1000 Throats now in normal - start AICS run - Data on 3660 - Mach 2.425 and 59,500 feet.

1002 Bypass aft - 820 then forward - right throat manual - left hand bypass aft and bottom out at 610 square inches.

Test Log (Cont'd)

1003:30	Forward to unstart at 280 square inches and 2.415 Mach - 59,800 feet - restart at 500 square inches - felt by pilot then light out when in white on shock position - throat to manual - duct performance to low - throat to automatic.
1005	Left bypass wheel aft to 880 square inches - shock position from bottom yellow to white - wheel forward - tank No. 1 is feeding - going to tank No. 8. Left throat wheel forward - bypass to 380 square inches - unstart - No. 4 engine EGT is down.
1006:30	Left bypass aft - hesitating at 650 square inches - to cross hatch. Throat to manual.
1007	Tank No. 8 off - No. 1 on.
1008	Left throat forward - bypass to top green 440 square inches - throat forward to unstart at 2.49 Mach - can tell jerk in airplane - throat aft for restart.
1008:30	Bypass in green - Data off 3744.
1009	Total temperature 326° - 60,000 feet - 2.43 Mach - 517 knots on both tape and pneumatic indicators.
1010	2.44 Mach - 60,200 feet - T/A 92° - Data on 3828 - total temperature 326° = fuel total 79,000. Right throat forward to 2.4 Mach - bypass to top green bottom out at 580 square inches in white - bottom of green at 500 - right throat forward to unstart - pressure ratio 1.25.
1013	Both bypasses to bottom green and throats to 2.3 Mach with airplane at Mach 2.4 - bypass at 730 square inches - unstart lights out - to low performance - Data off 3976.
1014	Throats to auto at 2.37 Mach - left throat indicates 2.17 and right 2.22.
1015	Total fuel 71,000 - 1C is feeding and still have 3/4 strip in 8B - 61,500 feet - 600 knots - 2.4 Mach and turning - engines and hydraulics look good. Troubles with radio reception in turn.
1016	Total fuel 67,000 pounds - to 8B.
1017	To UHF No. 2 - trouble with reception. Left duct to manual and shock to bottom green - Data on 4381 - right bypass aft - throat 2.42 at 2.41 Mach - bypass forward - top green at 460 P/R 1.2 - unstart at 280 - right bypass aft - No. 5 EGT to 720° and rpm holding - nozzle just about wide open - throttle back to check nozzle. No afterburner light - right throat panel extend light - trying to accelerate to 2.4 Mach - At 2.3 Mach - both throat panel extend lights on - Data off 4641. Back to UHF No. 1. Throats 2.28 left and 2.3 right - trying to get speed back.

Test Log (Cont'd)

1025	Data on 4673 - duct to low performance - shock at bottom green. Stability maneuvers - left shock bottoms out at top of yellow with left rudder - 1.4g - Data off 4788.
1026	Total fuel 50,000 pounds - turning - Duct O.K. with normal performance - pitch augmentation off - Data on 4895 - pull up - release - data off - controls forward - against stop - copilot closes bypass and throttles to military to try to recover pitch - then light all afterburners - throats to normal - unstart right - bypass aft - restarted - all to military power to slow aircraft. Now have control - to 100% rpm - unstart right - Data on - at 2.25 Mach in turn at 50,000 feet - to low performance on inlet - Data off.
1032	Now have individual tank readouts - tank No. 4 1,800 pounds - tanks No. 4 and No. 6 off - bypass to 400.
1036	Back to primary radio Tank No. 3 - 27,000 pounds.
1037:30	1.45 Mach, decelerating through 45,000 feet - tips to one-half.
1038	All tanks empty - sump 25,000 pounds. Pilot face plate fogged with full heat. Instrumentation accelerometer very erratic.
1040	40,000 feet and descending 1.3 Mach - LN_2 - 13/16.
1041	Through Mach jump - bypass forward and off.
1042	U_1 - 130% - primary pitch trim out - cycled switch to "OFF" then armed and got it back.
1043	Data on 5786 - for decel through .9 Mach.
1044:30	Cabin altitude 6,000 - Data on - windshield down - .77 Mach - Increase in noise - Data off - tank No. 3 23,000 pounds - 350 knots - 12,000 feet - water 3400 NH_3 - 390.
1045:30	Tips up at 340 knots and 11,000 feet.
1048	Tank No. 3 - 22,000.
1048:30	Gear down - augmentation off.
1049	Flaps down - flap pressure light - 239 knots on tape and 248 knots on pneumatic.
1050	Tank No. 3 - 19,400 - total 29,500.
1051:30	Tanks No. 6, No. 7 and No. 8 on - pilot reports frost spot on aft window.
1052:30	Tank No. 3 readout hung up at 62,000 - tanks No. 6, 7 and 8 off.
1053	Data on 6378.
1053:30	Tank No. 3 now 19,100 indicated but total is inoperative (Went to 240,000 pounds).
1055	Touchdown - pilot thinks a tire blew - 3 drag chutes blossomed but one collapsed - brakes don't seem to be

Test Log (Cont'd)

holding very well at low speed - tromps on them and they feel spongy and reliving. Smoke on right side.

1058 Stop on taxi way No. 1 - smoke from both sides after stop.

1059 Retract flaps.

1100 Engine Data:

Idle

	RPM	EGT	Nozzle	Vib ADS	Vib Eng.
1	61.8	470	74	10	22
2	61.8	450	70	2	10
3	61.8	450	65	12	8
4	61.8	470	67	8	10
5	61.5	475	73	10	12
6	62.	460	71	12	5

All six engines to military power slides tires.

Military power three engines at a time

	RPM	EGT	Nozzle	Vib ADS	Vib Eng.
1	100	875	45	15	25
2	100	900	42	20	40-50 occasional light
3	100.5	875	39	20	20-30
4	100.5	875	40	5	20
5	99.8	880	42	20	40-45
6	100.2	880	43	20	20

No. 5 engine to afterburner - no roll back.

1104:30 Data on flight control full throws.

1106 Shud down engines No. 1 and No. 6.

1107 Brake test - auto at 15 mph - Data on 7249 - stop - off 7265 left locked and skidded.

1108 Manual rear brake test - 12 mph - Data on 7295 - stop - Data off - left side skidded 38 feet - right side about one-half distance - started to taxi and No. 9 tire blew - all 6 ADS overpressure doors opened.

1112 Shutdown on taxiway.

III. DATA:

1. Hydraulic Quantity Log:

	P_1	P_2	U_1	U_2
Time	F.L.	F.L.	F.L.	F.L.
0845 Prior to taxi	162%	152%	158%	166%
0908 Prior to takeoff	145%	139%	147%	150%
0928 @ 1.15 Mach climb	200%	180%	200%	169%
0933 Throat to Auto				181%
1042 Subsonic			130%	
1051 Gear Down			80%	200%
1105 After landing	180%	199%	70%	198%

F.L. - Fluid Level % (full - 200%)

Head Pressure 0827 (Hyd. Sys. Reserviced) P_1, P_2, U_1 - 170 psi;

U_2 - 172 psi

IV. ENGINEERING COMMENTS:

1. Flight Controls:

At about Mach 2.3 and 60,000 feet and, after the pitch augmentation had been turned off for fifteen to twenty seconds, a pullup and release stability maneuver was executed. During the maneuver, the pitch augmentation servo drifted to a hard-over pitch-up condition at one-half degree per second. This condition lasted about two minutes and caused the air vehicle to gain approximately 4,000 feet in altitude. In an effort to recover the air vehicle, the pilot exerted full manual authority with the control column forward against the stop. Recovery from this temporary nose up condition was marginal. To reduce the effect should this problem recur, the authority of flight augmentation control system (FACS) has been reduced to one-half in both pitch and roll axes. NAA engineering is further investigating the cause of pitch servo drift to identify and correct the problem. When the pitch augmentation was intentionally turned off during the pullup and release stability maneuver, the primary pitch trim became unpowered and consequently inoperative. Loss of this pitch trim contributed to the problem and made recovery more difficult; therefore, a change to the control circuitry should be made to provide primary pitch trim when the augmentation control system is disengaged.

2. Inlet Operation:

a. For this flight, the left throat was biased open prior to flight by .035 Mach using the standby switches to correct for an improper schedule. This results in the throat indicator showing a lag which the pilot must contend with when the throats are being operated.

b. The copilot reported that the inlet start at Mach 2.0 was not readily apparent from the cockpit because the shock position indicator appeared to be "bottomed out." First indication of started inlets was that the unstart lights went "OUT" with the air vehicle above 2.17 Mach and was accompanied by over-sensitive shock position indicator movement. Unstarts were accompanied by a loud noise and light shaking of the airplane. Unstarts resulting from bypass closure were as predicted, while unstarts resulting from throat closure appeared to occur at a larger throat opening than predicted. Restarting also required a larger throat than predicted with the start best indicated by the unstart light going out.

c. As indicated on previous flights, the shock position indicator was reported to be too sensitive and needle oscillations

made it difficult to use when indicating below the "upper portion of the green." Also, it was reported that the indicator "bottomed out" in the white rather than below the crosshatch in the lower yellow, as it should. The copilot on this flight concluded that a down stream shock limit caution light should be incorporated. He stated that excessive time was spent with the indicator "bottomed out." This condition is not desirable and the Joint Test Force (JTF) feels that further work should be done to the present shock position indicating system to reduce or eliminate oscillations in the lower ranges, and to make the system indicate the far aft or down stream shock positions before adding more lights to the cockpit.

d. The copilot also reported that the rate of throat movement when changing performance from NORMAL to LOW was too fast and resulted in excessive shock movement before the bypass area could be changed. To circumvent this difficulty, the copilot "bottomed out" the shock position needle before switching from NORMAL to LOW performance. The bypass doors were probably opened in excessive amounts from anticipating forward shock movement.

e. NAA is planning a reduction in the rate of throat movement during the change from NORMAL to LOW performance over to approximately one-third the present rate to correct this condition. Improved aft shock indications may also help.

3. Shock Position Indicators:

The shock position indicators were still over-sensitive as they overshot and oscillated when indicating an aft shock position. Even though some indicator damping was expected after Flight 1-10, a more readable and accurate shock position indicator is still required. Because interface of the shock position indicators with the instrumentation package could possibly be causing the indicator unstability, NAA engineering intends to disconnect, before the next flight, the right hand indicator from the instrumentation package and to change the electrical power wiring so that the left hand indicator and the instrumentation package are connected to the same phase of electric power.

4. Fuel Indicating System:

a. While doing stability maneuvers at 55,000 feet, 2.35 Mach, the copilot reported loss of all fuel quantity indications. He then used the fuel quantity indicator test switch and determined that the individual tank read-out was locked up at the maximum stop of 62,700 pounds. He later determined that the totalizer was working but it was his first impression that it was also locked up. Tank No. 7 was manually selected and, after watching the tank

sequence strip for a period of time, he determined that No. 7 was feeding and the test mission was continued with manual fuel control.

b. During deceleration and descent at about Mach 2.25 at 50,000 feet, the individual tank read-out became operative except for a short time just prior to landing. The fuel totalizer also drove to a reading of 240,000 pounds just prior to landing.

c. The problem with the totalizer was attributed to a circuit breaker. The individual tank indicator was given extensive bench test and disassembled without identifying the problem. It was found that while making the full and empty adjustments of the replacement indicator, one of the potentiometer wipers was moved too far, causing it to go beyond the coil and causing the indicator to drive to the full stop (62,700 pounds). Excessive adjustment in this potentiometer was required, due to an off center matching potentiometer in the No. 3 tank module. Tank No. 3 modules were then taken to Liquidometer Corporation for adjustment. Instrumentation data indicated that the fuel automatic sequencing continued to operate at the time the copilot reported the indicator failure and the flight could have continued on automatic sequencing rather than manual control.

5. Brakes and Tires:

Brake operations for this flight were as follows:

a. During taxi out for flight, excessive chatter was experienced with some momentary skidding.

b. On the landing roll the pilot reported that the brakes didn't seem to hold as well as on previous flights and that they felt spongy or were relieving. This was at lower speeds after the chute was jettisoned.

c. Brake tests using rear brakes only on manual, resulted in a skid and flat spotting the tires. Immediately after starting to taxi again the No. 9 tire blew (skid was through twelve plies). The aircraft was then towed to the run pad with the No. 9 tire flat and in the process of backing into the run pad the No. 10 tire blew because of the added weight. Later in the day an attempt was made to lower the pressure in Nos. 7 and 8. A servicing tool was attached to No. 8 valve stem through the tire cage. While reducing pressure, the No. 7 tire blew lifting the tire cage and breaking the No. 8 tire stem causing that tire to go flat also. Tires and rims were not hot. No personnel injuries occurred and no pieces separated from the tire casings.

d. The brake computer was removed for bench tests. Data showed that the right front brake provided little to no braking below 70 knots. This was accounted for by an out of adjustment amplifier. The right rear torque sensor provided no signal below 10 - 20 knots and excessive droop in the sensor characteristics caused rough and erratic braking at 30 knots.

e. During checks of the brake computer it was found that stray signals from the rate feedback amplifier were being sensed in the slip computer which could have also caused erratic brake operation. Circuit changes were made to eliminate this.

f. Based on changes made to the brake system, improved operation is expected; however, further brake checks are required to demonstrate this.

6. Propulsion:

a. The malfunction of the nozzle area control (NAC) on engine No. 5 (S/N 170-552) was the major problem in the propulsion area during the flight. After the flight, the engine was removed from the air vehicle and the NAC was examined. The upper filters to A_8 and A_9 were partially clogged with the same type material (fiberglas strands, lint and metal slivers) that was found in the fuel servo pressure filters. The A_8 filter was approximately 45% clogged and the A_9 filter was approximately 30% clogged. Engine No. 170-552 was replaced by engine No. 170-566.

b. The following minor problem areas were encountered during Flight 1-11:

(1) Prior to takeoff, the A_8 indicator on engine No. 1 (170-574) would spin around as power was increased. The problem did not occur in flight. A postflight ground check revealed no discrepancies in its operation.

(2) The high vibration light on engine No. 2 (170-562) came on occasionally during the flight. The high vibration has been attributed to 520 cps vibration since it disappeared at high altitude or when the pilot used the two step (hesitation at 90% rpm) throttle advance technique. Minor foreign object damage (FOD) was found on the first stage of the compressor of engine No. 2. The FOD, which may have been caused by aerodynamic putty, can be benched out without removing the engine from the air vehicle.

7. Flap Pressure Light:

A flap pressure caution indication again occurred when the flaps were lowered for landing. This occurred on Flight No. 9

and during the postflight inspection following Flight No. 10. Components had been changed without positively identifying the cause of the failure. The problem was isolated to the primary 1 (P_1) hydraulic system. The No. 1 flap control valve, solenoids and flow regulator were removed as an assembly for bench test. A condition occurred during bench test which could have caused the flight problem. Two Parker solenoid operated valves are used in parallel on the P_1 system and both are de-energized for flaps up or energized for flaps down. If one valve is in the energized position and the other in the de-energized position, pressure is ported directly to the system return line. During bench test, one valve hung up and caused this condition. Valve clearances have been increased and the mounting plate checked for warp in an attempt to eliminate the problem. The flow regulator was found to be hanging up in the open position but this would not have caused this problem.

8. Indicators:

a. About twenty-five minutes after takeoff, with the air vehicle exceeding Mach 2.0, the mach tapes ran to Mach 0.4 on two occasions. As this erroneous mach tape indication occurred on both the pilot's and copilot's indicators, a faulty signal from the central air data system (CADS) to the indicators appears to be the most likely cause of the trouble. Dirt on a cam within the CADS unit has been defined as the probable cause.

b. At times, during the flight, the TACAN bearings were 20° to 30° off. After the flight the pilot's attitude director indicator (ADI) was checked and found to be indicating erroneously. Both the ADI and the TACAN unit were replaced after equipment bench checks.

9. Instrumentation:

a. No difficulties were encountered in processing the instrumentation data for this flight. Of 742 parameters there were 15 parameters inoperative or incorrect prior to flight; 4 additional parameters had improper preflight calibration information; and data squawks were written on 38 parameters by data analysts.

b. The cockpit (communications) recorder tape was heavily distorted and unusable. This is a persistent discrepancy that has occurred on several previous flights. A modification to eliminate the problem is in work.

10. NASA SUPERSONIC TRANSPORT TESTS AND INSTRUMENTATION:

a. Landing Gear Cameras and Instrumentation:

All cameras provided good coverage of the touchdown and roll-out. Data was obtained from the two main gear rate of sink arms, but the position transducer for the nose gear arm was inoperative. The up-lock mechanisms of both main gear arms were damaged as a result of the blown tires following the landing.

b. Cabin and Ballast Bay Microphones:

Internal noise data were recorded by the two microphone systems during the flight test points at q's of 700 psf and 800 psf and during a portion of the deceleration and descent.

c. Velocity Acceleration Altitude (VGH) Recorder:

A good VGH record was obtained for the entire flight.

d. Sonic Boom:

The sonic boom measurement station was set up just north of Edwards AFB. No data was recorded, however, because the XB-70 passed by the station too far off track.

e. Runway Noise:

Noise measurements were made for both the takeoff and the landing by microphones placed at several locations along the side of the runway.

V. PILOT'S WRITE-UPS:

1. Individual tank read-outs hung up at 62,700 pounds and later became intermittent; auto fuel system inoperative when tank read-out stuck.

2. Brakes grabbing badly, particularly the right hand aft. This caused tires No. 9 and 10 to blow on taxi-in.

3. No. 5 engine exhaust gas temperature (EGT) reduced to 710°, 100% rpm and nozzle went open at 2.4 Mach at 60,000 feet.

4. TACAN heading unreliable; 20° - 30° off at times.

5. Mach tapes ran to 0.4 twice during high speed flight (both instruments).

6. No. 1 nozzle indicator spinning when throttle moved out of idle.

7. Flap pressure light on after lowering flaps.

8. Face plate heater appeared to be inoperative.

9. Instrument accelerometer erratic during flight.

10. No. 3 utility pump status indicator yellow just before engine shutdown.

VI. CONCLUSIONS:

1. Stability and control and inlet data were gathered on this successful flight to 2.45 Mach and 64,300 feet.

2. The pitch servo of the FACS drifted full up causing the air vehicle to pitch nose up.

3. The fuel quantity indicators malfunctioned, but actual fuel flow and sequencing were normal.

4. Systems which gave overall satisfactory performance were:

Engines	Environmental
Landing Gear	Radios
Nose Wheel Steering	Hydraulics
Instrumentation	Oxygen
Electrical	Wing Fold
Communications	AICS (except indication)
Fire Detector (Eng & ADS)	Drag Chute
IFF	Nose Ramp

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

6. Control of the shock position is difficult when shifting from NORMAL to LOW duct performance.

7. Full elevator authority of the FACS pitch system made recovery from the temporary nose up condition marginal.

8. The primary pitch trim power is removed when the FACS pitch power switch is in the "OFF" position.

9. Partially clogged NAC filters caused abnormal EGT and nozzle positions.

10. Low speed manual brake tests caused excessive tire wear and subsequent tire failures.

11. The flap pressure malfunction was duplicated in bench check after the flight and appears to be a flap control valve hang up in the P_1 hydraulic system.

12. The erratic mach tape operation was probably caused by dirt on a cam within the CADS unit.

13. TACAN bearings were in error.

14. Cockpit voice tape recording was unintelligible due to distortion.

VII. RECOMMENDATIONS:

1. Identify and correct the cause of pitch servo drift.

2. Reduce pitch damper authority to less than full elevator.

3. Modify the FACS to provide primary pitch trim power with the augmentation systems disengaged.

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

5. Eliminate the audio distortion in the cockpit voice recorder.

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