Late 1940's,
Early 1950's

F.T. Events/Accidents

Turning to the fuel shift problem in airplanes, a notable case occurred on the Douglas A4D Skyhawk during early test flights. The A4D's ultra-simple fuel system has only two tanks, the fuselage tank, which had sloshing problems before a baffle was installed, and a single integral wing fuel tank, which runs from wing tip to wing tip. The wing ribs provide excellent slosh baffling, but prolonged lateral acceleration can transfer partial wing fuel across the airplane's centerline.

A4D wing fuel shift shows up as spiral instability, which can be easily corrected by the ailerons (Figure 14.3). However, the early A4D airplanes had a single, or nonredundant, aileron hydraulic system. When aileron hydraulics malfunctioned at a high Mach number during an early test flight, the airplane and pilot James Verdin were lost. The painful lesson was learned. Production A4D (now A-4) airplanes retain the single integral wing fuel tank, but dual, independent aileron power systems now guard against loss in lateral control due to fuel shift.

Another fuel shift incident from the same time period occurred at Wright Field in a North American YF-100 being flown by Captain H. Z. Hopkins. He took off for a short functional check of the 275-gallon external fuel tanks. Only 50 gallons were loaded into each tank; takeoff acceleration shifted this load aft. Fuel was being burned from the forward fuselage tank, adding to the aft shift in center of gravity. The center of gravity apparently shifted aft behind the maneuver point, the point at which pull stick forces are required for positive load factors. The airplane went through a rapid sequence of positive and negative maneuvers. The external tank fuel somehow shifted forward, and the structurally damaged airplane was brought back under control and landed.

14.2 Deep Stall

Deep stall requires a stable longitudinal trim point beyond the stall. In addition, in deep stall the combination of longitudinal trim and control are either insufficient to nose the airplane down to an unstalled attitude or control power is so marginal that recovery takes place slowly or requires unusual measures, such as rolling or sideslipping the airplane or rocking the airplane in pitch. Deep stall was first discovered in flight on the British Aircraft Corporation's Trident and BAC-111 jet transports, the latter leading to a flight test crash in 1965. The details of the BAC-111 crash were widely disseminated, leading to new series of wind tunnel tests of airplanes then under development, such as the McDonnell Douglas DC-9. There were subsequent accidents in which deep stall was suspected, notably on the Boeing 727, a jet that resembles the BAC-111.

There is an underlying cause for deep stall in airplanes with horizontal tails mounted on top of the vertical tail in the T position. The wing trailing vortex system is normally rolled up into concentrated vortices by the time it reaches the horizontal tail. In unstalled flight the rolled-up vortices are generally behind the wing tips, quite a bit outboard of the horizontal tail span. This weakens the downwash at the horizontal tail, which is a source of nose up pitching moment.

In airplanes prone to deep stall the outboard wing panels stall first when angle of attack is increased. In effect, new wing tips are formed at the tips of the unstalled wing portion. The rolled-up trailing vortices are now quite close in span to the horizontal tail. If the horizontal tail is in the T location, at the top of the vertical tail, the rolled up vortices at high angles of

Airplane Stability and Control
Abzug and Larrabee

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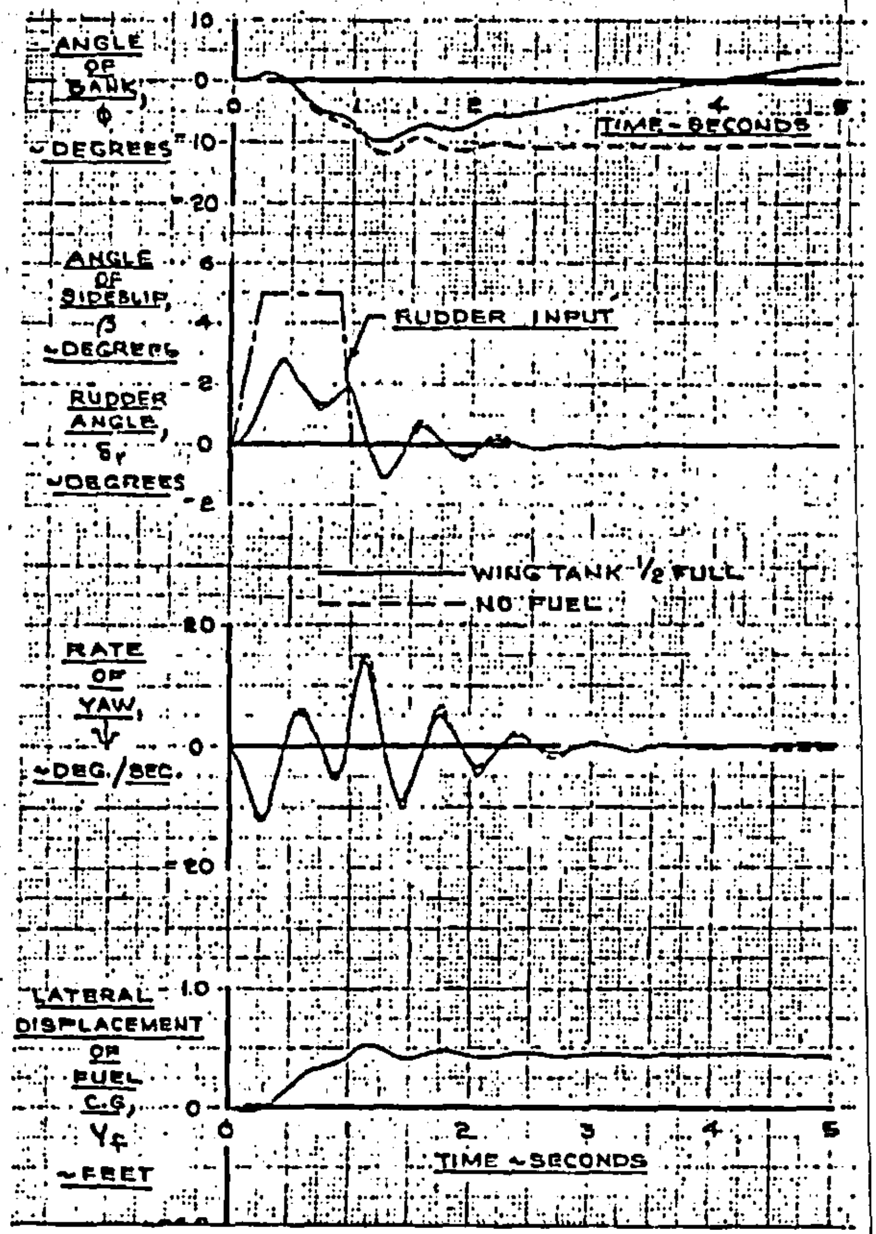

Figure 14.3 Calculated effect of fuel shift in the Douglas A4 Skyhawk's wing tip-to-wing tip wing tank. With half wing fuel, a rudder kick shifts the fuel, giving apparent spiral instability. The bank angle increases slowly with time. (From Abzug, Douglas Rept. ES 29551, 1959.)

Late 1940's

The speed record flights were made by test pilot Robert O. Rahn at very low altitudes over a measured course at Edwards Air Force Base in California. The low altitudes at which the compressibility trim change occurred exaggerated its effect. At Mach 1 and at sea level, the F4D-1 changed load factor or g by about 1.5 for each degree change in angle of attack. At the highest speed attained, Rahn used a pull force to overcome the nose-down trim change. At the end of the runs, turning to return to the course, speed dropped off and a push force was required. This of course was contrary to the usual pull control forces required in turns.

When the F4D-1 was fitted with a higher-powered engine, the J57-P-2, Rahn flew the new version to maximum speed at low altitude. The airplane reached a Mach number of 0.98, while 500 feet over the ocean. This time Rahn used the F4D's trim surfaces in the nose-up direction to overcome the diving tendency near Mach 1. This provided more precise path control at that tremendous speed close to the water. However, when Rahn cut off the afterburner to decelerate the airplane, the nose-up trim setting produced an uncontrollable pullup to 9.1 g. The airplane was over-stressed and badly buckled, but landable.

Flight tests of a well-instrumented North American F-86 Sabre provide an unusually good look at the transonic trim change problem (Anderson and Bray, 1955). The measurements show marked increases in longitudinal static stability and decreases in elevator control power as Mach number increases from 0.94 to 0.97. The record of a dive pullout (Figure 11.12) shows a trim change when the F-86 traversed the same Mach number range, slowing down in a dive pullout.

The transonic trim change problem was experienced also with the North American F-100 Super Sabre, although less dramatically. In unpublished correspondence Paul H. Anderson recalls these events:

> The first complaint was that the airplane could not be trimmed at cruise speed. Much time and effort was spent redesigning and flight testing modifications to the trim system (with no improvement) until we finally recognized what was happening. The answer, of course, was to feed back Mach number to the flight control system...
>
> Prior to that, the slope of stabilizer position versus speed was called static longitudinal stability. When the aerodynamic center shift [with Mach number] was encountered some people said that the airplane was statically unstable, when it was actually more stable than before. We finally changed the name of stabilizer position versus speed to Speed Stability and the problem went away.

Mach trim compensators as separate systems continued to be features of transonic airplanes for many years, up to the advent of integrated fly-by-wire control systems. As an example of one of the older separate Mach trim compensators, the Boeing 707 transport has an automatic Mach trimmer that puts in 2 degrees of nose-up stabilizer trim starting at Mach number 0.82. In modern integrated fly-by-wire control systems Mach trim change compensation is just one of the many stability augmentation programs in a flight control computer.

11.9 Transonic Pitchup

Transonic high angle of attack pitchup is an instability caused by reversal of the normal, stable wing-fuselage pitching moment variation with angle of attack. In the normal,

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XI-89

02/22/50

under the designation YF-89.

In March of 1949, the name "Scorpion" was officially applied to the XF-89, the suggestion being originally made by ground crews at Edwards who thought that the parked plane with its upward-curving rear fuselage and its high tail looked a lot like the dangerous creature with the deadly stinger in its tail.

On July 14, 1949, the USAF made the order of 48 production F-89A aircraft official. Serials 49-2431/2478 were assigned. An additional 27 aircraft were added to the contract on September 19, 1949.

The second prototype (46-679) made its maiden flight on November 15, 1949. Modifications made when the airframe was almost 90 percent complete led to a change in designation to YF-89, as it was envisaged as being a test vehicle for the production F-89A fighter. The XF-89 had been painted black, but the YF-89 was finished in natural metal overall.

The XF-89 had been unarmed, pending the availability of the nose turret. However, the nose-mounted turret was eventually abandoned as being too complicated, and a more conventional armament of six forward-firing 20-mm Mk 24 cannon was chosen for the Scorpion.

Since the USAF wanted the Scorpion in service right away, production of the F-89A got underway immediately, even before testing of the prototypes was completed. This commitment to production proved to be premature. On February 22, 1950, the XF-89 prototype crashed while making its 102nd flight. During a high-speed low altitude run in front of Air Force officials, the right horizontal stabilizer peeled off, and the aircraft tore itself apart in midair. Pilot Charles Tucker was thrown clear during the breakup and he was able to parachute to safety, but flight engineer Arthur Turton was killed. The cause of the crash was later found to be a failure of the horizontal stabilizer due to excessive flutter.

The YF-89 was grounded for changes, and production of the F-89A was halted. As a result of the grounding, the YF-89 was extensively modified. The nose was completely redesigned. It was reconfigured to be more tapered and was increased in length by three feet. An AN/ARC-33 radar set was fitted in the nose, along with a Hughes E-1 fire control system. Since the XF-89 was somewhat underpowered and had poor takeoff characteristics, more powerful engines were fitted--Allison J35-A-21s, rated at 5200 lb.s.t. dry and 6800 lb.s.t with afterburners. The engine air intakes were redesigned to include external boundary layer bleed ramps and auxiliary pop-in doors were added to the nacelle sides to allow additional air to be supplied to the engine during ground runups. The engineers believed that pulsating exhaust gases from the engine were early June of 1948. The XP-89 was powered by a pair of Allison J35-A-9/-15 engines of 4000 lb.s.t. each. Neither the Martin nor the Northrop turrets were ready, so the prototype carried no armament. The aircraft was equipped with conventional ailerons which drooped for takeoff and landing, adding extra lift.For rollout, the XP-89 did not carry its jettisonable 600-gallon wingtip tanks. It was painted gloss black overall.

Even before the new Northrop fighter made its first flight, on June 11, 1948, the P-for-pursuit designation was replaced by the F-for-fighter designation, and the XP-89 became the XF-89.

Following a number of ground taxi and brake tests at Northrop Field, the XP-89 was disassembled and trucked out to Muroc Dry Lake (later Edwards AFB). The XP-89 made its maiden flight there on August 16, 1948, with test pilot Fred Bretcher at the controls. Flight test results were generally positive, but the aircraft proved to be seriously underpowered. For the first 32 flights, conventional ailerons were fitted, but on February 1, 1949 a new series of trials began with Northrop-invented "decelerons", which was a split surface that could be operated in one piece as a conventional aileron but which could be opened up to serve also as an airbrake. This feature was made standard on all subsequent F-89s.

Even though the flight test crews were enthusiastic about the XF-89, the USAF ordered that a flyoff take place between the XF-89, the Curtiss XF-87, and the Navy's Douglas XF3D-1 Skyknight. The Curtiss XF-87 with its side-by-side seating arrangement was judged to have the best cockpit arrangement, with the XF3D-1 coming in second. The tandem seating arrangement in the XF-89 made communication between pilot and radar operator difficult. Ease of maintenance was found to be the best in the XF3D-1, with the XP-87 coming in second. However, the evaluation team judged the XF-89 as being the superior fighter and having the best development potential.

Since the Northrop XF-89 was judged as having the superior potential as a fighter, on October 10, 1948, the USAF officially cancelled the Curtiss XF-87 project. The failure of the XF-87 to win any production orders was the end of the line for the Aeroplane Division of Curtiss-Wright. Shortly thereafter, the Aeroplane Division of Curtiss-Wright declared bankruptcy, sold all of its assets to North American, and closed its doors forever.

Even though the XF3D-1 did not succeed in obtaining any USAF orders, it nevertheless did receive orders from the US Navy and the US Marine Corps, and went on to serve as both a land-based and carrier-based interceptor fighter for many years.

In January of 1949, President Harry Truman authorized the Air Force to make an initial purchase of 48 F-89As. The second XF-89 would be converted into a service test aircraft

Northrop F-89A Scorpion

Last revised November 6, 1999

The first production version of the Scorpion was the F-89A (Model N-35). Forty-eight F-89As had been ordered on July 14, 1949. Production of the F-89A got underway even while the XF-89 and YF-89 were still under test, but the crash of the XF-89 prototype on February 22, 1950 brought the whole program to a halt while the problems were being fixed.

At the time of the XF-89 accident, three F-89As were nearing completion. It was decided that these three machines, acting in conjunction with the YF-89A, would be the test force used to wring out the problems with the Scorpion. The first production F-89A was accepted by the USAF on September 28, 1950, followed by the second and third examples a few weeks later.

The F-89A could be distinguished from the YF-89A by the mounting of an armament of six 20-mm T-31 (M-24) cannon in the nose with 200 rpg. Neither the XF-89 nor the YF-89A had carried any armament. Underwing pylons were provided which could carry sixteen rockets or up to 3200 pounds of bombs. An A1-CM gunsight was fitted, and an AN/APG-33 radar was mounted in the nose.

The fix for the tail flutter problem was found to be the fitting of a series of external mass balance horns attached to the hinge area of the horizontal stabilizer/elevator. The configuration of the underfuselage exhaust deflector fairings was changed, and a number of different fairing designs were tried until a final design was adopted. The lines of the rear fuselage behind the jet pipes were altered to overcome some of the excessive turbulence that had been encountered by the YF-89A at high speeds. With these changes, the fail flutter problem was finally believed to be cured, and in January of 1951 production of the F-89A was resumed.

The engines of the F-89A were originally a pair of Allison J35-A-21s. After a rash of engine failures on early F-89As, these aircraft were reengined with Allison J35-A-21A turbojets, rated at 5100 lb.s.t.dry and 6800 lb.s.t with afterburning. These engines had an engine oil scavenging system and different kinds of afterburner eyelids, which gave smoother afterburner control.

responsible for the tail flutter problems that had wrecked the XF-89, and the engine exhaust area was redesigned by adding deflector plates to the fuselage to direct the exhaust away from the tail. The pitot tube was moved from the vertical tail and installed in the nose. The jettisonable 300-gallon wingtip tanks of the XF-89 were replaced by permanently-attached more-streamlined 300 gallon tanks.

The heavily-modified YF-89 was redesignated YF-89A (Model N-49), and made its first flight on June 27, 1950, and the Scorpion flight test program was resumed.

Serials:

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46-678  Northrop XP-89 Scorpion - redesignated XF-89 in 1948.
46-679  Northrop YF-89 Scorpion
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Sources:

1. United States Military Aircraft Since 1909, Gordon Swanborough and Peter M. Bowers, Smithsonian, 1989.

2. F-89 Scorpion in Action, Aircraft Number 104, Larry Davis and Dave Menard, Squadron/Signal Publications, 1990.

3. Fighters of the United States Air Force, Robert F. Dorr and David Donald, Temple Press Aerospace, 1990.

4. The American Fighter, Enzo Angelucci and Peter Bowers, Orion, 1987.

5. American Combat Planes, Third Enlarged Edition, Ray Wagner, Doubleday, 1982.

6. Post World War II Fighters, Marcelle Size Knaack, Office of Air Force History, 1986.

solved as in the case of the F-89A and B by retrofitting these early F-89Cs with the improved and more reliable J35-A-21A engine.

Beginning with the F-89C-25-NO production block, the engine was changed yet again to the Allison J35-A-33 jet rated at 5400 lb.s.t. dry and 7400 lb.s.t. with afterburner.

Finally, production blocks -35 and -40 were fitted with the Allison J35-A-33A, rated at 5600 lb.st. dry and 7400 lb.st with afterburner. The -33A engine not only had more power, it also had a redesigned inlet, deicing equipment, inlet guide vanes, and redesigned forward engine mounts. The F-89's engines, being mounted quite low on the fuselage, had a tendency to scoop up runway debris into their intakes. To cure this problem, retractable inlet screens were added to the -33A engine.

Other problems with the Scorpion turned out to be much more serious. During 1952, several F-89Cs crashed due to wing structural failures. No less than six aircraft were lost in the spring and early summer of 1952, one spectacular crash taking place in front of thousands of spectators at the International Aviation Exposition at Detroit. The Air Force was forced to ground the entire Scorpion fleet on September 22, 1952 until the cause could be found.

After an exhaustive series of flight tests, the problem was finally traced to a previously unknown effect, known as aero-elasticity. During high-G maneuvers, the wing tended to twist at the tip, exerting excessive strain on the wing attachment points and causing them eventually to fail. The large wingtip fuel tanks were found to be a significant factor in exerting this twisting moment. A total of 194 F-89A, B, and C aircraft were shipped back to Northrop where they were fitted with stronger wings with forged steel attachment points. At the same time, a small fin was added to the outboard rear of each wingtip tank, which reduced the aerodynamic forces on the tank that caused it to flex and twist during maneuvering.

Before the F-89C fleet had been fully retrofitted with the new stronger wing, a total of fourteen months had passed and it was not until 1954 that the Scorpion force reached its intended level. As fast as the F-89Cs could be modified, they were flown directly to their operational units. With the modified wing and the improved engines, the Scorpion became one of the safest and most reliable combat aircraft in the USAF inventory. The 74th Fighter Interceptor Squadron, following its transfer to Thule, Greenland in August of 1954 completed a full year of service with the type without a single accident of any kind.

The F-89C served with the 27th, 74th, and 433rd Fighter Interceptor Squadrons from 1952 onwards. The 57th FIS, based in Iceland, the 65th and 66th FIS based in Alaska, and the stateside 438th FIS took delivery of the F-89C in 1953.

03/21/1950

AirDisaster.Com
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AirDisaster.Com Accident Database

> Accident Database > Accident Synopsis > 03211950

Date of Accident:	21 March 1950
Airline:	Bristol Co.
Aircraft:	Bristol 170
Location:	Cow Bridge, United Kingdom
Registration:	G-AHJJ
Previous Registrations:	Not Available
Flight Number:	Not Available
Fatalities:	4:4
MSN:	12742
Line Number:	Not Available
Engine Manufacturer:	Not Available
Engine Model:	Not Available
Year of Delivery:	Not Available
Accident Description:	Crashed during test-flight.

Related Links/Information:

02/01/1951

02/01/51
10/ 145

Douglas XB-43 - *Chapter 1*

Fisrt American Jet Bomber

Last revised: 29 May 1998

Douglas XB-43
Douglas XB-43 - Sources

The Douglas XB-43 was the first American jet bomber. It was a development of the XB-42 Mixmaster twin-engined bomber, with turbojet engines replacing the twin inline Allison piston engines.

The XB-43 had its origin back in October of 1943, when first consideration was given to fitting turbojets to the XB-42. Preliminary studies indicated that the scheme was practical, and on March 31, 1944 Douglas received a change order to the original XB-42 contract which called for the production of two jet-powered versions under the designation XB-43. The USAAF wanted the XB-43 to have a gross weight of 40,000 pounds.

Two General Electric TG-180 (later redesignated J35-GE-3) axial-flow turbojets were mounted in the forward fuselage bays that were previously occupied by the Allison piston engines of the XB-42. Flush intakes were incorporated in the upper fuselage sides immediately behind the two-seat pressurized cockpit. The hot gases from the engines were exhausted via long tail pipes which extended all the way down the fuselage to side-by-side openings in the tail. Since there was no longer any rear propeller which had to be protected against hitting the ground, the lower ventral fin of the XB-42 could be omitted. This omission required that the upper vertical fin be increased in area to provide adequate lateral control.

Assuming tests on the prototypes to be satisfactory, plans were made for an initial production order of 50 B-43s for the USAAF, while Douglas submitting a proposal for an eventual production rate of as many as 200 per month. The production B-43 would have had a conventional canopy in place of the two small bug-eye canopies of the XB-42. Two versions were planned -- a bomber version with a transparent nose and a maximum bombload of 6000 pounds and an attack version with 16 forward-firing 0.50-inch machine guns with an unglazed nose and an armament of 35 5-inch rockets. Both versions were to be fitted with a remotely-controlled, radar-directed tail turret with two 0.50-inch machine guns.

The end of the war resulted in a slowdown in the B-43 program, since a jet bomber was no longer urgently needed. In addition, late delivery of the turbojets resulted in a delay of several additional months. During an engine run-up test at Clover Field in October of 1945, the starboard engine shed some of its first-stage compressor blades, causing an instantaneous separation of all blades and damaging the engine casing and fuselage skin. The repairs that were required delayed the first flight by another seven months.

The first XB-43 (44-61508) finally took off on its maiden flight on May 17, 1946, with test pilot Bob Brush and engineer Russell Thaw in the cockpit. Performance was generally satisfactory, but the aircraft was somewhat underpowered. During flight trials, the Plexiglas nose cracked due to temperature changes, and had to be replaced by a plywood cone.

However, by the time of the XB-43's first flight, the USAAF had already decided against ordering the B-43 into production. USAAF thinking now favored a four-engined rather than a twin-engined configuration for its future jet bombers, and had already decided to order the North American B-45 Tornado into production. The XB-43 program would still continue, but it would now be relegated to the status of a flying testbed.

The second aircraft (44-61509) was fitted with a single canopy and was delivered to Muroc in May of 1947. It was used there as an engine testbed. For this purpose, one of its J35s was replaced by a General Electric J47. This plane was kept flying by cannibalizing the first XB-43, which had been damaged in an accident on February 1, 1951. In late 1953, the second XB-43 was finally retired. The plane is now owned by the National Air and Space Museum. I presume that it is sitting in one of the hangars of the Paul Garber restoration facility at Suitland, Maryland. Has anyone seen it?

Serials of the two XB-43s were 44-61508 and 44-61509.

Specification of Douglas XB-43:

Powerplant:
: Two General Electric J35-GE-3 turbojets, 4000 lb.s.t. each.

Performance:
: Maximum speed 515 mph at sea level. Cruising speed 420 mph. Service ceiling 38,200 feet, absolute ceiling 41,800 feet, initial climb rate 2470 feet per minute. Range 1100 miles with 8000 pounds of bombs. Maximum range 2840 miles.

Weights:
: 21,755 pounds empty, 37,000 pounds loaded, 39,553 pounds maximum takeoff.

Dimensions:
: Wingspan 71 feet 2 inches, length 51 feet 2 inches, height 24 feet 3 inches, wing area 563 square feet.

Armament:
: Neither XB-43 was ever fitted with any armament.

Douglas XB-43
Douglas XB-43 - Sources

Joe Baugher jbaugher@worldnet.att.com
Maintained by Carl Pettypiece

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19 December 1950 1002 PST

LOCATION: Edwards AFB, Muroc, Calif

PURPOSE: Navy Evaluation

1-60

WOOD, [illegible] LCDR USN

DOUGLAS A/C Co., Inc., Santa Monica, Calif

Unl. 160 lite No

VFR

1.6 — 1.6 — 52 Min

Forced landing following engine failure

est 30° — 410' — Est 110

NAME & RANK OF OTHER PERSONNEL — INJ.

SKYSHARK

Not illustrated — Do not count.

AIRCRAFT MODEL & NO.: XA2D-1 #122988

DAMAGE DESCRIPTION & REMARKS

strike

GEN. NATURE: C-E

stall during forced landing, one engine failed

slow heights of desired but with [illegible] level [illegible] flare [illegible]

P-R113 right eng turbine failure

E-3 no instruments to indicate failure

CLASSIFICATION OF ACCIDENT CAUSES

PR [illegible]

ACCIDENT - Pilot took off from Edwards AFB for Navy prelim evaluation flight under authority from Buaer. After takeoff the a/c was climbed to 31,285', at which time dive in in the clean configuration was made to a max, indicated air spd of 486 mph & pullout made at 16,000' to a load factor of 5.5g. Following this dive the a/c was climbed to 21,000' & dive utilizing spd brake was made. Pullout from this dive was made on a NWly heading at an altitude reported by pilot to be about 7000'. When the a/c was observed by Douglas A/C employees in level flight attitude at about 8,500' altitude, the spd brake was still extended & slight trail of grayish-white vapor was noted emitting from rear portion of the a/c. The pilot was notified of this condition by Douglas radio pilot stated that he would land on the lake bed. By this time the spd brake had been closed & vapor previously noted had vanished. The a/c had then descended to an est. altitude of 4500' & was on an easterly heading, having made a gradual right turn. Shortly thereafter the pilot was requested to make low pass over the Douglas Radio car, which was located at east end of the r/w 6-24, for the purpose of observation by ground party. The pilot acknowledged these instructions via radio & commenced gentle turn to right toward a southerly heading. Ground observers believed that he was going to continue this turn until headed for the radio car & make the requested pass. The a/c at this point was approx. 6 miles from Douglas radio car. Ground observers noted that

AIRCRAFT ACCIDENT CARD
FORM NAVAER 339 C (REV. 5-48)

k) That a/c might have been successfully landed under power by declutching the failed power section or without power by feathering props if there had been positive indication of loss of power.

CONCLUSIONS & REC. - It is concluded that crash occurred as result of material failure of which pilot could not necessarily receive any indication by cockpit instrumentation. It is recommended that: a) Instrumentation available to pilot be provided to positively indicate malfunctioning or failure of each power plant section. b) Consideration be given to re-design of power plant such as to provide automatic declutching of a malfunctioning or failed power section. c) An observation or so called "chase plane" be required to accompany all flights of experimental a/c during initial flights & early stages of evaluation.

BAR EL SEGUNDO END. - Corrective action in accord with recommendation(a) is already underway. Torque meters for installation in the XT-40-A-2 engine were reqd this date. Recommendation (d) is being made the subj of separate correspondence.

It is recommended that BuAer or CNO consider issuance of instructions to guide fld inspection offices in reporting situations involving accidents to a/c in contractor custody, whether flown by contractor or naval personnel.

a/c was at considerably lower altitude than would normally be expected at that distance for tower pass for inspection purposes. When it became evident that a/c was so low that landing was being attempted, Douglas radio car called to inquire if gear was down. However, before this transmission could be made, the landing gear was extended, & within 4 or 5 seconds the a/c struck ground in relatively flat attitude but at what appeared to be high sinking spd estimated at about 60'/sec. The time of day was 1002PST. Fire broke out immediately. Crash equip was on scene within 4 minutes. Pilot was removed & fire brought under control in about 9 minutes. While the a/c was almost completely consumed by fire, there were, however, many relatively undamaged components, particularly the engine & prop.

ANALYSIS - From facts disclosed following reconstruction appears reasonable: a) That smoke or vapor being emitted by a/c in flt as observed by ground party was associated with failure of right hand power section turbine. b) That there were no instruments in cockpit which would necessarily indicate turbine failure to pilot. c) That pilot, preparatory to executing low pass over ground observation party, decelerated at reduced power setting to a point approx 1,200' above terrain & approx 4½ miles distant from ground observation party. d) That pilot then opened throttles demanding more power preparatory to making low, slow pass over ground observation party. e) That on opening of throttles sufficient power was not being delivered to props. f) That required power was not being delivered since L hand power section & wind-milling props were driving the failed R power section thru gear box assy. g) That the prop governing system in attempting to meet demands of hi prop rpms with little or no power input to props scheduled blade pitch angles into low range. h) That under conditions of low-power or wind-milling the props when in low pitch considerably increase the airplane drag. i) That increased a/c drag & blanketing of surfaces by prop probably caused a/c to stall resulting high rate of descent. j) That insufficient altitude remained to effect recovery & flare out for landing.

04/10/1951

The Aviation Safety Network

AviationSafetyNetwork

Accident Description

Accident description

Date:	**10.04.1951**
Type:	Handley Page HP.82 Hermes V
Operator:	Ministry of Supply
Registration:	G-ALEU
C/n:	HP.82/1
Year built:	1949
Crew:	0 fatalities / 5 on board
Passengers:	0 fatalities / 0 on board
Total:	0 fatalities / 5 on board
Location:	Chilbolton (UK)
Phase:	Landing
Nature:	Test
Flight:	- (Flightnumber)

Remarks:

The Hermes V G-ALEU was on a testflight when the no.3 engine oversped. The propeller was feathered. The no.1 and no.4 engines then also sudddenly failed. An emergency belly landing was carried out in a waterlogged field.

Source:

[disclaimer]

AviationSafetyNetwork

Main Page

Accident description

Date:	**03.12.45**
Type:	Handley Page HP.68 Hermes 1
Operator:	Handley Page Ltd
Registration:	G-AGSS
C/n:	HP.68/1
Year built:	1945
Crew:	fatalities / on board
Passengers:	fatalities / on board
Total:	fatalities / on board
Location:	Kendalls Hall (UK)
Phase:	
Nature:	
Flight:	- (Flightnumber)
Remarks:	.
Source:	

8/22/~~51~~ 1951

? ? /51

8/8/1955

X-1's

THE ADVANCED BELL X-1s

BY DR. RICHARD P. HALLION
Center Historian, Air Force Flight Test Center, Edwards AFB, Ca.

8/8/55

8/22/51

151.

Wingspan:	28 ft.
Length	35.55 ft.
Height:	10.70 ft.
Weight:	16,487 lbs. Launch Configuration
	7,266 lbs. Landing Configuration
Engine:	Reaction Motors, Inc. XLR-11-RM-5, 6,000 lb. static thrust

In mid-November 1947, the Air Force authorized Bell to begin development of a series of advanced X-1 airplanes, following this with a contract on April 2, 1948 for Bell to develop four aircraft under Project MX-984. Though similar in structure and internal details, each aircraft would receive a different alphabetical designation, i.e.: X-1A, X-1B, X-1C, and X-1D. In any case, the proposed X-1C, an armament test aircraft, was cancelled because of the availability of the F-86 Sabre as a transonic weapons test aircraft. Bell continued the development of the other three.

They retained the wings and tails of the earlier X-1 design, but had a completely different fuselage, with increased propellant tankage, a low-pressure turbopump fuel-feed system, and a stepped semi-bubble canopy. Unlike the XS-1s, the advanced X-1s incorporated a fighter-style control stick rather than control wheel. They could carry 500 gallons of lox and 570 gallons of diluted alcohol fuel, giving the craft an anticipated maximum performance of Mach 2.47 at 70,000 feet, and an engine burn time of 4.65 minutes. The first of the advanced X-1s completed was the X-1D, serial 48-1386, which arrived at Edwards in July 1951, subsequently being lost in an explosion on August 22 of that year prior to launch on a high-speed flight by test pilot Frank K. Everest. Fortunately, Pete Everest and the B-50 launch aircrew escaped injury, and the flaming rocket plane was jettisoned to explode in the desert. The surviving X-1A (48-1384) did not take to the air until 1953, when Bell test pilot Jean "Skip" Ziegler completed a short series of contractor flights at subsonic speeds. Subsequently, Ziegler perished near Buffalo, N.Y. in an explosion of the Bell X-2 #2 (46-675) in conditions reminiscent of the X-1D accident nearly two years previously, and the X-1A was returned to Bell for modifications to its propulsion system aimed at preventing such explosions in the future. It returned to Edwards in mid-October 1953, and pilot Chuck Yeager now began a series of flights aimed at achieving the X-1A's maximum speed potential. On his first powered flight he reached Mach 1.15, extending this to Mach 1.5 on his second, and Mach 1.9 on this third. His fourth flight was one of the most exciting in aviation history; Yeager reached Mach 2.44, 1,612 mph, at approximately 74,200 feet. The X-1A then tumbled completely out of control from inertial coupling, finally winding up in an inverted spin at 34,000 feet. Yeager, groggy, battered and semiconscious, recovered to a normal spin, and then recovered from that into a glide that carried him back to Rogers Dry Lake. Yeager's Mach 2.44 mark represented the high-water mark of the entire X-1 program, for no X-1 airplane ever equaled or exceeded this speed again.

During the spring and summer of 1954, test pilot Arthur "Kit" Murray flew the X-1A on a series of high-altitude flights, eventually achieving a record altitude of 90,440 feet on August 26, 1954. Thereafter, the X-1A was delivered to the NACA for further research. The X-1B (48-1385) had arrived at Edwards on June 20, 1954 and flew briefly in an Air Force pilot checkout program before itself being delivered to the NACA at Edwards for aerodynamic heating researc During the course of the Air Force program, Frank Evere flew the craft to Mach 2.3 on December 2, 1954. Subsequentl NACA transferred the aircraft to the Langley laboratory f instrumentation installation, and it returned to Edwards i August 1955. By that time, the NACA had embarked on it flight test program with the X-1A. But on August 8, 1955, a with the X-1D and X-2 #2 before it, the X-1A exploded whil being transported to launch altitude by its B-29 mothershi Though the explosion was a low-order one, the damage wa severe enough so that the drop crew had no option but t reluctantly jettison the steaming craft into the Mojav Earlier, in 1951, the X-1-3, known as "Queenie" had also e ploded while being de-fueled following a captive fligh destroying both Queenie and its B-50 launch aircraft. At thi point a painstaking Air Force-NACA-Bell accident i vestigation team determined that the cause of all of thes explosions was detonation of Ulmer leather gaskets durin pressurization of the rocket planes' propulsion systems. Th gaskets were changed, and the subsequent X-1 and X- programs were safely concluded.

Following the loss of the X-1A, only the X-1B was left c the original advanced X-1s. It remained flying with th NACA on aerodynamic heating investigations until the en of 1957, by which time the airplane had been fitted wit experimental reaction control thrusters in preparation fo the upcoming X-15 program. The X-1B was retired in Ma 1958 after NACA technicians discovered four fatigue crack in its liquid oxygen tank. It is now on exhibit at the Air For ce Museum, Dayton, Ohio.

With the retirement of the X-1B, only one other X- remained flying: The X-1E. This had started out as the Be XS-1 #2 (46-063). After grounding in 1951 because of fatigu problems in its high-pressure fuel system, the craft wa rebuilt with a new low-pressure turbopump fuel feed systen and a special 4% thickness-chord ratio wing with an aspec ratio of 4 developed by the Stanley Aviation Corporatior The new X-1E, as it was redesignated, used a Reactio Motors LR-8 engine from the Douglas D-558-2 Skyrocke program. It began its first flight research in December 195 and thereafter, flown by Joseph A. Walker and Jack McKay undertook a number of research flights to above Mach 2 Following the loss of the X-2 #1 (46-674) in September 195 one proposal existed to modify the X-1E for Mach 3 fligh using ventral fins for added stability and boosted engine pe formance. Though eventually the plane was flown with a experimental fuel consisting of a mix of 60 percent unsym metrical dimethylhydrazine (UDMH) and 40 percen diethylene triamine (the fuel mix being known as U-Deta, o Hidyne), NACA rejected going beyond Mach 2. In Decembe 1958, while grounded for inspection of its ejection system cracks were discovered in its alcohol tank, and the decisio was made to retire the craft. The X-1E is now on exhibit i front of the Dryden Flight Research Facility at Edwards Ai Force Base.

08/26/1951

HP 88

UNLIMITED.

E1

[redacted] [redacted]

N8426678

Structures Dept. Note No. Acc.245

July, 1952

ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH

Note on the structural failure of Handley Page 88 (E6/48) VX.330

Prepared by A.J. Almond

Approved by D.T. Jones

R.A.E. Ref: Structs/44/11129/AJA/104

SUMMARY

The Handley Page 88 prototype (E6/48) crashed at Stansted airfield on 26/8/51 following structural failure in the air. The pilot was killed.

An examination of the wreckage made at the R.A.E. leads to the conclusion that primary failure occurred in the fuselage. This failure was probably due to pitching oscillations.

Investigations into the oscillations which had previously been encountered are proceeding.

(RAE-Struct-Acc-245) NOTE ON THE STRUCTURAL FAILURE OF HANDLEY PAGE 88 (E6/48) VX.330 (Royal Aircraft Establishment) 22 p HC A02 N84-26678

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1 Introduction

1.1 The Handley Page E6/48 prototype crashed at Stansted airfield following structural failure in the air on 26th August 1951. At the request of the Chief Inspector of Accidents, Ministry of Civil Aviation, the R.A.E. assisted in the investigation of the accident and this note gives an account of the examination of the wreckage at the R.A.E.

2 The aircraft

2.1 The aircraft was a prototype built to specification E6/48 and its wing was a scale representation (about $^1/_3$rd full size) of that of the aircraft being built by the firm to specification B35/46.

2.2 A Supermarine "Attacker" fuselage and engine installation with certain modifications were incorporated in the design. The wing was of an unusual plan form known as "Scimitar" having reducing sweep back from root to tip.

2.3 It was fitted with Boulton Paul fully powered controls operating the ailerons and an all-moving tailplane. Artificial "spring feel" was provided for the pilot and a g-restrictor bob weight was incorporated in the tailplane circuit. The installation for power operation of the rudder had been disconnected and direct rudder bar control substituted as it had been found that the powered response was inadequate to maintain directional control during take-off and landing.

2.4 A V-G recorder was fitted in the aircraft and the results obtained from the slide recovered from the wreckage are discussed below.

2.5 Data from previous flights

Approximately 14 hours flying, comprising 28 flights had been completed at the time of the crash.

On the second flight sensitivity of control in pitch at approx. 230 kts. I.A.S. was experienced resulting in oscillations which became more pronounced when the pilot attempted to take orthodox corrective action with the control column. The most satisfactory method of controlling the oscillations was found to be holding the stick firmly or releasing altogether (which gave a condition equivalent to stick fixed with a powered control system as fitted to this aircraft) and reducing power. Further flight tests confirmed that the speed at which the sensitivity in pitch became apparent was about 230 kts.

For the sixth flight a short length of light alloy angle was riveted to the upper surface of the tailplane trailing edge. It appears that this had the effect of raising the speed at which sensitivity in pitch was acceptable to about 270 kts. By the addition in stages of varying lengths of angle to the upper and lower surfaces of the tailplane the aircraft was flown satisfactorily at speeds up to 450 kts. I.A.S. and M = 0.82.

3 Circumstances of the accident

3.1 The meteorological conditions recorded at the control tower, Stansted, at the time of the crash were as follows:-

Surface wind	-	17 - 18 kts (210°)
Visibility	-	15 miles
Cloud	-	$^1/_8$th at 2,500 ft.

These conditions were unlikely to have contributed to the accident.

3.2 It has been calculated that the all-up weight and C of G position at the time of the accident were within the prescribed limits.

3.3 The purpose of the flight was to fly at speeds up to M = 0.85 at altitudes varying from 20,000 ft down to 10,000 ft. This was part of the general programme of flight tests. A copy of the programme is given in Appendix I.

3.4 From the Stansted control tower radio log given in Appendix II, it is apparent that about 14 mins elapsed between take-off and the time of crash. During this time no untoward incident was reported by the pilot and the last verbal contact with the pilot was made a few seconds before the accident occurred.

3.5 There were several witnesses of the accident and the statements obtained from them by the Accident Investigation Branch indicate that the aircraft was in level flight or in a very shallow dive at moderately high speed and at a low altitude when the break-up of the aircraft occurred. Some of the witnesses' statements indicated that the disintegration of the aircraft was preceded by a number of up and down pitching movements.

3.6 A member of the airport staff in endeavouring to photograph the aircraft in flight, obtained a picture of an early stage of the disintegration. This photograph is reproduced in Fig.1 and shows the fuselage (A) broken while the wings (B) were still intact or, at least, not widely separated. The engine (C) may be seen just forward of the aircraft nose. Both the wings and tail unit appear to be inverted and the all-moving tailplane seems to be at a very large negative angle of incidence relative to the rear fuselage. The break in the fuselage can be seen to have occurred at a section near the trailing edge of the wing.

4 Examination at the site

4.1 Included in Fig.2 is a plot showing the distribution of the wreckage on the ground. The falling wreckage was little affected by wind drift as the aircraft was on a heading almost directly into wind at a very low altitude.

4.2 The wreckage parts at the beginning of the trail were from the fuselage and engine jet pipe. Next were tail unit and the main planes and then front fuselage and cockpit. The engine, as is clear from the photograph mentioned in para. 3.6 (see Fig.1), was thrown forwards and upwards and struck the ground about $^3/_4$ of a mile from the head of the trail, but some distance to the right.

4.3 The rear fuselage and tail unit, including the tailplane and rudder power control unit were damaged by fire (which had probably not occurred until striking the ground as certain parts which became detached on striking the ground were unaffected by the fire). None of the other parts of the wreckage was affected by fire.

4.4 The ejector seat remained with the cockpit until it struck the ground; the pilot had not operated the seat. He did not survive the crash.

5 V-G Recorder

5.1 The V-G record recovered from the aircraft wreckage has been examined and the following is an extract from an interpretation of the record slide by the R.A.E. section concerned:-

"We have examined the above record, an enlarged photograph of which is attached, in an attempt to determine the acceleration and speed conditions during or immediately preceding the accident.

It can be seen from the photograph (Fig.3) that the smoking of the record glass is coarse, resulting in a thick trace, and that the surface of the record is covered with scratch marks caused by failure of the V-g recorder tracing linkage.

There are two traces on the record which indicate abnormally high accelerations and which it is fairly certain were recorded while the instrument was still serviceable. These traces are marked AA and BB.

Trace AA appears to build up or down in 2-2½ oscillations to a maximum of 7g and a minimum (dictated by the stop in the instrument) of -5g, all at about 475 m.p.h. I.A.S.

Trace BB is similar and builds up in at least 2 oscillations to the top and bottom instrument stops, indicating maxima of at least 12g and -5g at about 525 m.p.h. I.A.S.

It should be pointed out that the accelerations recorded by this type of accelerometer correspond, with reasonable accuracy, to the actual accelerations experienced provided that these accelerations do not build up faster than is equivalent to a sinusoidal oscillation of about 2 or 3 c.p.s. As the rate of application is increased the instrument progressively magnifies the acceleration.

We do not consider that the separation of the traces by 50 m.p.h. can be ascribed to the splitting of a single trace by mechanical failure in the instrument but the possibility remains that a spurious change in pitot pressure occurred during a single oscillation. It is not possible to state which trace was made first."

6 Wreckage examination

6.1 The main features observed in the examination of the wreckage are described on the sketch in Fig.2.

6.2 The only air failure of the wing structure occurred in download just inboard of the port wing joint with the centre section. Small portions of the wing were detached on ground impact. The air failure is illustrated in Fig.4. Neither the port nor starboard portions of the wing displayed any evidence of having struck any other part of the aircraft after detaching.

The only failures in the control circuit from the power control unit to the ailerons were associated with local damage to the wing structure as a result of ground impact. The ailerons did not travel beyond their normal limits in the air. The starboard aileron detached when the wing struck the ground.

Both the leading edge slats and the landing flaps on each wing were found in the retracted position.

6.3 Fuselage

Of the many failures in the fuselage those forward of the mainplane were identified as the result of ground impact after this portion had become detached from the centre section in the air. From the directions of the failures of the rivets and setscrews around the periphery of the fuselage at the broken section it was assessed that the nose portion detached in the nose up sense. As there is little deformation at this section compared with the general flattening of the centre section portion of the fuselage it seems probable that the nose portion detached before wing failure occurred.

The strong U-shaped frame (No.14) which is pin jointed to the wing at the trailing edge spread laterally. The main engine mounting trunnions carried at the upper ends of this frame pulled out laterally the studs used to secure the trunnions to the engine casing and thus released the engine.

The rear fuselage together with the tail unit detached in the air as a result of the fuselage failure, just aft of the wing trailing edge (Frame 14). This failure was found to be due to tail down bending. A development of the fuselage in this area, showing the characteristics of the failure on which this assessment was based, is given in Fig.5.

Both of the engine mounting drag struts (provided to restrain the engine from moving forward in the event of a crash landing) failed in tension at their attachment to the rear fuselage as a direct result of the fuselage failure.

6.4 Air Brakes

The starboard air brake broke away at its hinges, probably when striking the ground, as it was found immediately adjacent to the rear fuselage and burnt by the fire which began in the rear fuselage. The direction and manner of failure of the hinges indicated that the brake was in the open position. There is a small dark area at D on the photograph in Fig.1 which is consistent with what one might expect to see if this brake was in the open position.

The port brake did not detach from the aircraft but the operating strut failed under compression loads and the evidence of interference between the strut and the hole in the fuselage side through which it passes indicates that this brake also was in the open position. The operating strut could not be loaded in compression whilst the brake was in the closed position.

The operating jack as recovered from the wreckage, however, was in the closed position. The jack body had become detached from its mountings in a forward direction and it is possible that this moved the brakes to the open position.

The "open" button in the cockpit used for normal operation of the brakes was not recovered from the wreckage but examination of the pilot's emergency air brake control in the cockpit indicates that they had been selected open by the emergency method.

Fig.6 shows the lever and quadrant of the emergency control as found. The normal (i.e. closed) position for the lever is at A, and the gate does not bear any evidence of forcible movement of the lever. This also applies to the slot at B where normally there is a small clearance for the lever. File markings on the sides of this slot when viewed under the microscope do not show any smearing which would be expected had the lever been forcibly operated in the crash. The lever could not have reached the "open" position as a result of fuselage failure as the operating cable arrangement is such that tension loading (as would occur when the fuselage broke) would tend to move the lever to the "closed" position, i.e. in the reverse direction to the movement for the "open" position.

6.5 Fin and Rudder

No evidence has been observed on the fin or rudder to suggest that they were struck by debris from forward parts of the aircraft. The fin remained intact but the link connecting the rudder to the push-pull rod from the power controls in the fuselage failed in compression i.e. in a manner consistent with rudder moving heavily to port. Subsequently the rudder rotated hard to starboard and its nosing fouled the shroud. There is some evidence of fouling between the top trailing edge of the rudder and the under surface of the starboard tailplane which suggests that the rudder was hard to starboard when the rear fuselage struck the ground and bent the starboard tailplane downwards.

6.6 Tailplane

The all-moving tailplane rotated nose down about 80° and failed in compression the operating strut which was located in the leading edge nosing of the fin. This nose down rotation probably occurred before ground impact as impressions and scoring made by the tailplane root on the fin side were all confined to approx. 80° nose down position. There was a downward set of the starboard tailplane. Evidence of scoring on the upper surface shows that the set must have occurred on impact with the ground. The loads transmitted back through the circuit from this impact were in the reverse direction to those necessary to cripple the tailplane operating strut and it is therefore probable that the strut failure occurred in the air and this confirms that the tailplane was already at approx. 80° nose down before striking the ground.

6.7 Anti-spin parachute

The anti-spin parachute housed in a conical shaped container to the rear of the fairing at the junction of the fin and tailplane was found to have streamed and detached from the aircraft in the air.

The soft copper pin which serves as a "weak link" in the parachute cord lines bore no evidence of heavy loading nor did the bomb-slip type jettison mechanism. This suggests that the jettison mechanism operated before the parachute canopy became fully deployed and that both stream and jettison operations were initiated by the failure of the fuselage. There is no evidence on the control in the cockpit that it had (or had not) been operated by the pilot.

6.8 Undercarriage

Both port and starboard main undercarriage legs and doors were in the retracted position on striking the ground. The twin tail wheel unit was, however, in the lowered position. This is not considered significant as the lowering could have occurred as a result of failure in the fuselage (which might produce fractures in the hydraulic line to the undercarriage).

6.9 Powered Controls

The tail plane powered control unit was removed from the airframe and dismantled. No mechanical defect was observed and it was noted that the "change-over" solenoid had not operated. This meant that the duplicate auxiliary power unit had not been brought into operation and tended to discount the possibility of failure of hydraulic pressure. Inspection of the operating ram and seals revealed no defect. The position of the ram was approximately neutral and so was that of the artificial feel trimmer.

7 V-G records from previous flights

V-G records have been received at the R.A.E. for all flights of the aircraft. These have been examined and two slides appear to be of some interest for the present investigation. The following is an extract from the report made by the R.A.E. section concerned:-

> "The only traces which we believe may be of significance occur on the 2 record slides taken on the 4th and 5th August, 1951, copies of which are attached (Figs.7 and 8). It will be seen on both records that there is an acceleration trace at the maximum speed attained. These traces appear to have been caused by a pitching oscillation, possibly due to a gust or inadvertent control stick movement followed by over correction by the pilot. The importance of these traces lies in their similarity to the high speed traces on the accident record.
>
> According to the Data sheets which were supplied with the records, weather conditions were "Bumpy" on 4th August 1951 and "Slightly Bumpy" on 5th August 1951.

8 Discussion

There is little doubt that the primary structural failure was in the rear fuselage and that it was due to down load.

It seems probable, from the evidence available, that the breaking load on the fuselage was imposed during pitching oscillations of the aircraft. In the first place the statements of five independent witnesses can be interpreted to mean that the aircraft moved up and down or oscillated in pitch before it disintegrated. Observations of witnesses may be in error but the statements in this case are unusually definite and consistent with one another in respect of the observation of up and down movements. Other witnesses are reported to have observed the pitching movements but could not be certain when they occurred in relation to the break-up.

Secondly, the V-G recorder slide shows that oscillations, severe enough to break the fuselage in the manner observed in the wreckage, were imposed.

These oscillations were recorded at approximately constant speed and therefore probably occurred before the fuselage failure. With failure of the fuselage and loss of engine there would be a complete loss of thrust and an increase in drag which would reduce the speed. This reduction would be expected to appear on the record. Furthermore the firm have estimated that aircraft, less tail and engine, would be stable in pitch and that any pitching oscillation of this forward part would be well damped.

Thirdly, during early flights the aircraft had been subject to pitching oscillation but the speed at which these oscillations occurred had been increased by the additions of tail plane trailing edge angle. It may be significant that the aircraft speed when the accident occurred (as shown by the V-G recorder) was greater than on any previous flight at very low altitude. This speed had, however, been successfully exceeded previously at considerably higher altitude.

9 Conclusions

The primary structural failure occurred in the fuselage and was due to download.

It seems probable that the failure was due to pitching oscillation of the aircraft. These oscillations may have been of the same kind as those previously encountered by this aircraft but there is no direct evidence on this.

10 Further work

The possibility that heating or aeration of the fluid in the power controls may have contributed to pitching oscillations of the aircraft is being investigated at the firm.

As explained above it was found during the early flights that adding angle pieces to the tail plane trailing edge alleviated the oscillations.

In order to assess quantitatively the effect of angle pieces on the aerodynamic damping in pitch the R.A.E. are carrying out wind tunnel investigations. Preliminary results indicate, as would be expected, that the effects are small but further more representative tests are to be made.

The firm are also examining the stability of the aircraft taking into account the effect of the "g" restrictor bob-weight.

Attached:

Drg. Nos. SME 18682 and 18683
Neg. Nos. 100475 to 100479

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APPENDIX I

MEMORANDUM

MD/TDO/GHL/DD

23rd August, 1951

From: Chief Designer

To: Mr. Pratt, Mr. McPhail, Mr. Bennett, S/L Hazelden, F/L Broomfield, Mr. Robinson (Insp.), Mr. Ashworth

Copy to: Mr. MacRostie, Mr. Joy, Mr. Hayes, Aerodynamics Dept., Mr. Rosenberg, R.T.O., Mr. Borthers, A.I.D.(2)

H.P. 88 Flight Test Programme

It has been agreed that the flight programme necessary to prepare the H.P. 88 for participation in the S.B.A.C. Show at Farnborough is as given below. (This is the programme given in Aerodynamics Memo. of 15.8.51).

1 Flights at an altitude of 20,000-25,000 ft to bring the Mach number up to 0.85 at a moderate airspeed (350 knots approximately) This is as already agreed with Blackburn's, see para. 1.5 of the report on Mr. Lee's visit 31.7.51-7.8.51. } 26/8

2 When it has been shown that the aircraft handles satisfactorily at M = 0.85 at moderate speeds, the I.A.S. can be increased in stages up to 550 knots, the Mach number not being greater than 0.85 (550 knots I.A.S. at sea level is equal to Mach number 0.83).

3 During the course of these tests the aircraft will be stalled, in preparation for the slow flying demonstration, and some rolls will be done. Aerodynamics and Stress are to inform Mr. Broomfield as to strength limitations as regard to this rolling.

It is estimated that the above tests can be completed in three or four flights of about 35 minutes duration each.

4 Having satisfactorily completed the above programme, Mr. Broomfield will do about four short practise flights in which he will rehearse the actual routine for the S.B.A.C. Show.

(Sgd.) G.H. Lee
for R.S. Stafford

[redacted]

APPENDIX II

Radio Log

Date 26th August 1951 Service Aerodrome Control Frequency 123.7 mc/s

Station STANSTEAD Call Sign STANSTED TOWER

x Written log.

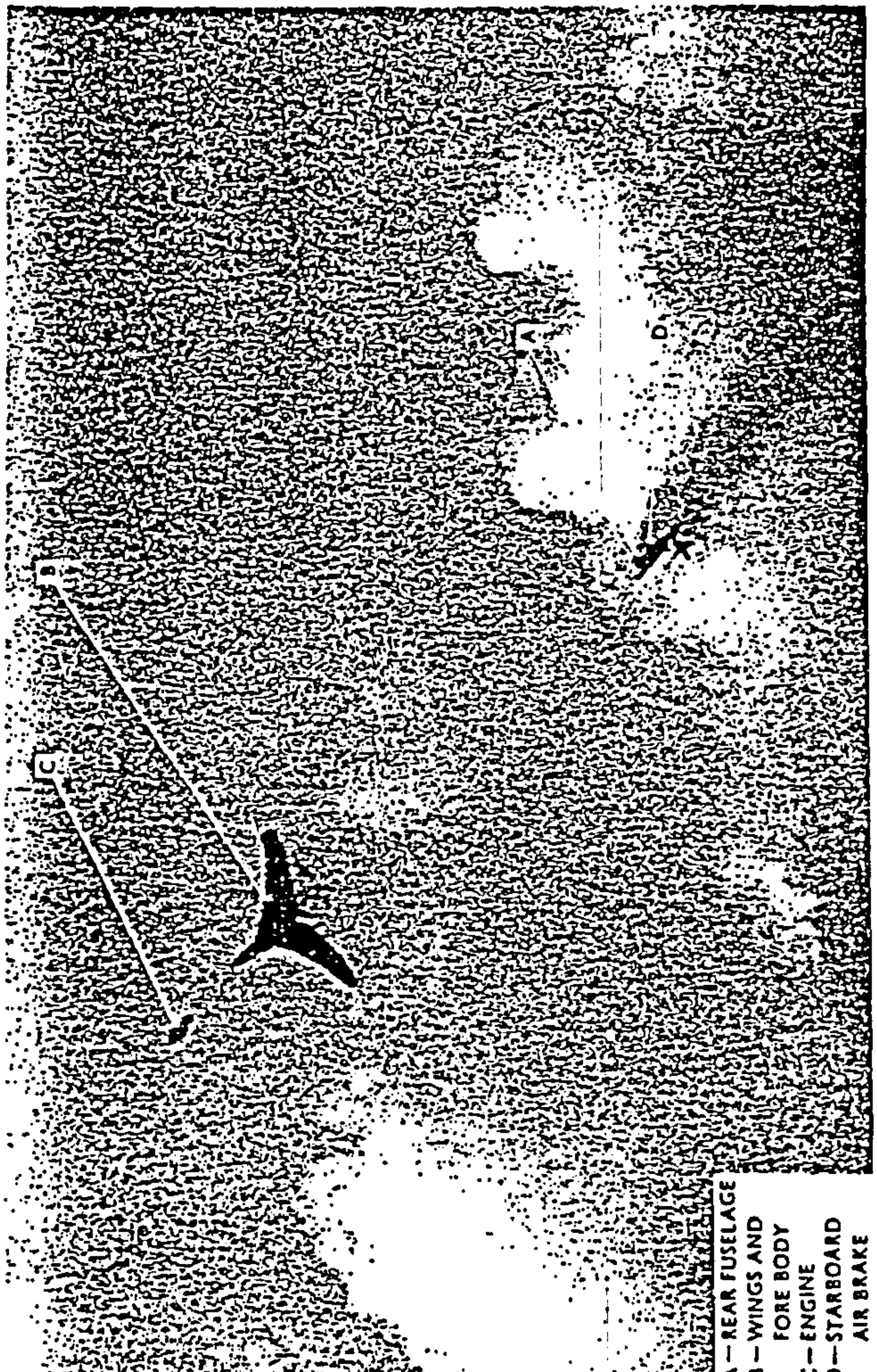
Time	To	From	Message
1620			Quiet
1630			Quiet
1644	Stansted Tower	Chock Ice Two	May I taxi?
	Chock Ice Two	Stansted Tower	You are clear to taxi to holding point on runway 23 the present regional barometric pressure reduced to mean sea level in the south eastern flight information is 995 millibars and the present regional barometric pressure at official aerodrome level at Stansted is 998 millibars
	Stansted Tower	Choc Ice Two	Roger
1648	Stansted Tower	Choc Ice Two	Request permission to enter runway and take off
	Choc Ice Two	Stansted Tower	You are clear to enter runway and take off the surface wind at Stansted is 210 degrees 18 knots
1651	Stansted Tower	Choc Ice Two	Can you let them know adjustments carried out by Mr. Lyon are OK
	Choc Ice Two	Stansted Tower	Roger understood
1658	Stansted Tower	Choc Ice Two	I have finished my flying exercise would like to do low level run across airfield same direction as take off is that OK?
	Choc Ice Two	Stansted Tower	Yes
1702	Stansted Tower	Choc Ice Two	Just coming round now
	Choc Ice Two	Stansted	Roger
1710			Quiet
1715			Quiet

Certified plain language version of written log.

S.T.C. Sgd. T.D. Fookes.

[redacted]

[redacted]



A — REAR FUSELAGE
B — WINGS AND FORE BODY
C — ENGINE
D — STARBOARD AIR BRAKE

FIG.1. EARLY STAGE OF DISINTEGRATION

Nº S.M.E. 18682.
9/1.

[redacted]

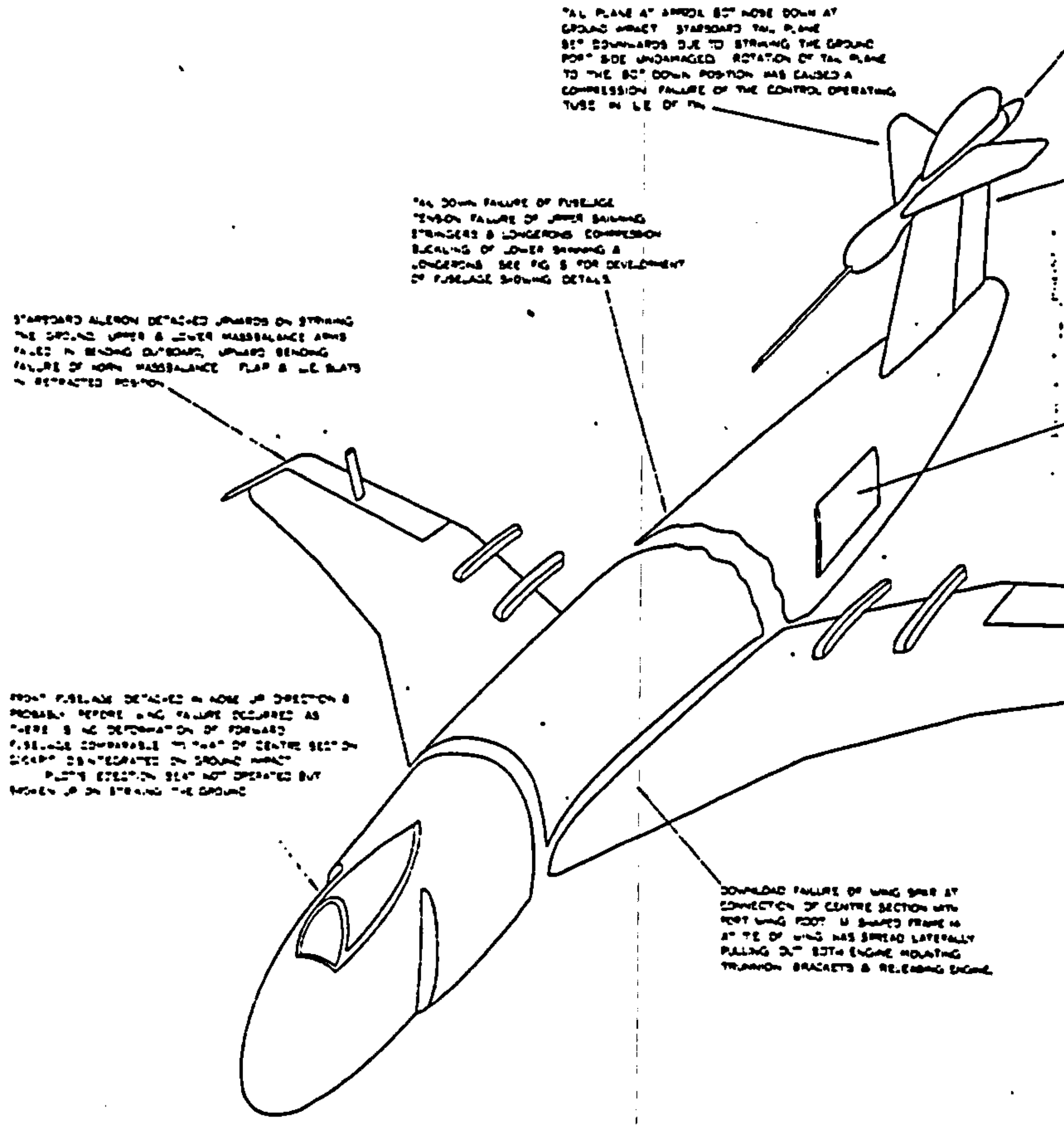
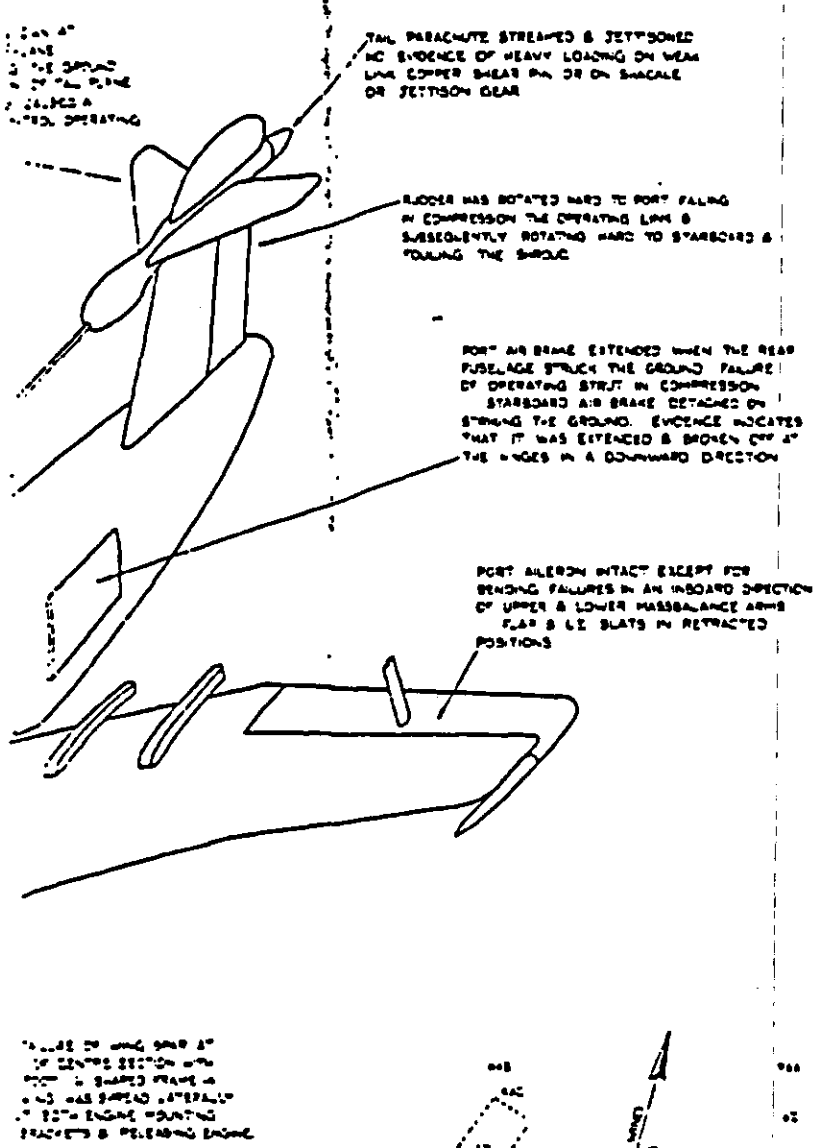
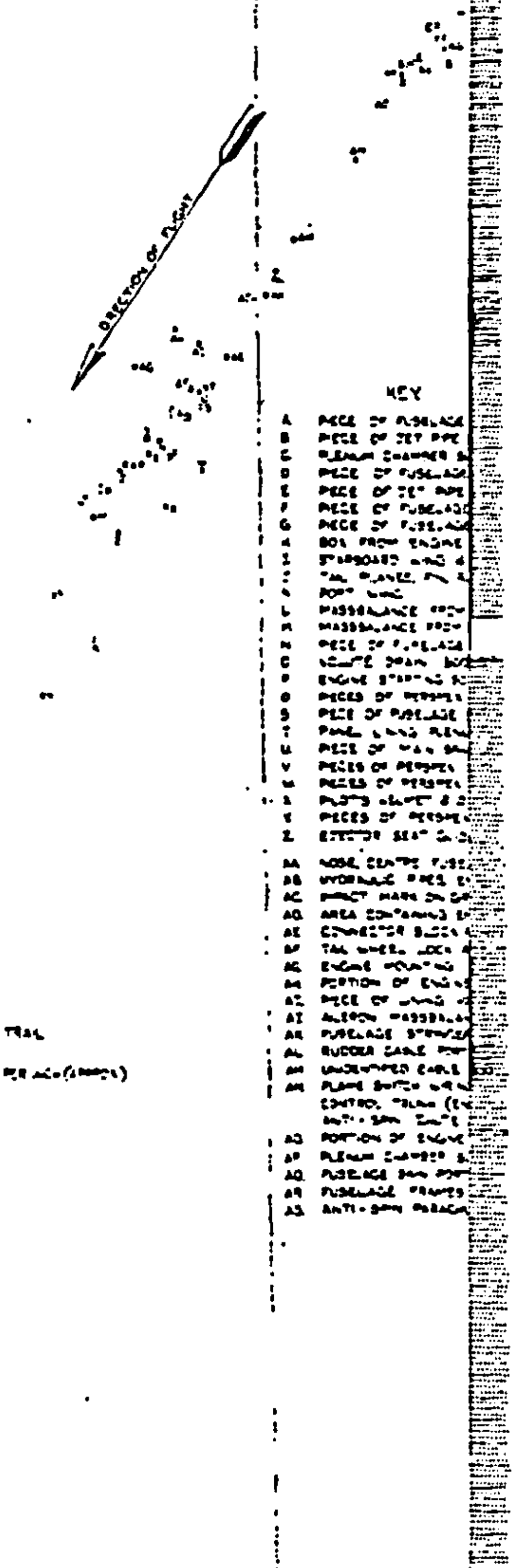


FIG.2. HANDLEY PAGE 88. VX 33

MAJOR AIRFRAME FAILURES.

[redacted]

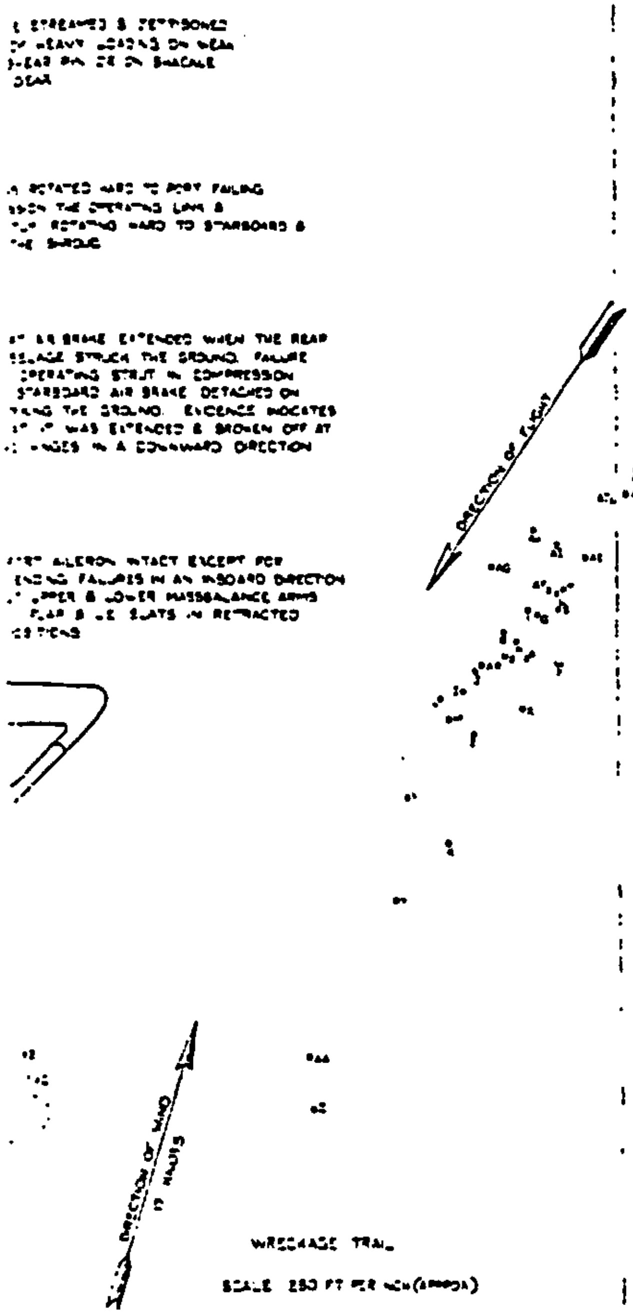




PAGE 88. VX 330.

?AME FAILURES.

FIG.2.



WRECKAGE TRAIL

SCALE 250 FT PER INCH (APPROX)

KEY

A	PIECE OF FUSELAGE SKIN FROM ENGINE BAY
B	PIECE OF JET PIPE HEAT SHIELD
C	PLENUM CHAMBER SUCTION DOOR
D	PIECE OF FUSELAGE SKIN FROM ENGINE BAY
E	PIECE OF JET PIPE HEAT SHIELD
F	PIECE OF FUSELAGE SKIN
G	PIECE OF FUSELAGE STRINGERS
H	BOX FROM ENGINE BAY
I	STARBOARD WING & AILERON
J	TAIL PLANES, FIN, RUDDER & TAIL BAY
K	PORT WING
L	MASSBALANCE FROM STARBOARD AILERON
M	MASSBALANCE FROM STARBOARD AILERON
N	PIECE OF FUSELAGE SKIN
O	VOLUTE DRAIN BOOSTER COIL
P	ENGINE STARTING SOLENOID PANEL
R	PIECES OF PERSPEX
S	PIECE OF FUSELAGE SKIN WITH LONGERON
T	PANEL LINING PLENUM CHAMBER
U	PIECE OF MAIN SPAR
V	PIECES OF PERSPEX
W	PIECES OF PERSPEX
X	PILOT'S HELMET & OXYGEN MASK
Y	PIECES OF PERSPEX
Z	EJECTOR SEAT GUIDE RAIL
AA	NOSE, CENTRE FUSELAGE & COCKPIT
AB	HYDRAULIC PIPES, ENGINE TO AIRFRAME
AC	IMPACT MARK ON GROUND WHERE ENGINE LANDED
AD	AREA CONTAINING ENGINE PARTS
AE	CONNECTOR BLOCK PANEL (FUSELAGE AT PORT WING ROOT)
AF	TAIL WHEEL LOCK ACTUATORS (BOTTOM OF FUSELAGE, FRAMES 14-16)
AG	ENGINE MOUNTING DRAG STRUT
AH	PORTION OF ENGINE BAY
AI	PIECE OF LINING PANEL FOR PLENUM CHAMBER
AJ	AILERON MASSBALANCE END FAIRING
AK	FUSELAGE STRINGER
AL	RUDDER CABLE PORT
AM	UNIDENTIFIED CABLE
AN	FLAME SWITCH WIRING ATTACHED TO PIECE OF ENGINE BAY CONTROL TRUNK (ENGINE BAY) GENERATOR COOLING DUCT ANTI-SPIN CHUTE BAG
AO	PORTION OF ENGINE BAY SADDLE TANK COOLING CASE CLIP
AP	PLENUM CHAMBER SUCTION DOOR
AQ	FUSELAGE SKIN PORT AROUND FRAME 16
AR	FUSELAGE FRAMES 14-17
AS	ANTI-SPIN PARACHUTE

[redacted]

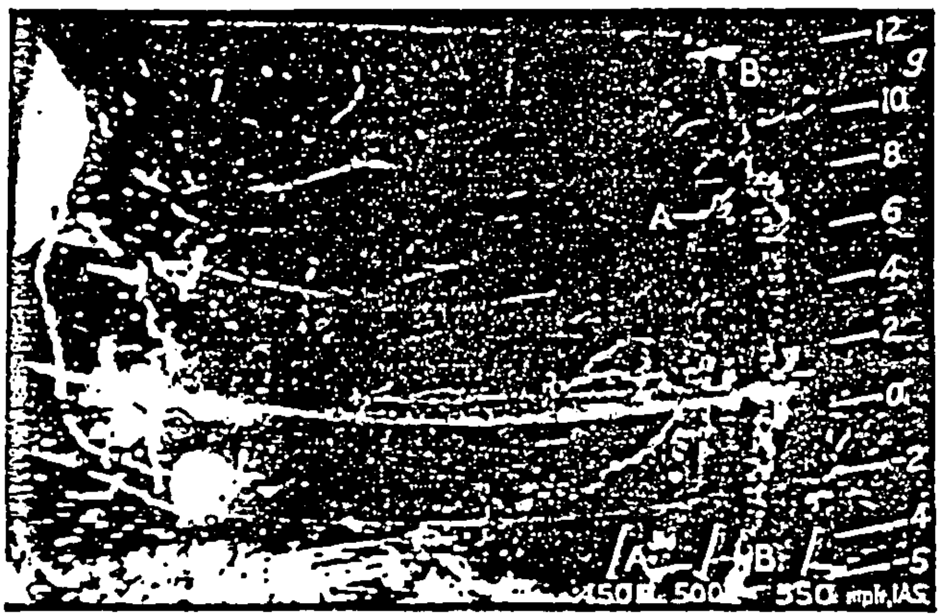


FIG.3. V-G RECORDER SLIDE - ACCIDENT FLIGHT

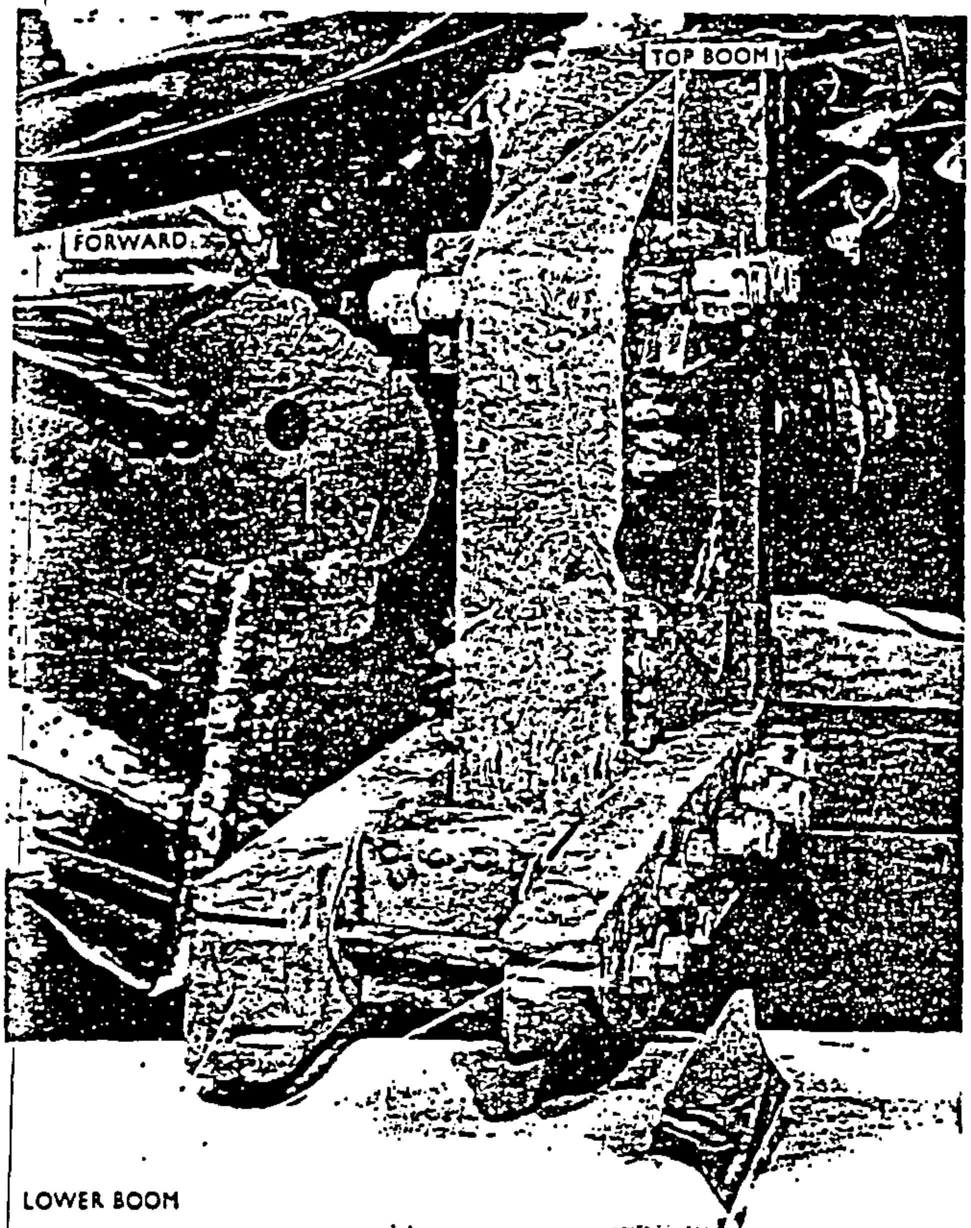
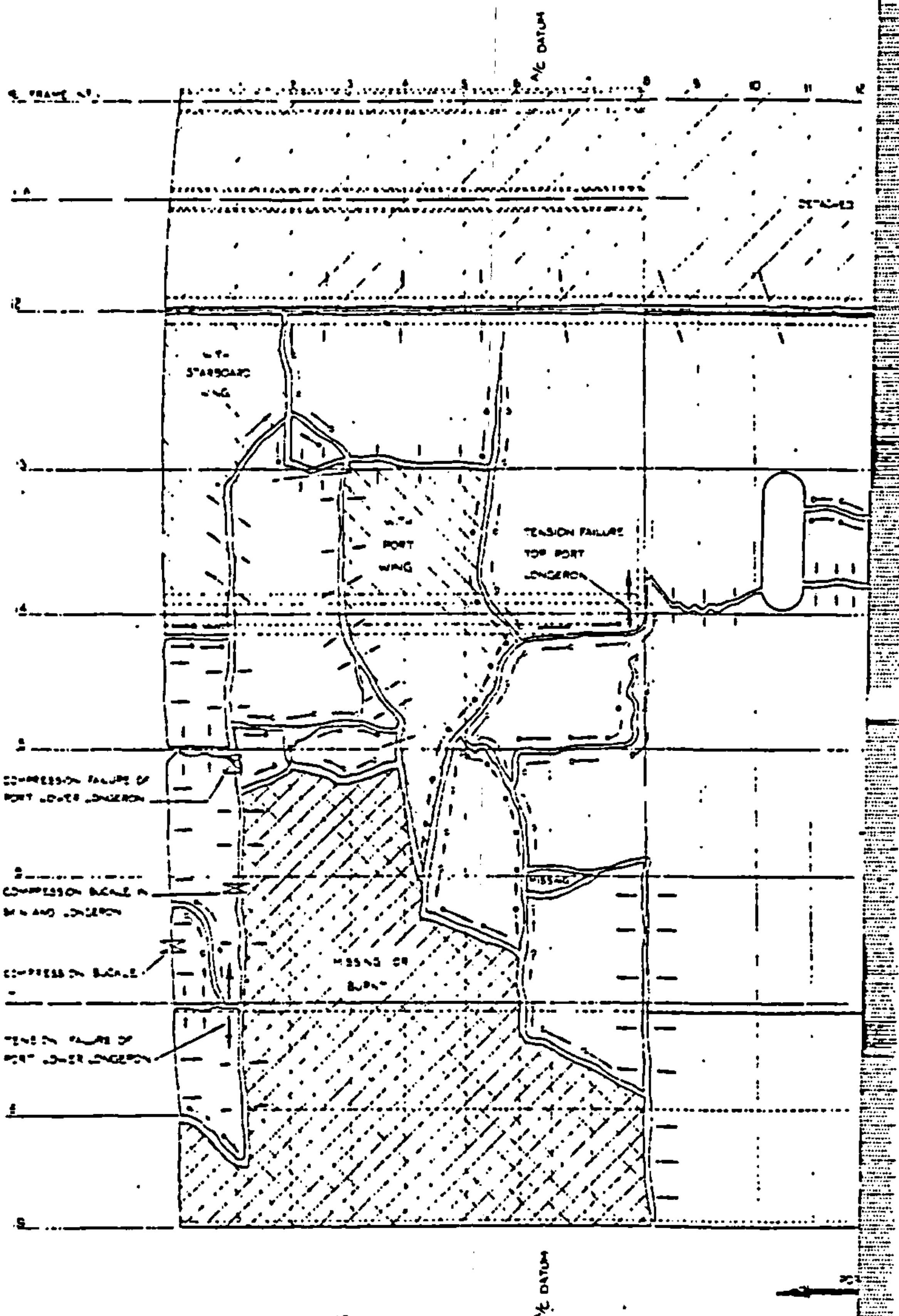


FIG.4. MAIN SPAR FRACTURE - PORT WING

Nº 5 M.E. 18683



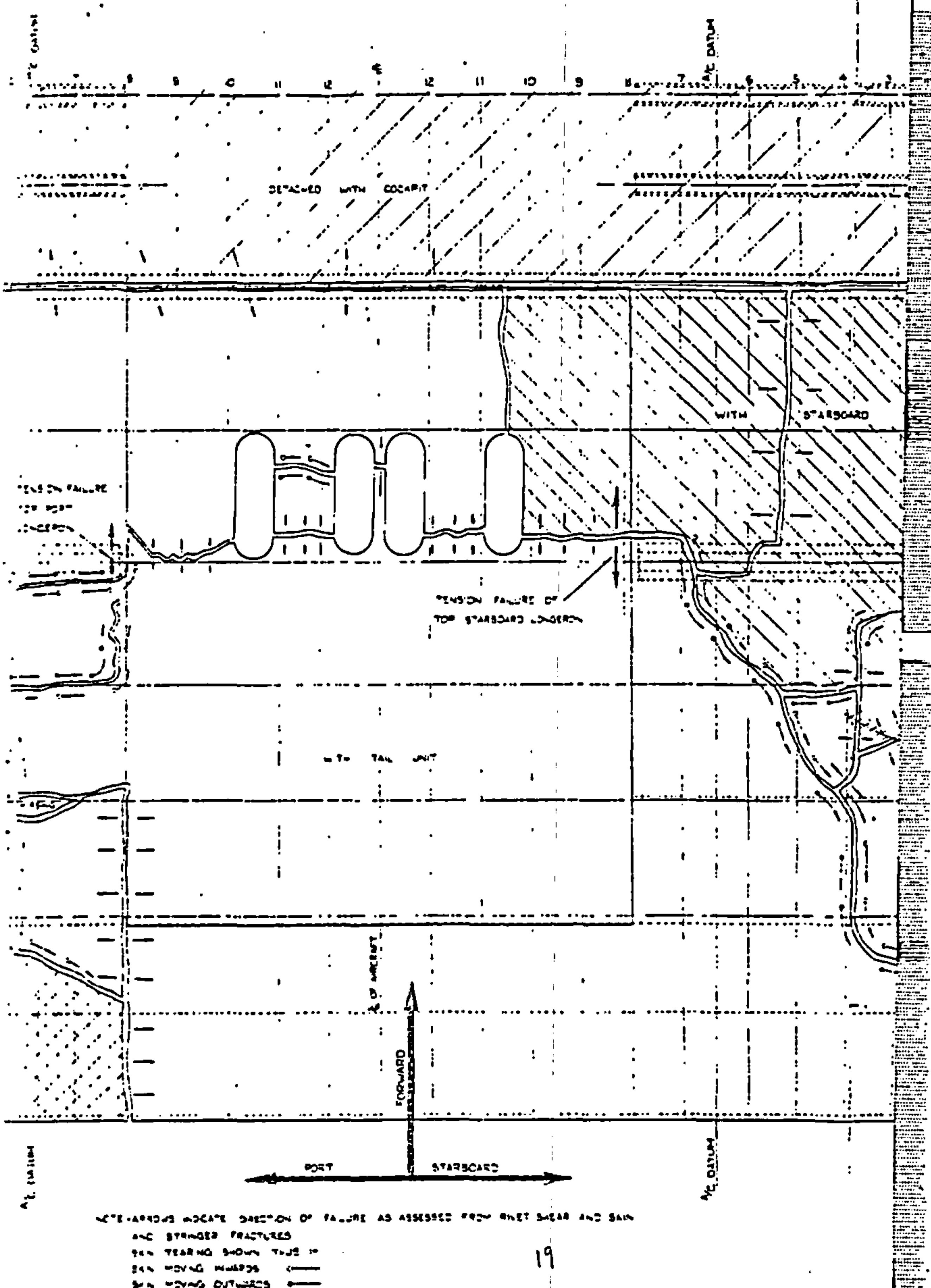
NOTE: ARROWS INDICATE DIRECTION OF
AND STRINGER FRACTURES
SKIN TEARING SHOWN THUS
SKIN MOVING INWARDS
SKIN MOVING OUTWARDS

18

FIG.5. DEVELOPMENT

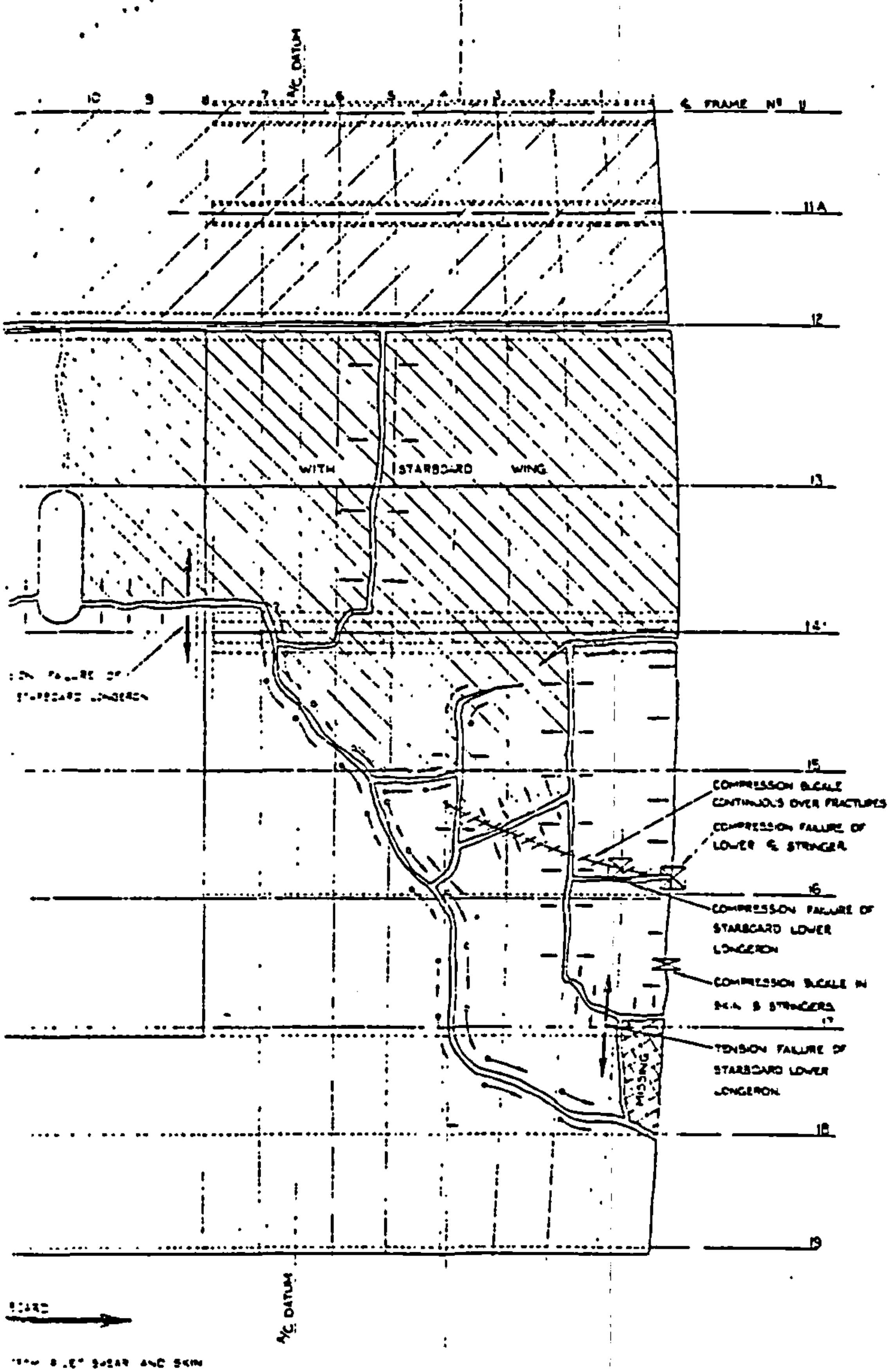
SHOWING

[redacted]



19

FIG.5. DEVELOPMENT OF FUSELAGE (FRAMES 11 TO 19)
SHOWING DETAILS OF FAILURES.



20

·GE (FRAMES 11 TO 19)
F FAILURES.

21

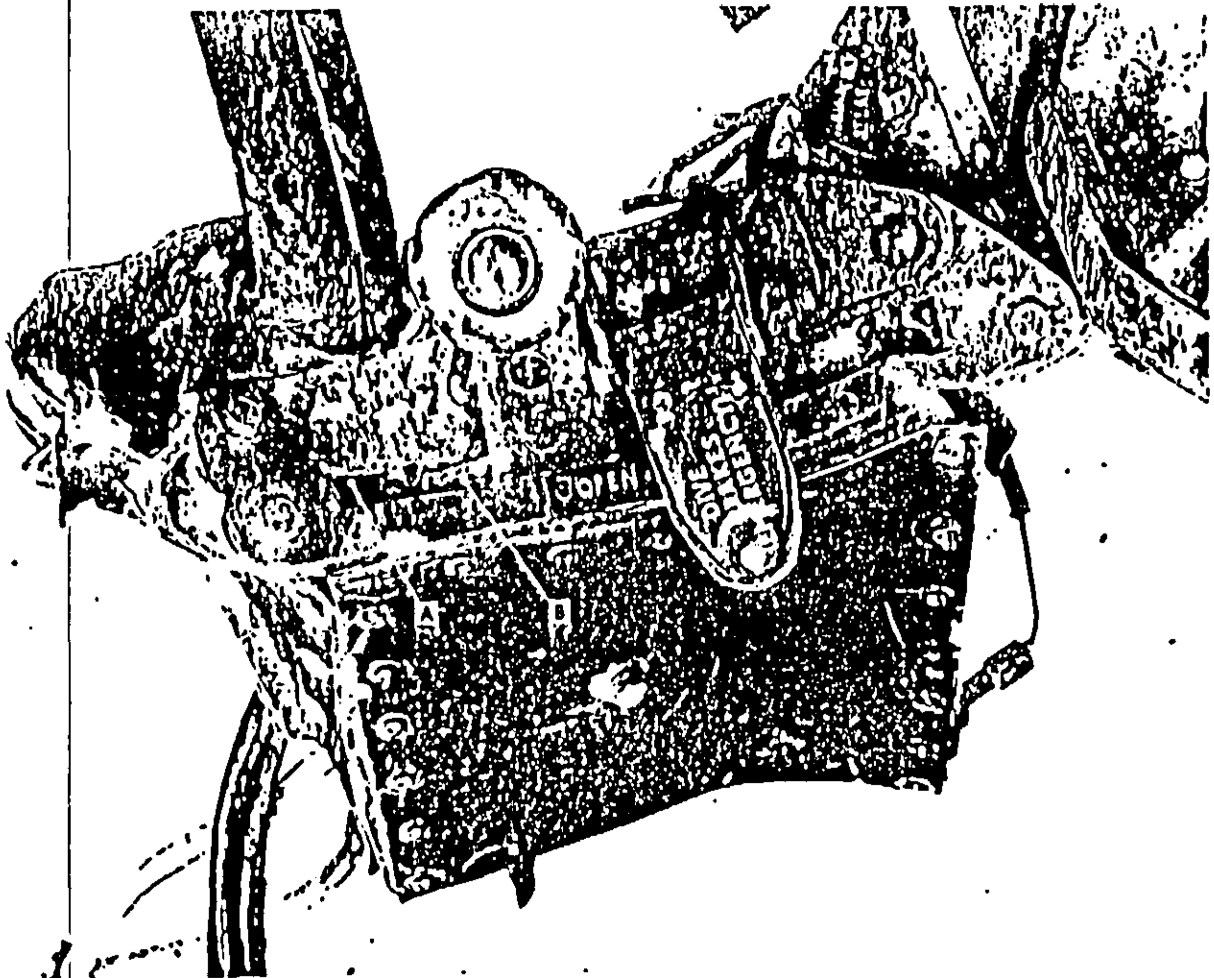


FIG.6. DIVE BRAKE EMERGENCY CONTROL IN COCKPIT

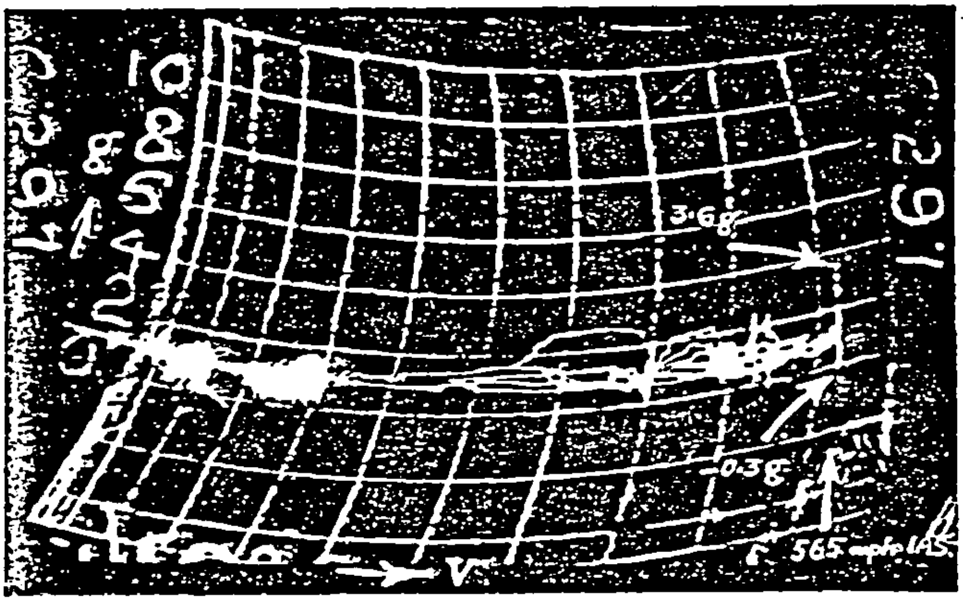


FIG.7. V-G RECORDER SLIDE. 4th AUGUST. 1951

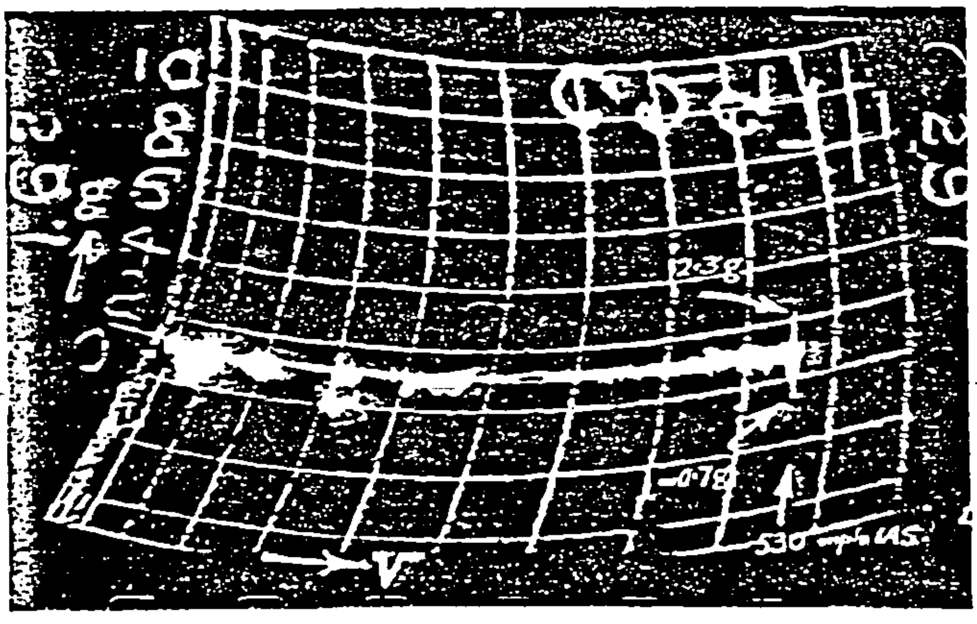


FIG.8. V-G RECORDER SLIDE. 5th AUGUST. 1951

08/22/1951

X-1D

N-T USAF

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REPORT OF AF AIRCRAFT ACCIDENT

Use this form in accordance with AF Reg. 62-14 and AF Manual 62-5, "Aircraft Accident Investigators' Handbook." Fill in all spaces applicable. If additional space is needed, use additional sheet(s) and identify by proper section letter and subsection number.

Section A—GENERAL INFORMATION

Field	Entry
1. Place of Accident: State, county, nearest town—Distance and direction to accident	California Kern Edwards
2. Nearest Airport suitable for landing this plane—Distance and direction to accident	Edwards Air Force Base
3. Elevation above S. L. at accident scene	2,285 Ft.
4. Date of accident	22 Aug 51
5. Hour and time zone	1630 PST
6.	[X] Day [ ] Night [ ] Dawn [ ] Dusk
7. List numbers of all other aircraft involved (File separate Form 14 for each aircraft)	None
8.	[X] Incident to Flight [ ] Not Incident to Flight
9. Classification of accident	[X] Major [ ] Minor
10. Clearance	[ ] IFR [X] Local [ ] VFR [ ] Other; If Other— From: To:
11. This was a:	[ ] CAP Flight [ ] Air Reserve Flight [ ] ANG Flight [X] Other
12.	[X] Fire Occurred Before Accident [ ] Fire Occurred After Accident [ ] Fire Did Not Occur
13. Airfield of last takeoff	Edwards AFB
14. Duration of flight since last takeoff	-
15. Mission of flight (Use Form 1 Symbol)	X-1
16. Activity aircraft was engaged in just prior to accident	Being carried aloft prior to drop.

Section B—AIRCRAFT

Field	Entry
1. Aircraft No.	48-1386
2. Type, Model, Series and Block No.	Bell, X-1D
3. Organization reporting aircraft on AF-110 Report — Major Command	ARDC
Subcommand	Hq, AFFTC
AF Wing	-
Group Number and Type	-
Squadron or Unit	-
Base	Edwards Air Force Base Edwards, California
4. Technical Orders affecting this aircraft were not complied with at time of accident. (List number and title of these T. O.'s on separate sheet.)	0

Section C—OPERATOR (Person at controls at time of accident)

Last Name (Jr., II, etc.)	First Name	Middle Name	Grade	Component	Serial No.	Nationality and Race	Year of Birth
Everest	Frank	Kendall	Lt. Col.	USAF	9100A	White	1920

	Base	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit
2. Assigned Base	Edwards AF Base	ARDC	Hq. AFFTC	-	-	-
3. Attached Base for Flying	-	-	-	-	-	-

4. Original Aeronautical Rating and Date Received	5. Present Aeronautical Rating and Date Received	6. Primary Duty Assignment
Pilot 3 July 1942	Senior Pilot 12 July 1949	Asst. Chief of Flight Test Section

OPERATOR'S FLYING EXPERIENCE (Including Civilian)

Item	Entry
7. Type of Instrument Card — Expiration Date	Green — 10Aug52
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours	3899:00
9. Total 1st Pilot Hours	3372:00
10. 1st Pilot Hours Last 90 Days	126:15
11. 1st Pilot Hours Last 30 Days	31:00
12. 1st Pilot Hours This Model (B-25, F-51, etc.)	10:00
13. Other Pilot Hours (CP, C, SC) This Model	:00
14. 1st Pilot Hours Last 90 Days This Model	:00
15. 1st Pilot Hours Last 30 Days This Model	:00
16. Total Time Spent in Air During 24 Hrs. Prior to Accident	:00
17. List by Type and Model 1st Pilot Experience in Similar Aircraft (e.g., B-26, 50 hrs.)	None
18. Was Operator on Instruments at Time of Accident or Immediately Before?	[X] No [ ] CWR [ ] Yes [ ] Hood [ ] Weather

If above answer is "Yes" or if accident occurred at night or during IFR weather or unknown conditions, fill in items below.

Item	Entry
19. Total 1st Pilot Instrument Weather Hours	
20. Total 1st Pilot Instrument Hood Hours	
21. 1st Pilot Instrument (Weather and Hood) Hours Last 6 Months	
22. 1st Pilot Instrument (Weather and Hood) Hours Last 60 Days	
23. 1st Pilot Night Hours Last 6 Months	
24. 1st Pilot Night Hours THIS MODEL Last 60 Days	

Section D—PERSONNEL INVOLVED (Including operator and all other persons, whether in plane or not)

Duty at time of accident (1)	Name (Last name first) (2)	Type of Aero. Rating (symbol) (3)	Serial No. (4)	Grade and Branch of Service (5)	Component (See AFM 62-5) (6)	Organizational Assignment—Command, subcommand, Group Number and Type, Base (7)	Fatal, Major, Minor, None, Missing (8)	Parachute Used Yes (9)	Parachute Used No (10)
P	Everest, Frank K.	SP	9100A	Lt. Col. USAF	USAF	Air Research and Development Command Hq, Air Force Flight Test Center	None		X

AF FORM 14 — Previous editions are obsolete. Supersedes AF Form 14A, 1 Jan 48, which is obsolete.

RESTRICTED (WHEN FILLED IN)

51-8-22-1 N-T USAF

RESTRICTED (WHEN FILLED IN)

Section E - RATED PERSONNEL AT OTHER SET OF DUAL CONTROLS (Instructor, Copilot, etc.)

1. Last Name (Jr., II, etc.)	First Name	Middle Name	Grade	Component; Serial No.	Nationality and Race	Year of Birth

2. Assigned Base	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit

3. Attached Base for Flying	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit

4. Original Aeronautical Rating and Date Received	5. Present Aeronautical Rating and Date Received	6. Primary Duty Assignment

FLYING EXPERIENCE (Including Civilian)

7. Type of Instrument Card — Expiration Date
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours
9. Total 1st Pilot Hours
10. Total Hours, ☐ IP ☐ CP ☐ C (Check applicable box)
11. Pilot Hours Last 90 Days
12. 1st Pilot Hours Last 90 Days
13. Hours Last 90 Days, ☐ IP ☐ CP ☐ C
14. Pilot Hours Last 30 Days
15. Total Pilot Hours This Model (B-25, F-51, etc.)
16. 1st Pilot Hours This Model
17. Hours This Model, ☐ IP ☐ CP ☐ C
18. Total Pilot Hours This Model Last 90 Days
19. 1st Pilot Hours This Model Last 90 Days
20. Hours This Model Last 90 Days, ☐ IP ☐ CP ☐ C
21. List by Type and Model ☐ IP ☐ CP ☐ C Experience in Similar Aircraft (e.g., B-29, IP; etc.)

Fill in items below if Instrument and Night Experience of Operator was listed in Section C.

22. Total 1st Pilot Instrument Weather Hours
23. Total 1st Pilot Instrument Hood Hours
24. 1st Pilot Instrument (Weather and Hood) Hrs. Last 6 Months
25. 1st Pilot Instrument (Weather and Hood) Hrs. Last 90 Days
26. Total Pilot Night Hours Last 6 Months
27. 1st Pilot Night Hours Last 6 Months
28. Night Hours Last 6 Mos., ☐ IP ☐ CP ☐ C
29. Total Pilot Night Hours This Model Last 90 Days
30. 1st Pilot Night Hours This Model Last 90 Days
31. Night Hrs This Model Last 90 Days, ☐ IP ☐ CP ☐ C

Section F - DAMAGE

1. Describe Briefly in General Terms the Extent of Damage to the Airplane, Engines, and Propellers.

Destroyed.

2. Check Proper Damage Classification	
None	
Minor	
Substantial	
Destroyed	X

3. ☒ Plane or Wreckage Was Returned to an AF Base
☐ Plane or Wreckage Was Left at Scene of Accident

4. Is Plane Damaged Beyond Economical Repair? ☒ Yes ☐ No

5. If Plane Is To Be Repaired, Give Engineering Officer's Estimate of Number of Man-Hours Required for Repair: ______ Man-Hrs.

6. Was Private Property Damaged? ☐ Yes ☒ No
If "Yes," Describe Damages on Separate Sheet.

7. Give below a considered estimate of cost of this accident to the Air Force:

Cost of Damage to Aircraft	$ Unknown
Cost of Damage to Other Government Property	$
Cost of Damage to Private Property	$
Cost of Injuries	$
Cost—Other (Explain)	$
Total Estimated Cost of Accident	$ —

Section G - SPECIAL EQUIPMENT

1. Check items of special equipment which affected the accident.

☐ Radios ☐ Armament ☐ De-Icers ☐ Equipment for Clear Vision From Cockpit
☐ Instruments ☐ Fire Extinguishing Equipment on Plane ☐ JATO ☐ ______

2. Describe Briefly How the Use, Nonuse, Misuse, or Absence of Special Equipment Affected the Accident

Section H - WEATHER (At time and place of accident)

Ceiling	Visibility	Wind Direction and Velocity	Temp.	Dew Point	Other Weather Conditions
Clear	40 Miles	SW 22	90°	29°	None

If weather other than unfavorable wind conditions for takeoff, landing, or taxiing was a factor in the accident, attach statement of weather officer describing climatic conditions and how they probably contributed to accident.

Section I - CHECK LIST FOR ATTACHMENTS

☒ Form 1 ☒ Clearance ☒ Photographs ☒ Form 14C
☒ Form 1A ☒ Crew Members' Statements ☐ Form 14A ☐ Form 14D
☐ List of T.O.'s Not C/W ☒ Witnesses' Statements ☐ Form 14B ☐ Form 14E
☒ Minutes Radio Transcript

Section J—ACCIDENT TYPE

Check one accident type as "Primary." Check all others applicable as "Secondary."

Primary	Secondary	
		Ground or Water Loop
		Wingtip Landing
		Wheels-Up Landing
		Hard Landing
		Collapse or Retraction of Landing Gear
		Undershoot
		Overshoot
		Nose Up or Nose Over
		Collision With Other Aircraft
		Collision With Ground or Water
		Other Collisions
		Spin or Stall
		Fire on Ground
X		Fire and XX Explosion in Air
		Airframe Failure in Flight
		Abandoned Aircraft
		Prop or Jet Blast Accident
		Other (List)
		Undetermined

Section K—PHASE OF OPERATION

(Check only ONE)

	Taxiing Incident to Flight
	Take-Off
X	In Flight
	Landing
	Go Around
	Engine Running, Not Taxiing
	Ground Operations
X	Undetermined while attached to mother aircraft.

Section L—CONDITIONS AFFECTING ACCIDENT

(Check all applicable)

	Immediate Forced Landing
	Precautionary Landing
	Fuel Exhaustion
	Engine Stoppage
	Lost
	Pertinent Thing Not Complied With
	Other (List)

Section M—VIOLATIONS

(Check all applicable)

	Improper Taxiing Procedure
	Failure To Use Checklist
	Unauthorized Low Flying
	Instrument Flight Without Clearance
	Unauthorized Formation
	Other (List):

Section H—CA ACTOR ANALYSIS

Check one specific cause as "Primary." Check all others applicable as "Secondary."
(See AFM 62-6 for definitions)

1. ERRORS OF AIR CREW

- Misused Power Plant or Power Plant Controls
- Misused Brakes and/or Flight Controls on Ground
- Improper Use of Flight Controls in Air
- Exceeded Stress Limits of Aircraft
- Inattentive To Fuel Supply or Fuel Selector Valves
- Failed To Extend or Retract Landing Gear Properly
- Selected Unsuitable Terrain or Runway for Takeoff or Landing
- Failed To Compensate for Wind Conditions
- Misjudged Distance
- Failed To Level Off Properly
- Failed To Observe Other Aircraft or Objects
- Failed To Maintain Adequate Flying Speed
- Became Lost (Weather not at fault)
- Continued VFR Flight Into Unfavorable Weather
- Improper Operation or Attempted Instrument Flight
- Operated Aircraft in Reckless Manner
- Made Inadequate Flight Preparations
- Attempted Flight Beyond Ability or Experience
- Failed To Use or Incorrectly Used Miscellaneous Equipment
- Other (List):

2. ERRORS OF OTHER PERSONNEL (X X)

- Aircraft Inadequately Maintained
- Aircraft Improperly Cleared for Flight
- Weather Incorrectly Forecast
- Improperly Operated Airport Airway Facilities
- Improperly Accomplished Training (Ground Personnel)
- Improperly Accomplished Training (Flight Instructor and Flight Leader)
- Other (List):

3. MATÉRIEL FAILURE—POWER PLANT

- Cooling System
- Lubricating System
- Fuel System
- Engine Structure (Includes Jet Engines)
- Engine Control System
- Propeller and Pitch Control Assembly
- Supercharger (Reciprocating Engine only)
- Ignition System
- Engine Accessories
- Other:
- Undetermined

4. MATÉRIEL FAILURE—AIR FRAME

- Flight Control System
- Wings, Rotors, and Flaps
- Cowling and Fairing
- Fuselage
- Other:
- Undetermined

5. MATÉRIEL FAILURE—LANDING GEAR

- Main Landing Gear
- Nose Wheel or Tail Wheel
- Landing Gear Position Indicators
- Brakes
- Tires
- Other:
- Undetermined

6. MATÉRIEL FAILURE—EQUIPMENT AND ACCESSORIES (X X)

- Automatic Pilot
- Radio Equipment
- Electrical System
- Hydraulic System
- Oxygen or Pressurization System
- Safety Equipment
- Instruments
- Canopy, Seal, Cabins, Fittings, Doors, Hatches
- Armament
- Other:

7. WEATHER (X X)

- Low Ceiling
- Smoke, Haze
- Rain, Fog
- Snow, Hail
- Icing Conditions
- Unfavorable Wind Conditions for Landing, Taking or Taxiing
- Turbulence in Flight
- Winds Aloft
- Thunderstorms
- Inadequate Climate
- Other:

8. LANDING AREA

- Wet
- Soft
- Snow
- Ice
- Rough
- Gravel
- Runway Too Short
- Other Hazards

9. GROUND EQUIPMENT

- Airport Facilities
- Airway Facilities
- Approach Devices
- Launching Devices
- Other:

10. MISCELLANEOUS

- Bird in Flight Path
- Shot Off Target in Flight Path
- Other:

11. UNDETERMINED

Section O - DESCRIPTION OF ACCIDENT

Tell in narrative form, in as much detail as necessary, everything that is known about the accident. Make certain that items checked on reverse side are justified by this narrative. If fire was involved in accident, explain in detail its origin and progress and steps taken to extinguish it.

EB-50A, Serial No. 47-006A departed Edwards Air Force Base approximately 1535 PST, 22 August 1951 with the X-1D, 48-1386 attached, which was to be released at approximately 35,000 feet for a high altitude and high speed investigation. At approximately 7,000 feet, the pilot entered the cockpit of the X-1D and made a check of the cockpit instruments and noticed that the pressure and temperatures were normal with the exception of the nitrogen source pressure which had fallen to 1500 p.s.i. (Nitrogen pressure should be 4800-5000 p.s.i.) The drop was aborted because of the low nitrogen source pressure. The escort pilot was alerted that the flight had been aborted and preparations were being made to jettison the LOX. The pilot of the X-1D started to load the LOX tank to 46 p.s.i. which is the pressure required for jettisoning. When the LOX tank pressure reached 20 p.s.i., the pilot closed the valve and tapped the gauge in case the needle was sticking. The pressure valve was then reopened to complete the tank pressurization. At about the same time as the indicator needle of the LOX tank gauge started to move upward from 20 p.s.i., the pilot heard and felt an explosion from the mid-section of the X-1D. A rapid exit by the pilot was made from the X-1D into the B-50, and a few seconds later, the airplane X-1D was dropped from the mother aircraft.

Loss of nitrogen source pressure is attributed to the failure of the landing gear regulator.

During the investigation, it was found that the inner surface of the dorsal fin area was scorched by fire prior to impact with the ground. The fire was caused by a fuel leak somewhere in the dorsal fin or center section area. In the center section area, it could be the bulkhead manhole cover on the fuel tank or the pressure and vent valve. In the dorsal fin area, it could be the line from the rear of the fuel tank going forward.

Although no conclusive evidence was found as to the exact cause of the low order explosion and fire, it is the belief of the investigating board that there was a leak in the fuel system of sufficient quantity to allow a combustible mixture of alcohol and air to accumulate in the center section which was ignited, probably by an electrical spark from the radio transmitter, or possibly an electrical spark from the external power supply plug.

RECOMMENDATIONS for action to prevent similar accidents:

It is recommended that a study be initiated to determine an absolutely foolproof system of fuel venting on this series of aircraft, to prevent accumulation of fuel vapors and actual draining of fuel overboard onto the fuselage. It is recommended further, that a study be initiated for making both the fuel and hydrogen peroxide tanks absolutely leak proof, both in the matter of any vent installation and in the method of installation in the aircraft.

Section P - AUTHENTICATION (Each investigating board member must sign below)

1. [illegible] No Rebuttal [illegible] Rebuttal Statement Attached
2. [illegible] Death [illegible] Other (Explain) [illegible]

Base Submitting Report	Member (Name and Grade)	Medical Officer (Name and Grade)
EDWARDS AIR FORCE BASE	FRANKLIN B. SEWARD, MAJ.	HOWARD C. KNAPP, COL.
President (Name and Grade)	Aircraft Accident Officer (Name and Grade)	Recorder (Name and Grade)
FRED J. ASCANI, COL.	FORREST J. SMITH, CAPT.	WILLIAM R. [illegible], 1ST LT.

ENGINEERING OFFICER'S REPORT

of AF Aircraft Accident Involving Inadequacy, Malfunction, or Failure of AF Matériel

Use this form in accordance with AF Reg. 62-14 and AF Manual 62-5—"Aircraft Accident Investigators' Handbook"

Section A—GENERAL INFORMATION

1. DATE OF ACCIDENT	2. TYPE AND MODEL OF AIRCRAFT INVOLVED	3. AIRCRAFT NO	4. DATE OF LAST 50-HOUR INSPECTION	5. AIRCRAFT HOURS AT LAST 50-HOUR INSPECTION
22 August 1951	X1-D	48-1386	None	None
6. DATE OF MANUFACTURE	**7. TOTAL HOURS**	**8. DATE LAST OVERHAUL**	**9. OVERHAULING DEPOT OR SUBDEPOT**	**10. HOURS SINCE OVERHAUL**
15 June 1951	8 Min. 57 Sec.	New	None	8 min. 57 sec.

Section B—POWER PLANT

Fill in this section if power plant failure or malfunction was a contributing factor in the accident

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. ENGINE SERIAL NO.	2		(#1 Turbin Pump)					
2. ENGINE HOURS SINCE LAST MAJOR OVERHAUL	38 Min. 45 sec.		43 min. 49 sec.					
3. DEPOT OR SUBDEPOT PERFORMING OVERHAUL	New							
4. TOTAL ENGINE HOURS	38 min. 45 sec.							
5. NUMBER OF MAJOR OVERHAULS PERFORMED ON ENGINE	New							
6. PROPELLER MODEL	Not Applicable							
7. PROPELLER HOURS SINCE LAST MAJOR OVERHAUL	Not Applicable							

8. ENGINE MODEL	9. OCTANE RATING OF FUEL
XLR11-RM-5	Not Applicable

Section C—DESCRIPTION OF DIFFICULTY

Describe here, in as much detail as necessary, what part of the plane failed, malfunctioned, or was inadequate, your reasoning as to why it occurred, and your recommendations for necessary action to prevent recurrence. Cover any recent Form 1A write-ups concerning this difficulty. Be sure to state what part, if any, maintenance or operating personnel played in this occurrence. (Finish description on reverse side.)

The circumstances creating this accident were almost entirely unknown. A search of the wreckage revealed very little. This report is almost entirely supposition.

The fire and explosion were probably caused by a fuel leak somewhere in either the dorsal fin or the center section areas. If it were the dorsal fin area it was probably a line from the rear of the tank leading forward. If it were in the center section area it was probably in either the manhole cover on the fuel tank or the pressure and vent valve. This leak would allow a mixture alcohol and air to accumulate in the center section. This accumulation was probably ignited by an electrical spark from an unknown source. The burning caused a low order explosion blowing off the access doors and alarming the B-50 crew.

Since this aircraft was highly experimental, detailed and comprehensive procedures were effected. It is most probable that the leak developed during either takeoff or the ensuing flight.

No corrective or preventitive action of a positive nature can even be stated at this time. A concerted effort to improve on methods of maintaining experimental aircraft has always been in effect and should continue.

HAS YOUR BASE PREPARED & SUBMITTED A U. R. ON ANY FACTOR INVOLVED IN THIS ACCIDENT? ☐ YES ☒ NO (IF "YES", ATTACH COPY)

IS A U. R. BEING SUBMITTED AS A RESULT OF THIS ACCIDENT? ☐ YES ☒ NO (IF "YES", ATTACH COPY)

GRADE, TITLE, AND SIGNATURE

DAVID . . SHARP, Captain, USAF
Chief, Aircraft Maintenance & Repair .r.

24 August 1951

STATEMENT

I, Lieutenant Colonel Frank K. Everest, Jr., USAF, Serial No. 9100A, Assistant Chief, Experimental Flight Test Section, Directorate of Experimental Flight Test & Engineering, Air Force Flight Test Center, Edwards Air Force Base, Edwards, California, make the following statement:

On 22 August 1951, I was scheduled to fly the X-1D #48-1386 on a high altitude and high speed investigation. Take-off was made and the undersigned entered into the X-1D at approximately 7,000 feet. After strapping myself in the X-1D, I made a check of the cockpit gauges and noticed that the pressures and temperatures were normal with the exception of the nitrogen source pressure which had fallen to 1500 p.s.i. Normal source pressure should have been above 4000 p.s.i. The drop was aborted at that time because of the nitrogen source pressure, and I climbed out of the X-1 to rid myself of the pressure suit paraphornalia.

After further discussion between Major Ridley, Mr. Moore, Power Plant Engineer of Bell Aircraft, and myself, we decided to check the Lox top-off system of the B-50. Upon completion of that test we would time the Lox jettisoning to determine amount of Lox that the X-1 contained. The Lox top-off test was accomplished several times to my satisfaction. By stating that I was satisfied, I mean that it appeared to me that the X-1 Lox tank was full and that the Lox overflow was venting overboard. We then decided to prepare for Lox jettison. Lt. Colonel Askounis was alerted in the chase airplane to start his stop watch when he first noticed Lox flowing from the jettison pipe so as to time the jettison operation. Shortly thereafter, I started to load the Lox tank to 46 p.s.i. When the Lox tank pressure reached 20 p.s.i., I closed the valve and tapped the gauge in case the needle was sticking. Apparently it was not, so I reopened the Lox tank valve to complete tank pressurization.

At about the same time as the indicator needle of the Lox tank gauge started to move upward from 20 p.s.i., I heard and felt an explosion from the mid-section of the X-1. A rapid exit from the X-1 was made and a few seconds later Major Ridley dropped the X-1 from the B-50.

As I was making my exit from the X-1 I noticed one of the Hydrogen Peroxide warning lights burning. I am not positive which one was on but feel certain that it was the H_2O_2 line cold warning temperature light.

I have no statement to make as to what caused the explosion or the fire that followed. Everything was normal up to the time of the explosion with the exception of the low source pressure.

RE-1 D...

One further item which may or may not have contributed to the accident is the fact that the Lox quantity gauge was indicating slightly less than half full when I started jettison operation. I was advised that this gauge is supposed to be actuated by a flow meter in the manifold line to the rocket motor, thus the gauge should not indicate correctly unless rockets are on. If the gauge was correct in its reading, it would mean that a large amount of Lox had been vented overboard.

Frank K. Everest, Jr.

FRANK K. EVEREST, JR.
Lt. Colonel, USAF

STATEMENT OF X-1D AIRCRAFT ACCIDENT

The flight of the X-1D on 22 August 1951 was scheduled as the first power flight of this aircraft. The aircraft was completely serviced with propellants, which includes hydrogen peroxide to run the turbine pump and alcohol and liquid oxygen as propellants for the main rocket engine. Take-off of the B-50 with the X-1D airplane on board was normal and after reaching an altitude of 5000 feet the pilot of the X-1, Colonel Everest, put on the pressure suit and entered the cockpit of the X-1. By this time the B-50 had reached approximately 10,000 feet. Before the canopy was placed on the X-1 the pilot made a quick check of the instruments in the X-1 and noted that the source pressure of nitrogen gas had dropped to 1500 psi from a normal reading of 4800 psi. The information was relayed to the B-50 crew with the information that the flight would be discontinued.

Colonel Everest got out of the X-1 into the B-50 and took off the pressure suit helmet so normal conversation could be conducted without the use of the radio. It was decided at this time that the liquid oxygen "topping off" system would be checked before the fuel was jettisoned out of the X-1. Colonel Everest re-entered the cockpit of the X-1 and opened the main and auxiliary vents to the liquid oxygen tank. The topping off tanks in the B-50 were pressured to approximately 12 psi and the valve was opened to top off the liquid oxygen tank in the X-1. The vent lines in the X-1 were opened and closed several times in an attempt to determine if the topping off process had been completed. A report from the chase plane indicated that liquid oxygen and gaseous oxygen were coming out the large vent line intermittently. This indicated that the liquid oxygen tank in the X-1 was full and the topping off process was discontinued. It was decided to jettison the liquid oxygen from the X-1 under normal tank pressure (42 psi) in order to check that the liquid oxygen tank was full on completion of the topping off process. At this time there was approximately 20# pressure on the liquid oxygen tank and Colonel Everest was just opening the pressure valve to load the tank to 42# when a loud explosion was heard. At the time of the explosion I was standing in the navigator's compartment of the B-50 looking into the bomb bay and noticed flames approximately two feet long shooting out of the X-1 at the point where the X-1 is attached to the mother airplane. I hurried to the co-pilot's station, immediately pulled the release mechanism, and the X-1 dropped from the mother airplane. After the X-1 was clear of the mother airplane I went back to the bomb bay and noted that no fire or other damage had been done to the B-50.

A normal landing was made by the B-50 on the runway.

Jack L. Ridley

JACK L. RIDLEY,
Major, USAF

JLR/cag
Ext 362
P 201

STATEMENT

1. I, Lt. Col. Gust Askounis, AO-913059, Chief Exp. Flight Test Section, make this statement:

2. While acting as escort pilot during the flight of the X1-D conducted at Edwards Air Force Base, 22 August 51, 16:30 hours, an explosion occured at an altitude of 10,000 feet which resulted in the jettison of the aircraft.

3. I had been in contact with the B-50 Mother ship checking the venting of the LOX test and confirming any questions requested by Col. Everest, pilot of the X1-D. I had been in formation for approximately twenty minutes and was in position to check the time for jettison of the LOX fuel. Col. Everest was in the process of loading the first stage when an explosion occured and the aircraft caught fire. This information was relayed to Col. Everest and the B-50 pilot suggesting they jettison the X1-D. There was approximately 25 seconds delay from the time of the explosion and the jettison of the aircraft.

Gust Askounis
GUST ASKOUNIS
Lt. Col., USAF
Chief Exp. Flight Test Section

BELL Aircraft CORPORATION

August 30, 1951

Captain Smith
E. A. F. B.

Subject: X-1D CRASH INVESTIGATION

My duties in connection with the drop crew of the X-1D consisted of: helping the pilot of the X-1D into the cockpit, getting his oxygen equipment connected, radio, microphone plugged in, the pilots canopy in place and sealed, then during the climb to drop altitude scanning the plane and various connections and to report to the B-50 pilot any evidence of trouble.

In the five minute period that preceeds the drop, I had to disconnect the loxygen top off "quick disconnect" and stow, remove the N_2 source line, stow the line, plug and secure the access door, then return to the flight deck of the B-50 resume scanning during the count down and drop. My last station was to be by the emergency drop handle to use only in case of electrical failure of the bomb shackle.

During the climb to 10,000 feet I had just helped the pilot into the cockpit of the X-1D. On the primary check of his flight instruments Col. Everest noticed that his N_2 source pressure had fallen to 1500 p.s.i. from 4850 p.s.i. and we started a check to find the cause of the low source pressure. Not having found the leak and in the meantime the flight having been aborted we leveled off at 10,000 ft. I returned to the flight deck of the B-50 while Mr. Moore and Col. Everest continued to try and locate the pressure loss. After Mr. Moore had returned to the B-50 flight deck he and Col. Everest continued to check the X-1D as to the operation of the jettison valves.

The first indication of trouble that I noticed was a distinct spluttering sound. I don't know if this noise came from an electrical short or one of the relief valves working at a high cyclic rate to relieve over-pressurization of one of the three tanks. In looking back into the bomb bay and at the X-1D I noticed a blue haze and flame at the forward bomb shackle. At this instant (about 3-5 seconds from the first indication of trouble) I heard the sound and felt the concussion of a sharp explosion, the flame then turned from blue to yellow and the haze or smoke turned dark with the indication of a torching effect around the forward bomb shackle. While yelling for Col. Everest to get out of the cockpit of the X-1D I backed from the bulkhead door of the B-50 and he popped out of the X-1D and through the bulkhead door and in onto the flight deck of the B-50.

Major J. L. Ridley got to the drop handle and dropped the X-1D clear of the B-50. I dropped onto my hands and knees and watched the X-1D fall away. It fell down and back from the B-50 then heeled over on the left wing and while falling to the left its course being 90° off the course of the B-50. I was able to see the R.H. side of the X-1D. Both battery compartment doors had been blown off and I could see flames in the forward section of the battery compartment and the aft lox tank wall of the X-1D. I continued to watch the fall until the X-1D hit the earth in a long sweep to the right and explode into a yellow flame and black smoke.

Russell W. Ringle
Russell W. Ringle
Crew Chief

RWR/jt

BELL Aircraft CORPORATION

August 30, 1951

To: Captain Smith
E. A. F. B.

Subject: X-1D Crash Investigation

Statement of Duties & Observations Preceeding the Crash

The duties of the undersigned were to act as civilian observer and assist in technical problems involving the X-1D rocket powerplant, as well as man the lox top-off controls and aid in installation of the X-1D canopy.

Observations of the incident were as follows:

After the X-1D pre-flight servicing operation was completed the B-50 take-off was accomplished in a normal manner. Between 5,000' and 7,000' the pilot, Col. Everest, got into the cockpit of the X-1D and was assisted in donning his face mask by Mr. Lutz of Aero Medical Lab. Immediately thereafter, Mr. Ringle and myself proceeded to the bomb bay to install the canopy. At that time Col Everest called my attention to the fact that the source pressure gauge indicated approximately 1500-1600 p.s.i. which I personally observed. At this time the original flight plans were immediately cancelled and it was decided to level off at 10,000' and try the lox top-off procedure. The operation was concluded successfully in approximately twenty minutes with a chase plane reporting observations of liquid oxygen coming from the newly installed auxiliary lox vent valve. At this time the lox top-off hose was disconnected from the X-1D and stowed in the B-50 bomb bay. The next plan was to pressurize the fuel tank to 26 p.s.i. and lox tank to 35 p.s.i. and jettison, getting a jettison time reading from the chase plane. Col. Everest proceeded to pressurize the lox tank using the dome loader needle valve with the switches in the proper position. The pressure gauge needle rose to slightly over 20 p.s.i. and stopped in a normal manner. At this time Col Everest was standing on the X-1D seat with his head turned to the right, Maj. Ridley was stooped at my left and I was stooped at the right hand side of the B-50 bomb bay door facing aft. A bright orange flame rimmed with white vapor, shot out of the dorsal fin immediately forward of the front support hook around the external power plug immediatly followed by an explosive report similar to the crumpling of sheet metal. The flame grew to approximately eighteen inches wide. I immediately cleared the bomb bay door and turned to follow Maj. Ridley forward, stopping approximately at the aft edge of the B-50 nose wheel hatch. Maj. Ridley, apparently seeing Col. Everest clear of the X-1D and inside, immediately released the X-1D. A split second before the release I turned to watch the fire area and saw it drop away with the flame still coming from the dorsal fin and immediately went to the bomb bay door beside Mr. Ringle and watched it fall until it hit the ground and exploded with a dark orange flame rimmed with black smoke. Shortly thereafter it was hidden from view due to the B-50 turning.

To the best of my knowledge the following X-1D panel switches were as indicated below at the time of drop.

1. Fuel P & V ———"PRESS"
2. Lox P & V ————"PRESS"
3. H_2O_2 P & V ———"VENT"
4. All jettison switches ——"OFF"
5. Aux. Lox vent —————"CLOSED".

Signed *Wendell F. Moore*
Wendell F. Moore
Rocket Installation Engineer
Bell Aircraft Corp.

RESTRICTED

ROUTING AND RECORD SHEET — AIR MATERIEL COMMAND

SUBJECT: (Restricted) Report of Special Investigation of a Major Aircraft Accident Involving an X-1D, Serial No. 48-1386, Edwards Air Force Base, Calif., 22 Aug 51

TO Director, Flight Safety Research — FROM Chief, Investigation and Safety Engineering Division — DATE 2 Oct 51 — COMMENT NO. 1 — Maj Pritchard/ea/2221

File with #14

The Accident

1. On 22 August 1951, a B-50 aircraft with an X-1D rocket aircraft secured in its bomb-bay was flying over Edwards Air Force Base, California, at an altitude of approximately 10,000 feet. At 1630 PST a flash flame was observed in the bomb-bay of the B-50 directly above the X-1D. Immediately thereafter the Project Officer in the B-50 released the parasite aircraft. The X-1D then glided downward and crashed three miles South of Edwards Air Force Base and was completely destroyed by impact and fire.

Conclusions

2. It was concluded that:

a. As the X-1D fuel is highly volatile, vapors escaping from source pressure lines could have been of sufficient density to create an explosive mixture. (Ref. para 8)

b. Electric plug, furnishing stand-by power to the X-1D, could have provided sufficient spark to ignite the gaseous vapors. (Ref. para. 11)

c. Electrical and communication circuits within the X-1D, including the radio transmitter, are a potential source to ignite escaping vapors from the X-1D fuel when supported in the B-50. (Ref. para. 11)

Recommendation

3. None

Action Taken

4. None

History of Flight

5. On 22 August 1951 the X-1D, Serial No. 48-1386, was secured in the B-50 aircraft, No. 6006A, and fully loaded with fuel. The purpose of the flight was to release the X-1D at 35,000 feet for a high altitude and high speed investigation. The take-off and climb of the B-50 was normal, radio contact was being maintained with the tower and chase aircraft. When the B-50 reached 5,000 feet altitude, the pilot entered the X-1D. At 7,000 feet a routine check was made and it was noted that the nitrogen source pressure had dropped from approximately 4900 PSI to 1500 PSI. As a result of this decrease, a decision was made to abort the planned flight of the X-1D.

RESTRICTED

(CONTINUE ON OTHER SIDE)

RESTRICTED

ROUTING AND RECORD SHEET — MATERIEL COMMAND

SUBJECT (Restricted) Report of Special Investigation of a Major Aircraft Accident Involving an X-1D, Serial No. 48-1386, Edwards Air Force Base, Calif., 22 Aug 51.

TO	FROM	DATE	COMMENT NO.
Director, Flight Safety Research	Chief, Investigation and Safety Engineering Division	2 Oct 51	Maj Pritchard/ea/2221

6. However, in order to capitalize on the flight, a test to obtain liquid oxygen jettison time was undertaken. In about eight seconds, after the start to pressure the liquid oxygen tank, a flash was seen forward of the attaching hoist which supported the X-1D. The X-1D pilot quickly re-entered the B-50 after which the rocket aircraft was released. After the X-1D was released, it was observed to glide downward and strike the ground at a steep angle, resulting in an explosion and complete disintegration.

Investigation and Analysis

7. The flight of the X-1D on 22 August 1951 was scheduled as the first power flight of this aircraft. The aircraft was completely serviced with propellants, which includes hydrogen peroxide to operate the turbine pump and alcohol and liquid oxygen as propellants for the main rocket engine. Take-off of the B-50 with the X-1D airplane on board was normal. Upon reaching an altitude of 5,000 feet the pilot of the X-1D entered the cockpit of the X-1D.

8. As the B-50 reached 7,000 feet the pilot made a quick check of the instruments in the X-1D and noted that the source pressure of nitrogen gas had dropped to 1500 PSI from a normal reading of 4800 PSI. Realizing this decrease of nitrogen pressure would force abandonment of the flight, the B-50 crew was so informed. At this time it was decided that the liquid oxygen "topping-off" system would be checked before the fuel was jettisoned out of the X-1D. The system is a series of high pressure venting outlets.

9. The "topping-off" tanks in the B-50 were pressurized to 12 PSI and the valve was opened to top-off the liquid oxygen tank in the X-1D. The vent lines in the X-1D were opened and closed several times in an attempt to determine if the topping off process had been completed. As the pilot opened the pressure valve to jettison the liquid oxygen from the X-1D under normal tank pressure (42 PSI) a loud explosion was heard. Instantly flames two feet long emitted out of the X-1D at the point where it is supported to the mother aircraft. A rapid exit by the pilot was made from the X-1D into the B-50, and a few seconds later, the X-1D was dropped from the mother aircraft.

10. More than three months preparation had gone into the tests in anticipation of this flight. As a prerequisite to the airborne tests, all ground power plant tests had been completed, with satisfactory results.

11. On examination of the wreckage it was found that the inner surface of the dorsal fin area was scorched by fire prior to impact with the ground. The fire was caused by a fuel leak somewhere in the dorsal fin or center section areal. The leak in the fuel system was of sufficient quantity to allow a combustible mixture of alcohol and air to accumulate in the center section which was ignited, probably by an electrical spark from the radio transmitter or possibly an electrical spark from the external power supply plug.

RESTRICTED

AMC Form No. 8 (Rev 20 Jul 47)

ROUTING AND RECORD SHEET RESTRICTED MATERIEL COMMAND

SUBJECT (Restricted) Report of Special Investigation of a Major Aircraft Accident Involving an X-1D, Serial No. 48-1386, Edwards Air Force Base, Calif., 22 Aug 51.

TO Director, Flight Safety Research | FROM Chief, Investigation and Safety Engineering Division | DATE 2 Oct 51 | COMMENT NO. / Maj Pritchard/ea/2221

12. The aircraft flight report, AF Form 1 list the crew chief of the X-1D as a Bell Aircraft Company technician. His competence was not questioned. The aircraft inspection and maintenance record, Part II, AF Form I, indicated the total flight time of the X-1D as 0:8:57. The turbine pump 0:38:45.

Substantiating Data on File in Flight Safety Research

13. The following informational data is retained in file:

a. Personnel investigating the accident

b. Schematic perspective drawing of the X-1D aircraft

c. Artist sketch of X-1D

d. Schematic of the power plant

e. Drawing of the rocket motor XLR-11-RM-5

f. Aircraft Flight Report - Part 1

g. Aircraft inspection and maintenance record - Part II

h. Local flight clearance

i. Form 14 report

ROBERT W. KNIGHT
Colonel, USAF
Acting Chief, Investigation and
Safety Engineering Div.

Coordination:

Lt Col Maracchini

Lt Col Alcorn

Col Knight

RESTRICTED

(CONTINUE ON OTHER SIDE)

FILE
51-8-22-2

CLOSING STATEMENT

I-51-45 - Accident No. 51-8-22-202 (Informal)

X-1D, Serial No. 48-1386, Edwards AFB, Calif, 22 Aug 51

THE ACCIDENT

1. On 22 August 1951, a B-50 aircraft with an X-1D rocket aircraft secured in its bomb-bay was flying over Edwards Air Force Base, California, at an altitude of approximately 10,000 feet. At 1630 PST a flash flame was observed in the Bomb-bay of the B-50 directly above the X-1D. Immediately thereafter the Project Officer in the B-50 released the parasite aircraft. The X-1D then glided downward and crashed three miles south of Edwards Air Force Base and was completely destroyed by impact and fire.

CONCLUSIONS

2. It was concluded that:

a. As the X-1D fuel is highly volatile, vapors escaping from source pressure lines could have been of sufficient density to create and explosive mixture.

b. Electric plug, furnishing stand-by power to the X-1D, could have provided sufficient spark to ignite the gaseous vapors.

c. Electrical and communication circuits within the X-1D, including the radio transmitter, are a potential source to ignite escaping vapors from the X-1D fuel when supported in the B-50.

RECOMMENDATIONS

3. None.

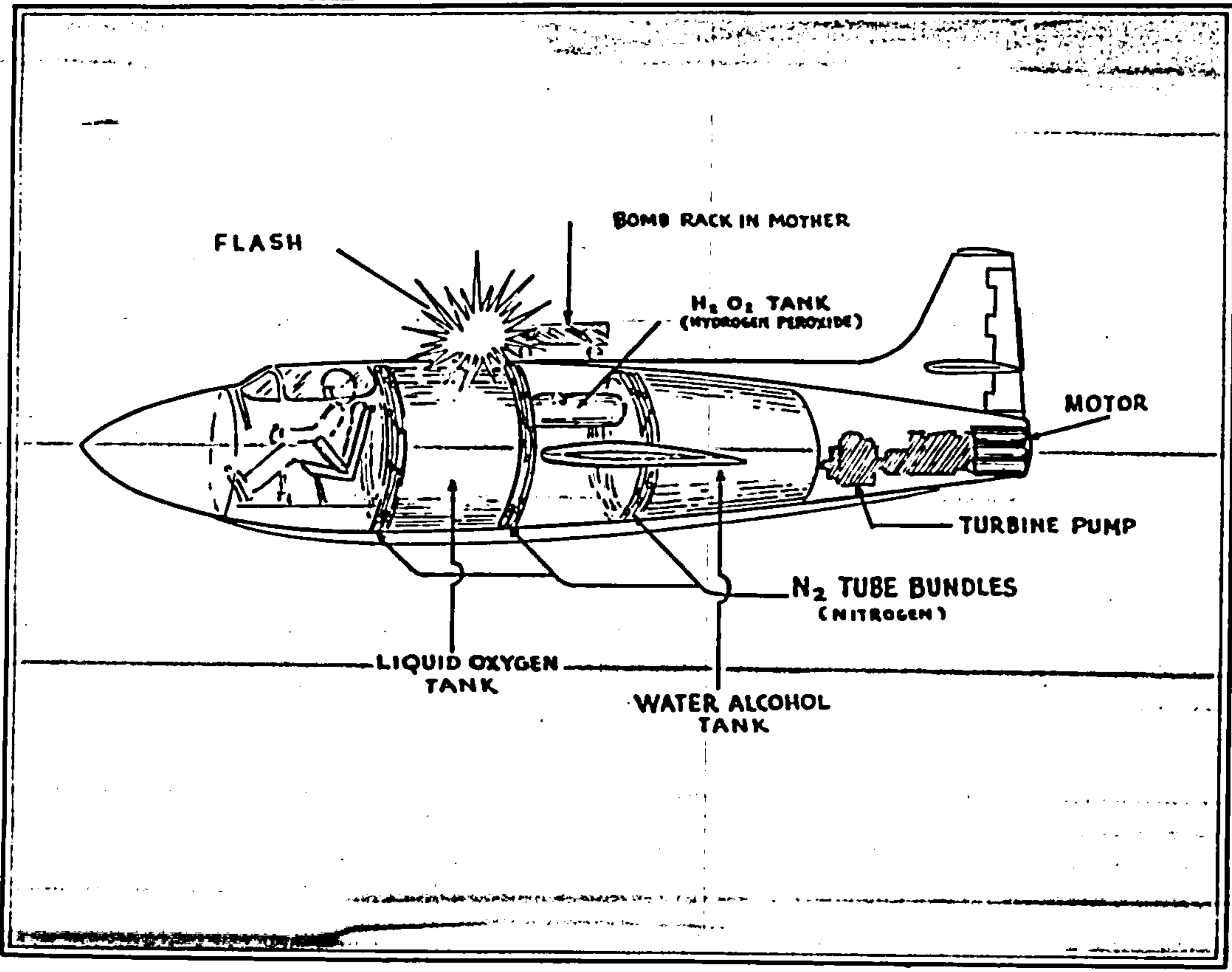
ACTION TAKEN

4. None.

STATEMENT

This completes action on subject investigation.

Signed Norman C. Anderson.



BOMB RACK IN MOTHER
FLASH
H_2O_2 TANK
(HYDROGEN PEROXIDE)
MOTOR
TURBINE PUMP
N_2 TUBE BUNDLES
(NITROGEN)
LIQUID OXYGEN
TANK
WATER ALCOHOL
TANK

The Aircraft Accident Investigating Board, appointed by Special Order #17, Headquarters, Edwards Air Force Base, Edwards, California, dated 24 January 1951, convened at 0800 on 31 August 1951 in the Conference Room, Edwards Air Force Base, Edwards, California.

Members present were:

Col. Fred J. Ascani
Col. Howard C. Knapp
Lt. Col. Walter L. Moore, Jr.
Maj. Franklin B. Bevard
Capt. Forrest G. Smith
1st Lt. William R. Coleman

Member absent was:

Maj. William A. Walker

Presiding Officer:

Col. Fred J. Ascani

The meeting was called to order by the Presiding Officer and a brief description of the accident was given by the Accident Investigating Officer.

1ST WITNESS: Lt. Col. Frank K. Everest, 9100A, Pilot of X-1D

Q. We would like to question you about some of this radio conversation that was transcribed. I am making reference to a statement made to the pilot of the chase aircraft, "When you get up here, check and see if you can see anything coming out of the vent on the underneath aft end of the airplane." Is that making reference to the LOX vent?

A. Yes sir.

Q. Was LOX to be jettisoning overboard from that vent at all times?

A. We set up the auxiliary LOX vent because that vent is about a one inch line and it wasn't enough to take any of the LOX boil off. We installed this larger one which was about two and a half (2½) inches at the bottom. We were interested in having the observer indicate if there was LOX coming out of the bottom.

Q. The statement, "You get some jettison now from the forward section of the LOX". Apparently, you were venting from the top vent but not from the bottom vent.

A. No sir. He couldn't see it from the top.

Q. Was the auxiliary vent that was just installed, the 2½ inch line, midway on the bottom, forward of the LOX section?

A. Right underneath the LOX section, forward of the wing.

Q. Col. Askounis states, "There it goes". Is he referring to the LOX venting again?

A. Yes sir.

Q. "Check your ready light". What significance does that remark have in connection with the entire accident?

A. Absolutely none.

Q. What ready light?

A. The ready-to-drop light.

Q. Does it indicate that they are ready to drop you? Has it anything to do with the drop shackle?

A. No sir.

Q. In your statement, you make reference to, "I was advised that this gauge is to be actuated by a flow meter in the manifold line to the rocket motor, thus the gauge should not indicate correctly unless rockets are on. If the gauge was correct in its reading, it would mean that a large amount of LOX had been vented overboard". Then, in the radio conversation, you say, "This LOX quantity gauge indicator has gone down to about one-fourth to one-half, pretty close to one-half". What was the pressure?

A. About half way between full and empty, and as you consume this fuel, the LOX quantity gauge drops.

Q. What did you mean by, "We're having quite a bit of turbulence around the elevator".

A. I don't believe that was me, sir.

Q. "Pete, go ahead and close your vents and pressurize - we will go ahead and jettison". It was brought out in our preliminary discussion that because of the possibility that fuel might leak and collect in the fuselage section, the vent in the fuselage section was closed off by a modification. Normally, wouldn't that vent be open just prior to your drop? When you pressurize fuel and LOX, would that vent be closed in the loading process?

A. Yes sir. You have to close it before you put any pressure in the fuel tank.

Q. That established the fact that whether it was closed off prior to take-off or whether it was closed off in the process of jettisoning and the tank was pressurized, that it might have been leaking fuel into the fuselage section.

A. Mr. Moore of Bell Aircraft states that he closed the vent to keep fuel from leaking into the aft section of the vent. I can't remember whether I closed it as I got into the cockpit, opened it, or left it alone, knowing it wouldn't make any difference. In my statement, I said that it was in the "OPEN" position because I consider that normal. I think I opened it when I climbed into the cockpit.

Q. Is there anything you would like to add to your statement?

A. Not anything that wouldn't be brought up later. I think it was definite that we had a fuel leak somewhere and the fire started in the aft section and worked its way up forward through the dorsal fin and reacted in an explosion.

Q. Couldn't the fire just as easily have started and traveled in the reverse direction?

A. I think they are positive it had been burning along the dorsal fin prior to the explosion.

Q. At what point in the dorsal fin do they believe it might have started?

A. Just somewhere in the dorsal fin.

Q. Would the fuel be venting into that area as it had been venting overboard?

A. I am not too sure. I don't believe it would except by reverse air flows.

Q. When Ridley said to go ahead and close off your venting and pressurize to begin jettisoning, to the time the explosion occurred, what did you do? Close the vents and take whatever action necessary to pressurize?

A. I closed both the LOX vents, pressurized to twenty (20) pounds, I stopped and tapped the gauge in case the needle was sticking.

Q. When the procedure was completed, what did you do?

A. Jettisoned LOX.

Q. In preparation for an actual drop, what would be your procedure?

A. Pressurize fuel, pressurize LOX, pressurize hydrogen peroxide, and drop. The procedure for jettisoning is LOX, fuel, and hydrogen peroxide. In the air, you would jettison both fuel and LOX at the same time.

Q. At the time you were working with the LOX and preparing to pressurize and jettison, was there anything in the cockpit that you could tell without your instruments about the fuel? Pressure, quantity, or anything else?

A. There was no fuel pressure on the gauges.

Q. Were you in the airplane at the time of the explosion?

A. Yes sir.

Q. Could you feel it?

A. Felt it and heard it. I glanced back after I jumped into the B-50 and I saw a small orange flame.

2ND WITNESS: Lt. Col. Gust Askounis, AO-413054, Escort Pilot, Chief of Experimental Flight Test Section

Q. What position on the clock and what approximate distance from the mother ship did you fly most of the time while you were observing?

A. The average position I maintained was approximately parallel to the outside of No. 4 engine and perpendicular to the waist gunner scanner position. About the three o'clock position. During the time the information was requested on venting, I moved in very closely and dropped down below the airplane about fifteen or twenty feet. At the time I observed the explosion and fire, I was in a position approximately ten feet below the aircraft. They had just completed checking the jettison valve and Col. Everest requested that I get into a good position to check the jettison of the LOX and the timing.

Q. You say they had just checked the jettison valve located where on the X-1D?

A. The jettison valve was on the mother aircraft and controlled for topping off. During the entire flight, I constantly checked back with Maj. Ridley and Col. Everest on the jettisoning of the LOX and fuel tanks. We wanted to be sure the tank was full and I continued checking the jettison tank when Col. Everest advised me that they were going to time and visibly check the LOX. The only configuration at the time he started the loading was a question of what the pressure should be. It was approximately forty (40) pounds, and he began loading and he asked what his pressure was. He said twenty (20) pounds, and he continued to load. A short time elapsed and the explosion occurred.

Q. Just before Col. Everest or Major Ridley indicated they were ready to jettison LOX, what was your position?

A. I was a little outside the parallel of No. 4 engine and a little bit back.

Q. You were not in a position to observe during the time Col. Everest was loading, whether any flame was trailing around the top of the X-1D?

A. No sir.

Q. What was your exact position at the time of the explosion or fire?

A. I was parallel to No. 4 engine, about the three o'clock position, about ten (10) feet below the airplane. It all happened very quickly, explosion and almost immediately, fire. Quite a bit of debris came out from approximately three feet back of the trailing edge of the pilot's cockpit underneath. The debris came off first and almost instantaneously, the fire started.

Q. What type of flame?

A. A yellowish burning flame, almost sun color.

Q. How far were the flames streaming back?

A. They were streaming underneath the wing and over it up to the B-50, about ten to twelve feet.

Q. Did they extend behind the tail of the X-1D?

A. No sir.

Q. Anything else you would like to add?

A. There is only one other comment I would like to make. I did not see any evidence of LOX. There was nothing other than fire. There was no evidence of the LOX leaking on the X-1.

Q. There was not any venting or any fumes coming from the X-1 at that time?

A. Some was coming out previously. They were getting intermittent fuel and vapor coming from the LOX vent.

Q. The auxiliary vent that was connected to the LOX tank was underneath the fuselage, midway back from the nose. Did you ever see anything coming out of it?

A. No sir.

Q. The one you are referring to in your radio conversation is the vent on the top coming from the LOX vent?

A. Yes sir.

3RD WITNESS: Major Jackie L. Ridley, AO-366647, Project Engineer on the project and on this flight, acting as co-pilot of the B-50.

Q. There is one point you can possibly clarify to the Board. There is reference to LOX coming out in spurts in gaseous form coming from a certain vent. What specific vent was the LOX coming from?

A. This vent was actually designed on the airframe as a vent for filling on the counter only. It is located on the bottom of the airplane between the line that runs from the bottom of the airplane to the top. The actual spurting is at the bottom of the airplane.

Q. Is there another vent through the top of the airplane?

A. Yes sir. On the right side of the X-1. Those are the only two vents, the one on top of the X-1 on the side and the auxiliary vent on the bottom of the airplane and that is the one the chase plane was supposed to be watching.

Q. When Col. Askounis said, "It's gas, Jack. You get liquid sometimes", what vent was he referring to?

A. That is the vent on the bottom of the airplane. That is referred to as the auxiliary LOX vent.

Q. Did you get a good look at the flame and explosion from your position in the bombay?

A. Yes sir.

Q. From your knowledge of liquid propellant, this flame was the result of what fuel?

A. It looked like an alcohol flame due to the fact that it was slightly orange.

Q. Were you able to ascertain from what pin point the flame may have originated?

A. Yes sir. It was coming out of the top of the X-1 at the forward dome shackle hook, approximately six feet to the rear of the canopy of the X-1.

Q. What is contained in the X-1 fuselage immediately under that point?

A. The hydrogen peroxide tank.

Q. Is the alcohol fuel tank near that?

A. Yes sir. Approximately in the same location only slightly farther back.

Q. Do you have any theory as to how the fire may have originated or any opinions you would like to express at this time?

A. I think the explosion we had was a low order explosion. I feel the fire was present some time before we heard the explosion.

Q. Why do you say that?

A. Because the low order explosion sounded like it was an accumulation of fire building up a slight pressure which eventually built up into an explosion that blew off the instrumentation doors.

Q. What do you believe could have caused the fire?

A. It could have been caused from a fuel leak and then ignited by any spark solenoid of any electric equipment that was present in the center section. There was a good deal of LOX vapor because we had been jettisoning LOX through the bottom vent.

Q. Could the LOX vapor have collected in the fuselage of the X-1D?

A. I think it could have, due to the type of cowling we have there.

Q. Are you inferring the explosion could have been caused by a compression of LOX vapor and alcohol fuel?

A. I feel there was an accumulation of alcohol vapors mixed with water.

Q. Was it a mixture of an oxidizer and a fuel, or just a fuel?

A. The tendency for burning is increased with LOX vapor present.

Q. In otherwords, the alcohol vapors alone wouldn't have given us the explosion.

A. The possibilities are less. The possibilities are made greater by the presence of oxygen vapors.

Q. What do you think about the possibility of a peroxide leak?

A. There is a possibility of a peroxide leak in turn causing a fuel leak.

Q. How is the hydrogen peroxide tank vented?

A. The hydrogen peroxide tank I don't think is vented. I may be mistaken.

4TH, 5TH, AND 6TH WITNESSES: Mr. A. Joseph Marchese, Mr. Wendell F. Moore, and Mr. William M. Smith, Bell Aircraft Corp. Representatives

Q. I would like to give you this opportunity to express your views or opinions as to what may have caused this accident.

A. All three of us were as one unit during the investigation and the examination of all the parts of the airplane and we all came to the same conclusions. Basically, we have arrived at the conclusion that the fire was caused by a fuel leak which allowed alcohol vapors to collect in the center section, and when these vapors rached the combustible mixture, they were ignited by a spark from the radio transmitter or the external power supply plug. When these vapors ignited, that caused a low order explosion which caused the doors to blow from the airplane. The only other damage we were able to find on the airplane was on the battery doors which did not burn, and the scorching of the external power supply plug, both the male and female; the scorching of the paint on the inside of the dorsal fin and the burning of the fibre glass insulation which was around the LOX line and the fuel line.

Q. On the matter of the burning of the paint inside the dorsal fin, were you able to establish if that was a flash explosion or was it burning in flight?

A. Our conclusion was that it was burning in flight. The evidence is such that there was not a fire of that nature after impact.

Q. It was observed that quite a bit of flame was coming out of the bottom section of the fuselage.

A. That was probably the after burning of the alcohol vapor.

Q. We are trying to arrive as to where the fire originated, whether it was in the forward section of the fuselage or in the dorsal fin.

A. That is a very difficult question to answer.

Q. Would the fuel, water and alcohol, leak in such a manner that it collected at the bottom portion of the fuselage in the vicinity of the batteries at the same time it was being blown back through the dorsal fin?

A. It is probable that the fuel was leaking somewhere along the line through the dorsal fin or possibly that it could have been leaking through the forward manhole door on the fuel tank. There is evidence of burning of the fuel inside of the dorsal fin. I feel that burning took place after the first explosion in the air and probably during its descent.

Q. Where is the fuel vented overboard when it is in the airplane?

A. The left hand side of the X-1D, the aft end of the center section about 45° up from the horizontal level. On the previous flight, when it reached an altitude of 30,000 feet, it was observed that water and alcohol was blowing outside that, so they closed the vent and that stopped the water alcohol. On this flight, Mr. Moore placed that switch on the instrument panel on the pressurize position prior to take-off. As far as we know, it was in that position during the entire flight.

Q. If it were in the open position and we would have water alcohol streaming along the fuselage of the X-1, would that represent a hazardous condition?

A. As I experienced on a previous flight, the alcohol was streaming along out of the vent and directly aft. There is a possibility that it could have done that and come through a crack in the engine door.

Q. If it is necessary to have a vent for the fuel tank, then didn't you consider that it might be dangerous to close the vent off?

A. The pressurization of the tank is normally way above that.

Q. To slow down pressure which has been put into the tank through the connections after you have jettisoned the remaining fuel, it is full of gas pressure and it would be a dangerous condition. With the valve to vent, you get rid of the pressure in the tank and bring it to "empty".

A. When you put it on "Pressurize", you don't pressurize the fuel tank until you turn on your source pressure. Col. Everest was starting to pressurize the LOX tank. I believe he had begun to pressurize to 20 pounds prior to jettisoning the LOX. That same pressure to pressurize the LOX wouldn't pressurize the fuel tank. They are separate regulators.

Q. Do you use nitrogen to pressurize the fuel tank too?

A. Yes sir.

Q. Even with the fuel streaming back alongside the fuselage from the vent, is there a possibility of a leak elsewhere in that vent line from its position from the fuel tank to the overboard position?

A. Yes, there is. The way the wreckage landed, there were signs of a hot fuel fire in the tail end of the airplane. Therefore, there is evidence of fuel burning prior to the drop. However, we have fire warning lights in that area and they did not come on. Just from looking at the overall picture, if the fire warning lights had come on, he would have had that fire originating back there.

Q. Possibly the LOX bled off and collected in the fuselage in gaseous form and may have contributed to the intensity of the fire.

A. If there was a collection of alcohol vapors in the tail end of the airplane, there was no indication of shearing of the rivets, even after the crash. It is possible that the concentration of alcohol was higher in that center section than it normally would have been.

Q. What is the percentage of alcohol?

A. Specific gravity of .85. 75% alcohol.

Q. From the known properties of alcohol, would it burn as intensely as it did?

A. We have actually ignited this water alcohol to burn at roughly around 1000°.

Q. Do you have any recommendations concerning engineering changes, for this fuel venting system is leaving us with potential accidents.

A. I feel we ought to take another look into that pipe section and eliminate as many joints as we can.

Q. What is the normal pressure in that fuel tank?

A. About 30 p.s.i. That means it is designed for a differential pressure one and one-half times, so it is 45 p.s.i., and the differential pressure would probably be 78 or 80 pounds, and under the circumstances we have on this flight, 3 or 4 p.s.i.

Q. Is there no connection at all between the part that malfunctioned and the source pressure line?

A. There is no connection. We had a malfunction in the landing gear pressure regulator that was closed and that regulator is set at about 1500 or 1600 p.si.

The meeting adjourned at 1100 hours.

William R. Coleman

WILLIAM R. COLEMAN
1st Lt., USAF
Recorder

X-1D FLIGHT August 22, 1951

X-1D Pilot: Col. F. K. Everest

B-50 Pilot: Maj. W. W. Sellers

Conversation recorded from this point:

X-R-S-B: This is X-Ray-Sugar-Baker, will you turn the radar beacon on for a short while? We would like to get a check.

Sellers: Pete, did you get that?

Everest: Roger, will turn it on for a short while and get a check.

Brown: 006, this is X-Ray-Sugar-Dog, are you cancelling out altogether?

Sellers: Roger, X-Ray-Sugar-Dog, we are aborting. We are remaining at about 10,000.

Brown: Sellers, this is Brown, can you give us a reading on that, or do you have to wait until you get down for that?

Flight Test: 006, this is X-Ray-Sugar-Peter, are you definitely aborting?

Sellers: That is roger, but send a chase plane up though, 914, to check jettisoning.

Tower: OK, he is coming up now, he should be starting engine now.

Sellers: OK, thanks. How do you read, Gus?

Askounis: Just starting out. Edwards Tower, 914 requesting taxi instructions.

NACA: 006 from Radar, we have a good radar beacon signal. You can turn it off.

Sellers: Roger Radar, thank you.

Ridley: Ringle, you can shut the radar beacon off.

Ringle: Roger

Brown: 006, this is X-Ray-Sugar-Dog, can you give the reason for aborting? Bell would like to know, to find out what to do with their personnel. over.

Ridley: Loss of source pressure.

Brown: OK, thanks a lot.

Ridley: We will go ahead and try to top off and then we will jettison and time it.

Everest: Roger.

Sellers: 914, are you on F for Fox?

Askounis: Roger, just taxiing out. 914 to Edwards Tower, ready to go.

Tower: 914 cleared for take off.

Ridley: Are you all set Pete?

Everest: Yeah, we can top it off now.

Ridley: See how much better he can talk?

Sellers: Must be in that mask.

Ridley: Pete, we are reading you much better than when you had that Buck Rogers on.

Everest: None of these radios are foolproof.

Ridley: What's that Pete?

Everest: None of these radios are foolproof.

Ridley: We can't read you Pete. What's that Pete?

Everest: Can you read me now?

Ridley: A little worse.

Everest: Do you read me? Can you read me?

Radar: We can read you from down here, Pete, this is Radar.

Everest: Do you read me Sellers?

Sellers: Roger, I can read you. It's much better without the mask.

Ridley: I can read you better.

Everest: OK, turn the radar beacon off.

Ringle: Roger.

Askounis: 6006 - 006, this is 914.

Sellers: 914, this is 006. I am right at 7'o'clock to you Gus, 10,000 feet. I will continue to turn to the left.

Askounis: OK, I got you spotted. I'm looping. ---6 g's.

Sellers: Pete, are you still on radio?

Everest: Right, OK.

Sellers: Are you up here where you can see yet, Gus?

Askounis: I am about --- yards away, just a second. I will be on your tail in a minute.

Sellers: When you get up here, check and see if you can see anything coming out on the vent on the underneath aft end of the airplane.

Askounis: Roger

Askounis: OK, Pete?

Everest: Roger

Sellers: Gus, do you see anything coming out the vent on the underneath aft section yet?

Askounis: Negative.

Sellers: OK, Pete, he is in position now, you can jettison now if you are fully topped off.

Everest: Roger.

Askounis: Pete, this is 914, can you hear me? OK any time you are ready.

Everest: I got you.

Sellers: OK, they will be jettisoning here in a minute. Roger, lox jettison is about 11 o'clock, if you are directly behind the airplane.

Ridley: Come around to the right then.

Askounis: OK

Askounis: You get some jettison now from the forward section of the lox.

Sellers: From the lox you say?

Askounis: Yes, from your tanks.

Sellers: Yes. OK, Pete? He can read you Pete, go ahead.

Askounis: There it goes. Go ahead Pete. Go ahead Pete, I am in position.

Everest: OK, it will be a little while yet.

Askounis: OK on the right side.

Ridley: Did you say on the right side?

Sellers: Do you see it?

Everest: Do you see it coming out of the bottom vent?

Askounis: Yes, it is.

Ridley: Is it liquid or gas, can you tell?

Askounis: It's gas Jack. You get liquid sometimes. It's just coming out in spurts. Three inches of liquid hanging out, then you get a little bit of gas. It's just coming out in spurts.

Ridley: Has it stopped yet?
How's that Gus?

Everest: Shouldn't be getting anything out of the bottom now. Getting anything now?

Askounis: Not now Pete, there hasn't been for about 20 seconds.

Everest: OK

General: B-29 to the X-1, from 324, do you read?

Sellers: Roger 324, this is 006.

General: Where are you now 006?

Sellers: Directly over the base, heading east at 10,000 feet.

General: Will you give your position and altitude again. I haven't read you yet.

Sellers: I think I see you taxiing out. I will pick you up.

General: 006, will you give your position and altitude again?

Sellers: We are directly north of the base, heading east at 10,000 -- heading west.

Everest: Sellers? Sellers?

Sellers: Are you calling Pete?

Everest: Yes, check the ready light.

Sellers: Still can't hear you.

Everest: Check your ready light Pete?

Ridley: Say it again, he still can't hear you.

Everest: Check your ready light. Check your ready light. Check your ready for drop lights. Are you OK?

Sellers: OK, Just a minute. Yeah, it's OK, I can see it.

Ridley: Gus, we are going to open up that bottom vent again. See if you can tell the dif erence between gas and liquid coming out.

Askounis: Right. There is some liquid. It shoots up, then you get some gas and then some liquid again.

Whiteside: Pete, this is Whitey, the light wasn't on.

Ridley: He said that light was not on.

Everest: I turned it off.

Tower: 006 from Edwards Tower, do you read, over?

Sellers: 006 to Tower, roger, I read you, go ahead.

Tower: The X-1D drop has been cancelled? Over. How long will you be airborne?

Sellers: The X-1D drop has been aborted. We are checking jettison of lox and fuel, over.

Ridley: We will jettison intermittently. See if you can tell the difference when you see liquid or gas.

Askounis: Roger.

Sellers: Yes, Pete, the ready light was flashing on and off. Is that right?

Everest: Roger.

Tower: 006, how long will you be airborne? Over.

Ridley: Say, Gus, we are going to jettison out the tail pipe now, see if you can't get some timing with the clock or something.

Askounis: Go ahead, OK.

Ridley: OK, Pete, that's right, I guess we can start. Yes, can we start unloading it? We have to disconnect the lox top off first, Pete.

Everest: Is that right?

Ridley: Yes, I think that's right. Yes, we are going to disconnect the lox top off first, Pete.

Askounis: How soon will you be ready to jettison Jack?

Ridley: What Pete?

Everest: This lox quantity gage indicator has gone down to about between 1/4 and 1/2, pretty close to 1/2.

Ridley: What indicator was that Pete?

Everest: This lox quantity indicator has gone down.

Sellers: Edwards Tower from 006, over.

Tower: Edwards Tower to 006, go ahead, over.

Sellers: Is that fire equipment I see going out on the lake? Is that for the X-1D? The drop has been aborted. We will land with the X-1D on the mother ship.

Tower: Roger, 006.

Askounis MJ ~~Everest~~: Having quite a bit of turbulence around the elevator.

Ridley: Pete, go ahead and close your vents and pressurise - we will go ahead and jettison.

Tower: 006, are landing on the runway?

Sellers: Roger.

Tower:	Fine. 006, when will you be landing? Over. What time?
Sellers:	I'll let you know.
Everest:	Ridley?
Tower:	Roger, thanks.
Ridley:	Yes, go ahead Pete.
Everest:	Ask Moore what the lox tank pressure should be for this altitude?
Ridley:	Go ahead Pete, we will load to 45, just like we were at altitude.
Ridley:	Roger, have 26 on the fuel.
Askounis:	Hey Pete!! Drop her, drop her, she's on fire!!! It's explosive, drop her! Get out of there, Pete? Pete, get out of there! Pete, Pete, Pete, get out of that!
Askounis:	Pete, get out of that!
Askounis:	OK, she's going to clear alright down there.
Harvey:	Edwards Tower, this is X-ray-Sugar-Yoke, send that fire equipment out to the lake.
Tower:	Roger, will do.
Askounis:	Pete, are you all right?
General:	Is Pete in the B-29?
Askounis:	Pete, you alright?
General:	Is Pete in the B-29?
Tower:	This is Edwards Tower, is Pete in the B-29?
Sellers:	Yes, Pete is in the B-50, General.
General:	OK, good, good, wonderful, don't scare me like that again.
Askounis:	I didn't see him in the airplane. I wasn't sure he got out.
General:	I didn't see him. I didn't know what happened to him. The airplane is in the clear. If anyone comes up, tell them to watch out for me. We'll be circling into each other.
Askounis:	Roger, General, I am circling to the right for the moment.
General:	That's fine.
Askounis:	General, when you get time, I would like you to check this 33.
General:	Roger.

Askounis: The B-50 is OK. I check it right after the fire.

General: Fine, I will check you, over. The airplane is immediately west to the south end of the lake about two miles west. We will come out in the helicopter in a while, we'll direct it out. It is in the clear. There isn't anything there for it to burn. It's OK.

Askounis: General, I am right over it about 9 o'clock from you at 10,000.

General: OK, come back over it to have a good look.

Askounis: Right Sir. I want you take a check on this airplane.

General: The X-1 is in the clear.

Harvey: You can direct the fire equipment, if you wish.

General: The airplane is two miles west of the south carpet. Immediately south of us.

Tower: Roger, thank you.

Askounis: OK, Sir?

General: OK, you can watch me and direct me back up to your airplane, after I make this low run here.

Askounis: A little bit to the east of the road going up from the base, to the accident.

General: Yes, I see you now.

Askounis: I am directly above you at 11 o'clock. Directly in front of you. I am crossing the road going east.

General: OK, I will turn east and see if I can pick you up.

Askounis: Right, Sir, I am going east. I am at 6,000 feet now. Immediately down the track. I am going to turn north, immediately down the north-south runway, going north.

General: OK, Pete, OK? Is Pete hurt at all?

Sellers: I don't think so General. I think he got out all right. When they saw the fire, they hollered for him to get out of it.

General: You can pass me now, I overshot you here.

Tower: This is Edwards Tower, is the X-1D visible from the tower with the glasses?

General: I don't think so. It's over to the west about one mile south of that trail court. Immediately south of that trailer court. About a mile south-west of that trailer court.

Askounis: Get up on your left wing General. It's going down.

General: OK. I will come on up.

Askounis: OK, thank you.

General: What do you want me to look for Gus? Do you feel that you hit some of the debris?

Askounis: No, Sir. Some of this stuff went right over the wing and tail here and I was going to follow the X-1D and had to drop the throttle. I thought it might have hit the tail.

General: OK, I will have a look now. Coming up now. OK, on the right side. Stand by, I will cross over the left side.

Askounis: OK

General: You are in good shape Gus.

Askounis: Thank you sir.

General: Edwards Tower from 324, is the fire equipment going out to the X-1D?

Tower: All fire equipment is on the way out.

General: OK, I will come down.

Tower: Are you landing on the runway, over?

General: Yes.

Sellers: 006 to Edwards Tower, over.

Sellers: You might be on B for Baker, Gus.

Askounis: OK, think you.

Tower: 914 from Edwards Tower, over.

Askounis: 914 to Edwards Tower, go ahead.

Tower: Is Pete in the B-50?

Askounis: Yes, he is OK.

Tower: Roger, thank you.

Certified true copy

FORREST G. SMITH
Capt., USAF
Flight Safety Officer

11/09/1951

X-1

12-7 | N I T U. S. A F /

RESTRICTED (WHEN FILLED IN) | endir 11-14

X-1 #3 11-9-51 (pencil: X-1 11-9-200 NOT USAF)

REPORT OF AF AIRCRAFT ACCIDENT

Use this form in accordance with AF Reg. 62-14 and AF Manual 62-5, "Aircraft Accident Investigators' Handbook." Fill in all spaces applicable. If additional space is needed, use additional sheet(s) and identify by proper section letter and subsection number.

Section A—GENERAL INFORMATION

1. Place of Accident: State, county, nearest town—Distance and direction to accident: California, Kern. Edwards	2. Nearest Airport Suitable for landing this plane—Distance and direction to accident: Edwards Air Force Base
3. Elevation above S. L. at accident scene: 2,285 ft.	4. Date of Accident: 9 Nov 51
5. Hour and Time Zone: 1604 PST	6. [X] Day [ ] Night [ ] Dawn [ ] Dusk
7. List Numbers of All Other Aircraft Involved: (File separate Form 14 for each aircraft) EB-50A, 47-006A	8. [ ] Incident to Flight [X] Not Incident to Flight
9. Classification of Accident: [X] Major [ ] Minor	10. Clearance: [ ] IFR [ ] VFR [ ] Other — If Other— To: — NOT APPLICABLE
11. This was a: [ ] CAP Flight [ ] ANG Flight [ ] Other — NOT APPLICABLE	12. [X] Fire Occurred Before Accident [ ] Fire Occurred After Accident [ ] Fire Did Not Occur
13. Airfield of Last Takeoff / 14. Duration of Flight Since Last Takeoff / 15. Mission of Flight (Use Form 1 Symbol): NOT APPLICABLE	16. Activity Aircraft Was Engaged in Just Prior to Accident: Preparing to jettison liquid oxygen.

Section B—AIRCRAFT

1. Aircraft No.	2. Type, Model, Series and Block No.	3. Organization Reporting Aircraft on AF-110 Report — Major Command	Subcommand	AF Wing
46-064	X-1 #3	ARDC	Hq, AFFTC	-

4. 1 Technical Orders affecting this aircraft were not complied with at time of accident. (List number and title of these T. O.'s on separate sheet.)	Group Number and Type	Squadron or Unit	Base
	-	-	Edwards Air Force Base

Section C—OPERATOR (Person at controls at time of accident)

1. Last Name (Jr., II, etc.)	First Name	Middle Name	Grade	Component	Serial No.	Nationality and Race	Year of Birth
Cannon	Joseph	A.	Civilian	-	-	USA W	1918

2. Assigned Base	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit
Bell Aircraft Corp., assigned to		Edwards Air Force Base			

3. Attached Base for Flying	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit

4. Original Aeronautical Rating and Date Received	5. Present Aeronautical Rating and Date Received	6. Primary Duty Assignment
		Test Pilot

7. Operator's Flying Experience (Including Civilian)	
7. Type of Instrument Card — Expiration Date	
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours	NOT
9. Total 1st Pilot Hours	AVAILABLE
10. 1st Pilot Hours Last 90 Days	
11. 1st Pilot Hours Last 30 Days	
12. 1st Pilot Hours This Model (B-25, F-51, etc.)	
13. Other Pilot Hours (CP, C, SC) This Model	
14. 1st Pilot Hours Last 90 Days This Model	
15. 1st Pilot Hours Last 30 Days This Model	
16. Total Time Spent in Air During 24 Hrs. Prior to Accident	
17. Last 90 Type and Model 1st Pilot Experience in Similar Aircraft (e.g. B-25, 50 hrs.)	
18. Was Operator on Instruments at Time of Accident or Immediately Before? [ ] No [ ] CFR [X] Yes [ ] Hood [ ] Weather — If above answer is "Yes" or if accident occurred at night or during IFR weather or unknown conditions, fill in items below.	
19. Total 1st Pilot Instrument Weather Hours	
20. Total 1st Pilot Instrument Hood Hours	
21. 1st Pilot Instrument (Weather and Hood) Hours Last 6 Months	
22. 1st Pilot Instrument (Weather and Hood) Hours Last 30 Days	
23. 1st Pilot Night Hours Last 6 Months	
24. 1st Pilot Night Hours THIS MODEL Last 60 Days	

Section D—PERSONNEL INVOLVED (Including operator and all other persons, whether in plane or not)

Duty at time of accident (1)	Name (Last name first) (2)	Type of Aero. Rating (Symbol) (3)	Serial No. (4)	Grade and Branch of Service (5)	Component (See AFM 62-5) (6)	Organizational Assignment—Command, Subcommand, Group Number and Type, Base (7)	Fatal, Major, Minor, None, Missing (8)	Parachute Used Yes (9)	Parachute Used No (10)
P	Cannon, Joseph A.		-	Civilian	-	Bell Aircraft Corp. Assigned to EAFB	Major		X

AF Form 14 — Previous editions are obsolete. | RESTRICTED (WHEN FILLED IN)

RESTRICTED (WHEN FILLED IN)

Section E. RATED PERSONNEL AT OTHER SET OF DUAL CONTROLS (Instructor, Copilot, etc.)

1. Last Name	First Name	Middle Name	Grade	Serial No.	Per. Classification	Year of Birth

2. Assigned Base	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit
3. Attached Base for Flying	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit

4. Original Aeronautical Rating and Date Received | 5. Present Aeronautical Rating and Date Received | 6. Present Duty Assignment

FLYING EXPERIENCE (Including Civilian)	
7. Type of Instrument Card Expiration Date	
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours	
9. Total 1st Pilot Hours	
10. Total Hours, ☐ IP ☐ CP ☐ C (Check applicable one)	
11. Pilot Hours Last 90 Days	
12. 1st Pilot Hours Last 90 Days	
13. Hours Last 90 Days, ☐ IP ☐ CP ☐ C	
14. Pilot Hours Last 30 Days	
15. Total Pilot Hours This Model (B-25, F-51, etc.)	
16. 1st Pilot Hours This Model	
17. Hours This Model, ☐ IP ☐ CP ☐ C	
18. Total Pilot Hours This Model Last 90 Days	
19. 1st Pilot Hours This Model Last 90 Days	
20. Hours This Model Last 90 Days, ☐ IP ☐ CP ☐ C	

21. List by Type and Model: ☐ IP ☐ CP ☐ C
Experience in similar aircraft (e.g., B-25, 117, 50 hrs.)

Fill in items below if Instrument and Night Experience of Operator was listed in Section C:

22. Total 1st Pilot Instrument Weather Hours	
23. Total 1st Pilot Instrument Hood Hours	
24. 1st Pilot Instrument (Weather and Hood) Hrs. Last 6 Months	
25. 1st Pilot Instrument (Weather and Hood) Hrs. Last 60 Days	
26. Total Pilot Night Hours Last 6 Months	
27. 1st Pilot Night Hours Last 6 Months	
28. Night Hours Last 6 Mos., ☐ IP ☐ CP ☐ C	
29. Total Pilot Night Hours This Model Last 60 Days	
30. 1st Pilot Night Hours This Model Last 60 Days	
31. Night Hrs. This Model Last 60 Days, ☐ IP ☐ CP ☐ C	

Section F—DAMAGE

1. Describe Briefly in General Terms the Extent of Damage to the Airplane, Engines, and Propellers.

Totally demolished

2. Check Proper Damage Classification

None	
Minor	
Substantial	
Destroyed	X

3. ☒ Plane or Wreckage Was Returned to an AF Base
☐ Plane or Wreckage Was Left at Scene of Accident

4. Is Plane Damaged Beyond Economical Repair? ☒ Yes ☐ No

5. If Plane Is To Be Repaired, Give Engineering Officer's Estimate of Number of Man-Hours Required for Repair: N/A Man-Hrs.

6. Was Private Property Damaged? ☐ Yes ☒ No
If "Yes," Describe Damages on Separate Sheet.

7. Give below a considered estimate of cost of this accident to the Air Force:

Cost of Damage to Aircraft	$ Unknown
Cost of Damage to Other Government Property	$
Cost of Damage to Private Property	$
Cost of Injuries	$
Cost—Other (Explain)	$
Total Estimated Cost of Accident	$ Unknown

Section G—SPECIAL EQUIPMENT

1. Check items of special equipment which affected the accident.

☐ Radios ☐ Armament ☐ De-Icers ☐ Equipment for Clear Vision From Cockpit
☐ Instruments ☐ Fire Extinguishing Equipment in Plane ☐ JATO ☐ ________

2. Describe Briefly How the Use, Nonuse, Misuse, or Absence of Special Equipment Affected the Accident

N O T   A P P L I C A B L E

Section H—WEATHER (At time and place of accident)

Ceiling	Visibility	Wind Direction and Velocity	Temp.	Dew Point	Other Weather Conditions
Clear	30	Calm	70°	30°	None

If weather other than unfavorable wind conditions for takeoff, landing, or taxiing was a factor in the accident, attach statement of weather officer describing climatic conditions and how they probably contributed to accident.

Section I—CHECK LIST FOR ATTACHMENTS

☐ Form 1 ☐ Clearance ☒ Photographs ☒ Form 14C
☒ Form 1A ☒ Crew Members' Statements ☒ Form 14A ☐ Form 14D
☒ List of T.O.'s Not C/W ☒ Witnesses' Statements ☒ Form 14B ☐ Form 14E
☒ Minutes Schematic drawing

Primary	Secondary	Section J—ACCIDENT TYPE Check one accident type as "Primary." Check all others applicable as "Secondary."
		Ground or Water Loop
		Wingtip Landing
		Wheels-Up Landing
		Hard Landing
		Collapse or Retraction of Landing Gear
		Undershoot
		Overshoot
		Nose Up or Nose Over
		Collision With Other Aircraft
		Collision With Ground or Water
		Other Collisions
		Spin or Stall
		Fire on Ground
X		Fire and ~~or~~ Explosion ~~in Flight~~ on Ground
		Airframe Failure in Flight
		Abandoned Aircraft
		Prop or Jet Blast Accident
		Other (List):
		Undetermined

	Section K—PHASE OF OPERATION (Check only ONE)
X	
	Taxiing Incident to Flight
	Take-Off
	In Flight
	Landing
	Go Around
	Engine Running—Not Taxiing
X	Ground Operations
	Undetermined

	Section L—CONDITIONS AFFECTING ACCIDENT (Check all applicable)
X	
	Immediate Forced Landing
	Precautionary Landing
	Fuel Exhaustion
	Engine Stoppage
	Lost
	Pertinent T.O.'s Not Complied With
X	Other (List): Preparation for jettisoning liquid oxygen

	Section M—VIOLATIONS (Check all applicable)
X	
	Improper Taxiing Procedure
	Failure To Follow Checklist
	Unauthorized Low Flying
	Instrument Flying on VFR Clearance
	Unauthorized Formation
	Other (List)

Section N—CAUSE FACTOR ANALYSIS

Check one specific cause as "Primary." Check all others applicable as "Secondary."
(See AFM 62-5 for definitions)

Primary	Secondary	1. ERRORS OF AIR CREW
		Misused Power Plant or Power Plant Controls
		Misused Brakes and/or Flight Controls on Ground
		Improper Use of Flight Controls in Air
		Exceeded Stress Limits of Aircraft
		Inattentive to Fuel Supply or Fuel Selector Valves
		Failed to Extend or Retract Landing Gear Properly
		Selected Unsuitable Terrain or Runway for Takeoff or Landing
		Failed To Compensate for Wind Conditions
		Misjudged Distance
		Failed To Level Off Properly
		Failed To Observe Other Aircraft or Objects
		Failed To Maintain Adequate Flying Speed
		Became Lost (Weather average or above)
		Continued VFR Flight Into Unfavorable Weather
		Improper Operation on Authorized Instrument Flight
		Operated Aircraft in Reckless Manner
		Made Inadequate Flight Preparations
		Attempted Flight Beyond Ability or Experience
		Failed To Use or Incorrectly Used Miscellaneous Equipment
		Other (List):

		2. ERRORS OF OTHER PERSONNEL
X	X	
		Aircraft Inadequately Maintained
		Aircraft Improperly Cleared for Flight
		Weather Incorrectly Forecast
		Improperly Operated Airpt/Airway Facilities
		Improperly Supervised Training (Ground Personnel)
		Improperly Supervised Training (Flight Instructors and Flight Leaders)
		Other (List):

		3. MATÉRIEL FAILURE—POWER PLANT
X	X	
		Cooling System
		Lubricating System
		Fuel System
		Engine Structure (Includes Jet Engines)
		Engine Control System
		Propeller and Propeller Accessories
		Supercharger (Reciprocating Engine only)
		Ignition System
		Engine Accessories
		Other:
		Undetermined

		4. MATÉRIEL FAILURE—AIR FRAME
		Flight Control System
		Wings, Surfaces, and Flaps
		Cowling and Fairing
		Fuselage
		Other
		Undetermined

Prim.	Sec.	5. MATÉRIEL FAILURE—LANDING GEAR
		Main Landing Gear
		Nose Wheel or Tail Wheel
		Landing Gear Position Indicators
		Brakes
		Tires
		Other:
		Undetermined

		6. MATÉRIEL FAILURE—EQUIPMENT AND ACCESSORIES
X	X	
		Automatic Pilot
		Radio Equipment
		Electrical System
		Hydraulic System
		Oxygen or Pressurization System
		Safety Equipment
		Instruments
		Cockpit, Seat, Canopy, Fittings, Doors, Hatches
		Armament
		Other:

		7. WEATHER
X	X	
		Low Ceiling
		Smoke—Haze
		Rain—Fog
		Snow—Hail
		Icing Conditions
		Unfavorable Wind Conditions for Landing, Taxiing, or Takeoff
		Turbulence in Flight
		Winds Aloft
		Thunderstorms
		Downdraft—Updraft
		Other:

		8. LANDING AREA
X	X	
		Wet
		Soft
		Snow
		Ice
		Rough
		Gravel
		Runway Too Short
		Other Hazards:

		9. GROUND EQUIPMENT
X	X	
		Airport Facilities
		Airway Facilities
		Arresting Devices
		Launching Devices
		Other:

		10. MISCELLANEOUS
		Bird in Flight Path
		Shooting Target in Flight Path
		Other

		11. UNDETERMINED
X	X	X

(2) RE-1

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Section O—DESCRIPTION OF ACCIDENT

Tell in narrative form, in as much detail as necessary, everything that is known about the accident. Make certain that items checked on reverse side are justified by this narrative. If fire was involved in accident, explain in detail its origin and progress and steps taken to extinguish it.

Fire and a series of explosions resulted in the destruction of an X-1 #3 airplane and a specially modified B-50 mother aircraft. The X-1 was suspended from the B-50 at the time of the accident, which occurred during the preparation for jettisoning liquid oxygen on the ground.

During the morning preceding the explosion, the X-1 and the B-50 had performed a captive flight of approximately one hour. The flight was to serve as a rehearsal for an actual power drop as well as to test the jettisoning of rocket propellants and hydrogen peroxide, (the latter was simulated with distilled water). Jettisoning of fuel and liquid oxygen had to be aborted due to loss of nitrogen source pressure on the X-1. At 18,000 feet, the pilot of the X-1 had inadvertently tripped the hydrogen peroxide and fuel jettison switches while struggling to fasten the door of the X-1. Since at that time the peroxide tank was pressurized and contained only nitrogen, this could have been the cause of the loss of source pressure. A decision was made to accomplish a landing in the B-50 with the X-1 aboard and still containing liquid oxygen and fuel. The hydrogen peroxide system contained distilled water for this mission, and this had been jettisoned early in the flight.

After landing, the aircraft was taxied to the propellant loading area to obtain nitrogen source pressure for the purpose of on-the-ground jettisoning of the liquid oxygen and to attempt to locate any possible leaks in the nitrogen pressure system. Source pressure was obtained with no difficulty and the aircraft was towed to the East end of the ramp and swung around so that it faced into the wind. A standard procedure for jettisoning was then begun; i.e., the area to the rear of aircraft was cleared, fire truck and firemen were in position and an operator was in the cockpit of the X-1. The "all-clear" signal was given the operator and he began the normal liquid oxygen jettisoning procedure. He pressurized the liquid oxygen tank pressure regulator dome until the indicator reached the red line at 52 psi, and turned his attention to the liquid oxygen tank pressure gage. This pressure was rising slowly, (normal lag of this indicator is 10 to 15 psi behind the liquid oxygen dome indicator), and when this pressure had reached approximately 42 psi, the initial explosion occurred. All witnesses agree that the first explosion was a dull thud or contained explosion, quickly followed by a "hiss" and a small cloud of white vapor rising from the center section of the X-1. Some witnesses reported small flames following this explosion but the majority remembered none. Within one to five seconds, a sharp violent explosion occurred, containing yellow flame and black smoke. This was closely followed by numerous other explosions, varying in intensity from minor ones to very violent ones.

RECOMMENDATIONS for action to prevent similar accidents: It is recommended that: (1) Bell Aircraft Corp. conduct a complete investigation on the fuel and pressure system used in the aircraft. This investigation should be a continuation of that being conducted on the X-1D aircraft having the same system and should be completed before tests are initiated on the X-1A and X-1B. (2) Wherever possible, ground operation of all aircraft will be conducted with the aircraft detached from the mother ship. (3) The materials used in the nitrogen pressure system be metallurgically investigated by Bell Aircraft Corp.

Section P—AUTHENTICATION (Each investigating board member must sign below)

1. ☐ Personnel Responsible for This Accident Have Been Offered Opportunity of Rebuttal ☐ No Rebuttal Rec'd ☐ Rebuttal Statement(s) Attached
2. Personnel Responsible Not Available Because of: ☐ Death; ☐ Critical Injury; ☐ Other (Explain)

Base Submitting Report EDWARDS AIR FORCE BASE	Member (Name and Grade) WILLIAM A. WALKER, MAJ., USAF	Medical Officer (Name and Grade) HOWARD C. KNAPP, COL., USAF
President (Name and Grade) WALTER L. MOORE, Jr., LT.	Aircraft Accident Officer (Name and Grade) JAMES A. BRYANT, CAPT.	Member (Name and Grade) WILLIAM R. COLEMAN, CAPT.

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Section O—DESCRIPTION OF ACCIDENT

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Section D—AUTHENTICATION

(4) Provisions be made for venting liquid oxygen tanks and fuel tanks outside the carrier airplane. (5) Precautions be taken to prevent oxygen gas from venting into the bombay.

Walter L Moore Jr WALTER L. MOORE, Jr., LT.	James A. Bryant JAMES A. BRYANT, CAPT.	William R. Coleman WILLIAM R. COLEMAN, CAPT.

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Additional fire trucks arrived at the scene and the fire was extinguished in approximately eight minutes. The X-1 was totally demolished and the B-50 center section, except the wing, was burned away. While the wing center section was badly burned, it remained structurally intact and the fuel cells did not rupture.

Subsequent investigation of the wreckage revealed the following outstanding facts:

1. The liquid oxygen tank had failed at the rear bulkhead access plate and the access plate in the bulkhead separating the two tank cells. Two liquid oxygen outlet lines had separated from the tank at the attaching flanges.
2. The liquid oxygen tank had received a severe blow on the forward end.
3. The liquid oxygen tank had moved in a forward direction approximately two inches.
4. One part of a coil in the forward nitrogen tube bundle had failed.
5. One coil of the rear nitrogen tube bundle had failed.
6. The forward end of the hydrogen peroxide tank had received a very strong blow.
7. The forward end of the fuel tank had ruptured.
8. Most intense fire was in the center section of the X-1.

These, and many other facts were examined by a panel consisting of both Air Force and Bell Aircraft engineers and investigators as well as by the full Investigating Board, but no definite conclusions could be reached concerning the cause of the accident.

Based on the evidence available, one of the following events could have constituted the initial failure, with other observed conditions resulting therefrom:

1. Failure of the liquid oxygen tank at the rear bulkhead access door resulting from an abnormal internal pressure built up by a chemical reaction, explosive in nature. Such an explosion might have resulted from the introduction of a self-igniting contaminator into the liquid oxygen tank. The resultant movement of the liquid oxygen tank access door in the rearward direction could have imposed additional forces on already highly stressed nitrogen pressure coils, causing them to break and release the nitrogen pressure. Tube fragments then may have punctured the water-alcohol tank, thus supplying fuel to support the ensuing fire.
2. The high pressure nitrogen coil might have failed from abnormal stresses resulting from a reduction in pressure with consequent flexing of the coils and from a brittleness of the material resulting from low temperatures. The fragments resulting from this pressure explosion may have severed liquid oxygen lines and punctured the fuel tank, thus providing fuel and oxygen to support the fire. The steel fragments flying about the compartment could have produced sparks to start this fire.
3. Alcohol or other fuel fumes may have collected in the center section of the X-1, which combined with the known presence of an oxygen atmosphere in this region, may have caused the initial explosion, rupturing fuel and/or oxygen lines or tanks to support the resulting fire.
4. Fuel fumes may have gathered in the B-50 bombay, forming an explosive mixture with the gaseous oxygen known to be present in this area, and may have been ignited by static electricity sparks or some other means of ignition to generate an initial explosion with the same results noted above.

Any of the circumstances listed above as possible causes of the initial explosion and fire could have produced the subsequent explosions and large fire which destroyed the two aircraft.

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REPORT OF AF AIRCRAFT ACCIDENT

Use this form in accordance with AF Reg. 62-14 and AF Manual 62-5, "Aircraft Accident Investigators' Handbook." Fill in all spaces applicable. If additional space is needed, use additional sheet(s) and identify by proper section letter and subsection number.

Section A – GENERAL INFORMATION

1. Place of Accident. State, county, nearest town—Distance and direction to accident: California, Kern, Edwards
2. Nearest Airport Suitable for landing this plane—Distance and direction to accident: Edwards Air Force Base
3. Elevation Above S. L. at accident scene: 2,285 ft.
4. Date of Accident: 9 Nov 51
5. Hour and Time Zone: 1604 PST
6. [X] Day [ ] Night [ ] Dawn [ ] Dusk
7. List Numbers of All Other Aircraft Involved: X-1 #3, 46-064
8. [ ] Incident to Flight [X] Not Incident to Flight
9. Classification of Accident: [X] Major [ ] Minor
10. Clearance: [ ] IFR [ ] Local [ ] VFR [ ] Other — If other — NOT APPLICABLE
11. This was a: [ ] CAP Flight [ ] ANG Flight [ ] Other — NOT APPLICABLE
12. [X] Fire Occurred Before Accident [ ] Fire Occurred After Accident [ ] Fire Did Not Occur
13. Airfield of Last Takeoff / 14. Duration of Flight Since Last Takeoff / 15. Mission of Flight (Use Form 1 Symbol): NOT APPLICABLE
16. Activity Aircraft Was Engaged in Just Prior to Accident: Preparing to jettison liquid oxygen

Section B—AIRCRAFT

1. Aircraft No.: 47-006A
2. Type, Model, Series and Block No.: EB-50A
3. Organization Reporting Aircraft on AF-110 Report: Major Command: ARDC; Subcommand: Hq, AFFTC; AF Wing: -
4. — Technical Orders affecting this aircraft were not complied with at time of accident. (List number and title of these T. O.'s on separate sheet.)
Group Number and Type: -; Squadron or Unit: -; Base: Edwards Air Force Base

Section C – OPERATOR (Person at controls at time of accident)

NOT APPLICABLE

1. Last Name (Jr., II etc.) | First Name | Middle Name | Grade | Component | Serial No. | Nationality and Race | Year of Birth
2. Assigned Base | Major Command | Subcommand | AF Wing | Group No. and Type | Squadron or Unit
3. Attached Base for Flying | Major Command | Subcommand | AF Wing | Group No. and Type | Squadron or Unit
4. Original Aeronautical Rating and Date Received
5. Present Aeronautical Rating and Date Received
6. Primary Duty Assignment

OPERATOR'S FLYING EXPERIENCE (Including Civilian) — NOT APPLICABLE

7. Type of Instrument Card — Expiration Date
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours
9. Total 1st Pilot Hours
10. 1st Pilot Hours Last 90 Days
11. 1st Pilot Hours Last 30 Days
12. Pilot Hours This Model (B-25, F-51, etc.)
13. Pilot Hours (CP, C, PC) This Model
14. 1st Pilot Hours Last 90 Days This Model
15. 1st Pilot Hours Last 30 Days This Model
16. Total Time Spent in Air During 24 Hrs. Prior to Accident
17. List by Type and Model 1st Pilot Experience in Similar Aircraft (e. g., B-29, 50 hrs.)
18. Was Operator on Instruments at Time of Accident or Immediately Before? [ ] No [ ] Unk [ ] Yes [ ] Hood [ ] Weather
If above answer is "Yes" or if accident occurred at night or during IFR weather or unknown conditions, fill in items below.
19. Total 1st Pilot Instrument Weather Hours
20. Total 1st Pilot Instrument Hood Hours
21. 1st Pilot Instrument (Weather and Hood) Hours Last 6 Months
22. 1st Pilot Instrument (Weather and Hood) Hours Last 90 Days
23. 1st Pilot Night Hours Last 6 Months
24. 1st Pilot Night Hours THIS MODEL Last 90 Days

Section D - PERSONNEL INVOLVED (Including operator and all other persons, whether in plane or not)

Duty at time of accident (1)	Name (Last name first) (2)	Type of Aero. Rating (symbols) (3)	Serial No. (4)	Grade and Branch of Service (5)	Component (See AFM 62-5) (6)	Organizational Assignment—Command, subcommand, Group Number and Type, Base (7)	Fatal, Major, Minor, None, Missing (8)	Parachute Used Yes (9)	No (10)

XS-1 ...

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Section E – RATED PERSONNEL AT OTHER SET OF DUAL CONTROLS (Instructor, Copilot, etc.)

1. Last Name (Jr., II, etc.)	First Name	Middle Name	Grade	Component, Serial No.	Nationality and Race	Year of Birth

2. Assigned Base	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit
3. Attached Base for Flying	**Major Command**	**Subcommand**	**AF Wing**	**Group No. and Type**	**Squadron or Unit**

4. Original Aeronautical Rating and Date Received	5. Present Aeronautical Rating and Date Received	6. Primary Duty Assignment

FLYING EXPERIENCE (Including Civilian)

7. Type of Instrument Card ____ Expiration Date ____
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours ____
9. Total 1st Pilot Hours ____
10. Total Hours, ☐ IP ☐ CP ☐ C (Check applicable one) ____
11. Pilot Hours Last 90 Days ____
12. 1st Pilot Hours Last 90 Days ____
13. Hours Last 90 Days, ☐ IP ☐ CP ☐ C ____
14. Pilot Hours Last 30 Days ____
15. Total Pilot Hours This Model (B-25, F-51, etc.) ____
16. 1st Pilot Hours This Model ____
17. Hours This Model, ☐ IP ☐ CP ☐ C ____
18. Total Pilot Hours This Model Last 90 Days ____
19. 1st Pilot Hours This Model Last 90 Days ____
20. Hours This Model Last 90 Days, ☐ IP ☐ CP ☐ C ____

21. List by Type and Model: ☐ IP ☐ CP ☐ C Experience in Similar Aircraft (e.g., B-29, IP, 50 hrs.)

Fill in items below if Instrument and Night Experience of Operator was listed in Section C:

22. Total 1st Pilot Instrument Weather Hours ____
23. Total 1st Pilot Instrument Hood Hours ____
24. 1st Pilot Instrument (Weather and Hood) Hrs. Last 6 Months ____
25. 1st Pilot Instrument (Weather and Hood) Hrs. Last 60 Days ____
26. Total Pilot Night Hours Last 6 Months ____
27. 1st Pilot Night Hours Last 6 Months ____
28. Night Hours Last 6 Mos., ☐ IP ☐ CP ☐ C ____
29. Total Pilot Night Hours This Model Last 60 Days ____
30. 1st Pilot Night Hours This Model Last 60 Days ____
31. Night Hrs. This Model Last 60 Days, ☐ IP ☐ CP ☐ C ____

Section F—DAMAGE

1. Describe Briefly in General Terms the Extent of Damage to the Airplane, Engines, and Propellers.

Center section destroyed by fire and explosion.
Nose section destroyed by fire and explosion.
Damage to engines unknown, but is considered substantial.

2. Check Proper Damage Classification	
None	
Minor	
Substantial	
Destroyed	X

3. ☒ Plane or Wreckage Was Returned to an AF Base
☐ Plane or Wreckage Was Left at Scene of Accident

4. Is Plane Damaged Beyond Economical Repair? ☒ Yes ☐ No

5. If Plane Is To Be Repaired, Give Engineering Officer's Estimate of Number of Man-Hours Required for Repair: N/A Man-Hrs.

6. Was Private Property Damaged? ☐ Yes ☒ No
If "Yes," Describe Damages on Separate Sheet.

7. Give below a considered estimate of cost of this accident to the Air Force:

Cost of Damage to Aircraft	$ Unknown
Cost of Damage to Other Government Property	$
Cost of Damage to Private Property	$
Cost of Injuries	$
Cost—Other (Explain)	$
Total Estimated Cost of Accident	$ Unknown

Section G—SPECIAL EQUIPMENT

1. Check items of special equipment which affected the accident.

☐ Radios ☐ Armament ☐ De-Icers ☐ Equipment for Clear Vision From Cockpit
☐ Instruments ☐ Fire Extinguishing Equipment in Plane ☐ JATO ☐ ____

2. Describe Briefly How the Use, Nonuse, Misuse, or Absence of Special Equipment Affected the Accident

N O T A P P L I C A B L E

Section H—WEATHER (At time and place of accident)

Ceiling	Visibility	Wind Direction and Velocity	Temp.	Dew Point	Other Weather Conditions
Clear	30	Calm	70°	30°	None

If weather other than unfavorable wind conditions for takeoff, landing, or taxiing was a factor in the accident, attach statement of weather officer describing climatic conditions and how they probably contributed to accident.

Section I—CHECK LIST FOR ATTACHMENTS

☐ Form 1 ☐ Clearance ☒ Photographs ☒ Form 14C
☒ Form 1A ☒ Crew Members' Statements ☒ Form 14A ☐ Form 14D
☐ List of T.O.'s Not C/W ☒ Witnesses' Statements ☒ Form 14B ☐ Form 14E
☒ Minutes

Section J—ACCIDENT TYPE

Check one accident type as "Primary." Check all others applicable as "Secondary."

Primary	Secondary	
		Ground or Water Loop
		Wingtip Landing
		Wheels-Up Landing
		Hard Landing
		Collapse or Retraction of Landing Gear
		Undershoot
		Overshoot
		Nose Up or Nose Over
		Collision With Other Aircraft
		Collision With Ground or Water
		Other Collisions
		Spin or Stall
		Fire on Ground
X		Fire and X Explosion ~~XXX~~ on ground
		Airframe Failure in Flight
		Abandoned Aircraft
		Prop or Jet Blast Accident
		Other (List):
		Undetermined

Section K—PHASE OF OPERATION

(Check only ONE)

	Taxiing Incident to Flight
	Take-Off
	In Flight
	Landing
	Go Around
	Engine Running—Not Taxiing
X	Ground Operations
	Undetermined

Section L—CONDITIONS AFFECTING ACCIDENT

(Check all applicable)

	Immediate Forced Landing
	Precautionary Landing
	Fuel Exhaustion
	Engine Stoppage
	Lost
	Proficiency T.O.'s Not Complied With
	Other (List): Preparation for jettisoning liquid oxygen

Section M—VIOLATIONS

(Check all applicable)

	Improper Taxiing Procedures
	Failure To Use Checklist
	Unauthorized Low Flying
	Instrument Flying on VFR Clearance
	Unauthorized Acrobatics
	Other (List).

Section N—CAUSE FACTOR ANALYSIS

Check one specific cause as "Primary." Check all others applicable as "Secondary." (See AFM 62-5 for definitions)

1. ERRORS OF AIR CREW

- Misused Power Plant or Power Plant Controls
- Misused Brakes and/or Flight Controls on Ground
- Improper Use of Flight Controls in Air
- Exceeded Stress Limits of Aircraft
- Inattention to Fuel Supply or Fuel Selector Valves
- Failed to Extend or Retract Landing Gear Properly
- Selected Unsuitable Terrain or Runway for Takeoff or Landing
- Failed To Compensate for Wind Conditions
- Misjudged Distance
- Failed To Level Off Properly
- Failed To Observe Other Aircraft or Objects
- Failed To Maintain Adequate Flying Speed
- Became Lost (Weather average or above)
- Continued VFR Flight Into Unfavorable Weather
- Improper Operation on Authorized Instrument Flight
- Operated Aircraft in Reckless Manner
- Made Inadequate Flight Preparations
- Attempted Flight Beyond Ability or Experience
- Failed To Use or Improperly Used Miscellaneous Equipment
- Other (List):

2. ERRORS OF OTHER PERSONNEL

- Aircraft Inadequately Maintained
- Aircraft Improperly Cleared for Flight
- Weather Incorrectly Forecast
- Improperly Operated Airport/Airway Facilities
- Improperly Supervised Training (Ground Personnel)
- Improperly Supervised Training (Flight Instructors and Flight Leaders)
- Other (List):

3. MATÉRIEL FAILURE—POWER PLANT

- Cooling System
- Lubricating System
- Fuel System
- Engine Structure (Includes Jet Engines)
- Engine Control System
- Propeller and Propeller Accessories
- Supercharger (Reciprocating Engine only)
- Ignition System
- Engine Accessories
- Other:
- Undetermined

4. MATÉRIEL FAILURE—AIR FRAME

- Flight Control System
- Wings, Rotors, and Flaps
- Cowling and Fairing
- Fuselage
- Other:
- Undetermined

5. MATÉRIEL FAILURE—LANDING GEAR

- Main Landing Gear
- Nose Wheel or Tail Wheel
- Landing Gear Position Indicators
- Brakes
- Tires
- Other:
- Undetermined

6. MATÉRIEL FAILURE—EQUIPMENT AND ACCESSORIES

- Automatic Pilot
- Radio Equipment
- Electrical System
- Hydraulic System
- Oxygen or Pressurization System
- Safety Equipment
- Instruments
- Cockpit, Seat, Canopy, Fittings, Doors, Hatches
- Armament
- Other:

7. WEATHER

- Low Ceiling
- Smoke—Haze
- Rain—Fog
- Snow—Hail
- Icing Conditions
- Unfavorable Wind Conditions for Landing, Taxiing or Takeoff
- Turbulence in Flight
- Winds Aloft
- Thunderstorms
- Downdraft—Updraft
- Other:

8. LANDING AREA

- Wet
- Soft
- Snow
- Ice
- Rough
- Grassy
- Runway Too Short
- Other Hazard:

9. GROUND EQUIPMENT

- Airport Facilities
- Airway Facilities
- Approach Devices
- Let-Down Devices
- Other:

10. MISCELLANEOUS

- Bird in Flight Path
- Position Target in Flight Path
- Other:

XXX 11. UNDETERMINED

RESTRICTED (WHEN FILLED IN)

Section O - DESCRIPTION OF ACCIDENT

Tell in narrative form, in as much detail as necessary, everything that is known about the accident. Make certain that items checked on reverse side are justified by this narrative. If fire was involved in accident, explain in detail its origin and progress and steps taken to extinguish it.

This aircraft was mother ship for X-1 #3, Serial No. 46-064. While ground crew was preparing to jettison liquid oxygen from the X-1, it exploded and burned, resulting in destruction of the B-50.

RECOMMENDATIONS for action to prevent similar accidents:

See recommendations attached to Form 14 concerning X-1 #3, 46-064.

Section P—AUTHENTICATION (Each investigating board member must sign below)

1. [ ] Personnel Responsible for This Accident Have Been Offered Opportunity of Rebuttal [ ] No Rebuttal Rec'd [ ] Rebuttal Statement(s) Attached
2. Personnel Responsible Not Available Because of: [ ] Death; [ ] Critical Injury; [ ] Other (Explain)

Base Submitting Report EDWARDS AIR FORCE BASE	Member (Name and Grade) Bill A Walker WILLIAM A. WALKER, MAJ.	Medical Officer (Name and Grade) Howard C Knapp HOWARD C. KNAPP, COL.
President (Name and Grade) Walter L Moore WALTER L. MOORE, LT. COL.	Aircraft Accident Officer (Name and Grade) James A Bryant JAMES A. BRYANT, CAPT.	Recorder (Name and Grade) William R Coleman WILLIAM R. COLEMAN, CAPT.

RESTRICTED

ROUTING AND RECORD SHEET — AIR MATERIEL COMMAND

SECURITY INFORMATION

SUBJECT (Restricted) Report of Special Investigation of a Major Aircraft Accident Involving an X1-3, Serial No. 4-6064, Edwards Air Force Base, Calif. 9 Nov 51.

TO Director, Flight Safety Research FROM Chief, Investigation and Safety Engineering Division DATE 11 Dec 51 COMMENT NO. 1 Maj Pritchard/ea/2221

The Accident

1. On 9 November 1951, a B-50 aircraft with an X1-3 rocket aircraft secured in its modified bomb-bay, was parked on the east end of the ramp at Edwards Air Force Base, Calif. At 1604 PST a minor explosion was heard in the X1-3 by the pilot, who was in the cockpit, and standby personnel. The pilot of the X1-3 was in the process of removing the liquid oxygen from the tank by purging it with nitrogen gas. Immediately the X1-3 pilot made an exit from the aircraft as instantaneous flash flames engulfed both aircraft. Seven distinct explosions were heard subsequent to the initial explosion. The explosions and fire ensuing completely destroyed the X1-3 and mid-section of the B-50 aircraft.

Conclusions

2. It was concluded that:

a. As the X1-3 fuel is highly volatile, vapors escaping from source pressure lines could have been of sufficient density to create an explosive mixture.

b. Electrical and communication circuits within the X1-3, including the battery and radio transmitter, are a potential source to ignite escaping vapors from the X1-3.

c. From an unknown source the inflamible mixture of liquid oxygen and alcohol was ignited to create an explosion in the X1-3 aircraft. Subsequent explosions and fire destroyed both aircraft.

Recommendation

3. None

Action Taken

4. None

History of Flight

5. On 9 November 1951 the X1-3, Serial No. 4-6064, was secured in the B-50 aircraft No. 47-0068, fully loaded with liquid oxygen and alcohol. No hydrogen peroxide was used as the mission was scheduled as a "captive" flight. The X1-3 was to remain attached to the B-50 in flight while fuel system checks were being conducted. The take-off at 1051PST and climb of the B-50 was normal, with radio contact being maintained with the tower. When the B-50 reached 18,000 foot altitude, the X1-3 pilot began the planned flight rehearsal of flight procedures. As this was a captive flight, check of nitrogen source pressure system, oxygen jettison system test and pressurization as for

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RESTRICTED

ROUTING AND RECORD SHEET RESTRICTED AIR MATERIEL

Use this form for inter-office correspondence within headquarters. Number all comments consecutively. Use entire width of sheet, both sides.

SUBJECT (Restricted) Report of Special Investigation of a Major Aircraft Accident Involving an X1-3, Serial No. 4-6064, Edwards Air Force Base, Calif. 9 Nov 51

TO Director, Flight Safety Research

FROM Chief, Investigation and Safety Engineering Division

DATE 11 Dec 51

COMMENT NO. 1 cont

Maj Pritchard/ea/2221

the detonations and fire which engulfed both aircraft. The pilot of the X1-3 attempted to escape from the X1-3 after the initial explosion but was severely burned by the succeeding explosions and fire. The alertness of the standby fire crew personnel proved of inestimable value in suppressing the magnitude of the fire.

11. Upon examination of the wreckage, it was found that the entire surfaces of the X1-3, with the exception of the nose section, had been forcefully disintegrated as a result of the explosions. The bulkhead supporting the liquid oxygen tank consisting of thirty-seven (37) standard steel bolts was completely sheared from its housing. The alcohol tank was completely demolished. The explosion, in turn, had ripped all fuel lines, regulators, and instrument gauges from their normal positions. The frangible disk in the liquid oxygen tank had been blown from its normal position. The liquid oxygen tank regulator had likewise been ripped from its mounting. The entire electrical and communication circuit within the X1-3 was either torn from the aircraft or melted with the other metals in the common pool of moulded residue. Upon dismantling the forward portion of the X1-3, the nitrogen gas tube bundles revealed numerous ruptures. These ruptures indicated terrific force of impact from the adjacent liquid oxygen tank. The nitrogen gas regulator valve and pressure indicator was stuck at 41 psi. As the tank and fuel system disintegrated in the explosion, no known source of igniting could be determined. There is a strong probability that sufficient quantity of fuel leaked allowing a combustible mixture of alcohol to accumulate in the center section of the X1-3. This in turn could easily be ignited by an electrical spark or friction. No personnel were in the B-50 aircraft during proposed removal of liquid oxygen from the X1-3.

12. The aircraft flight report, Air Force Form I, list the pilot of the X1-3 as a Bell Aircraft Company civilian test pilot. His competence was not questioned. The aircraft inspection and maintenance record, Part II, Air Force Form I, indicated the total flight time of the X1-3 as 0:9:40. The turbine pump 0:44:16.

Substantiating Data on File in Flight Safety Research

13. The following informational data is retained in file:

a. Personnel investigating the accident.

b. Schematic perspective drawing of the X1-3 aircraft.

c. Schematic of the power plant.

d. Drawing of the rocket motor XLR-11-RM-5.

e. Statement by the X1-3 pilot - Joseph A. Cannon.

f. Statement by the X1-3 project officer - Quinton C. Harvey, Jr.

RESTRICTED

ROUTING AND RECORD SHEET — AIR MATERIEL COMMAND

Use this form for inter-office correspondence within headquarters. Number all comments consecutively. Use entire width of sheet, both sides.

Use authorized office symbols to designate addressor and addressee. Note warning signal at lower left of form. Remaining space is sufficient only for proper spacing of typewritten signature.

Place initials of dictator and typist, telephone number and location to right of signature. Separate comments by horizontal lines across page.

SUBJECT (Restricted) Report of Special Investigation of a Major Aircraft Accident Involving an X1-1, Serial No. 4-6064, Edwards Air Force Base, Calif, 9 Nov 51.

TO Director, Flight Safety Research | FROM Chief, Investigation and Safety Engineering Division | DATE 11 Dec 51 | COMMENT NO. 1 cont
Maj Pritchard/ea/2221

g. Statement by Bell Aircraft Inspector – Richard R. Davis.

h Statement by Bell Aircraft project foreman – William H. Means.

i. Statement by Bell Aircraft technician – E. A. Cardy.

j. Statement by Project Engineer, Rocket Propellant Serving Unit – 2nd Lt. George W. Mechert.

k. Statement by Ass't. Foreman, Rocket Propellant Unit – Wendell F. Stuart.

l. Statement by Bell Aircraft technician – Walter H. Myers.

m. Statement by Bell Aircraft technician – Russel W. Ringle.

n. Statement by Bell Aircraft technician – Martin A. Snyder.

o. AF Form 14, submitted by Edwards AFB.

Joseph F. Carroll
JOSEPH F. CARROLL
Colonel, USAF
Chief, Investigation & Safety
Engineering Division

Coordination:

Lt Col Maracchini ____

~~Lt Col Ahern~~ ____

Col Carroll ____

RESTRICTED

(CONTINUE ON OTHER SIDE)

AMC Form No. 8 (Rev 29 Jul 47)

This form replaces AMC Form No. 10-2, which will be used until stocks on hand are exhausted.

REMARKS MADE BY JOSEPH A. CANNON AT HOSPITAL ON BASE TO Q. C. HARVEY AT APPROXIMATELY 1800 ON EVENING AFTER THE ACCIDENT

12 November 1951

Joe remarked that he was pressurizing the lox dome and had stopped when the indicator on the lox dome gage had reached the red line on the indicator. The lox tank pressure was rising normally during this lox dome loading. When the lox dome indicator reached the red line on the lox dome gage the lox tank pressure was still rising slowly and at 42 psi the initial muffled explosion occurred. Joe immediately began to leave the cockpit and he feels that secondary explosion knocked him to the pavement on his hands and knees. He is not sure what the substance in which he fell consisted. He felt that he was surrounded by molten appearing metal parts which glowed somewhat like a magnesium fire. He attempted to get up but was unable to do so because the following explosions seemed to hold him to the ground. Bill Means and Walt Myers, who had been standing adjacent to the cockpit at this time of the initial explosion, returned from the position near the trucks, possibly 40 feet from the airplane, when they saw Joe attempting to crawl away from the fire. They carried Joe to the pickup truck in which they immediately drove him to the Base Hospital.

S T A T E M E N T

13 November 1951

I, E. A. Cardy, make the following statement:

The B-50 and the X-1 #3 were towed to the tie down ramp, spotted in position and preparations made for jettisoning lox. Mr. Means, Mr. Davis, and myself were standing beside the cockpit of the X-1 #3 talking to the test pilot, Mr. J. Cannon.

Mr. Cannon started to pressurize the lox tanks when the explosion took place.

The initial explosion occurred near the top center section just behind the cockpit. The first indication of trouble was a white phosphorous smoke and immediately thereafter, there occurred a series of explosions.

E. A. Cardy

E. A. Cardy

S T A T E M E N T

12 November 1951

I, Richard R. Davis, Bell Inspector, make the following statement:

I was standing at the left hand side of the X-1 #3 opposite the pilot's cabin. There was an amount of liquid oxygen leaking through the lox fill check valve. I would estimate this leakage as approximately one quart per minute. The lox topoff fill adapter was installed in the lox fill opening. I observed an explosion and two streams of lox emerged from the aft section of the lox tank through the fuselage. Immediately after a wall of flame shot up into the B-50 bomb bay. At this point, I turned and ran forward a distance I would estimate as thirty feet. I turned around and observed the X-1 cockpit enveloped in flames. I ran a short distance further, turned around, and saw Joe Cannon emerge through the flames, at which point I went back toward the airplane and helped Myers and Means put Cannon in the pick-up truck. Means immediately drove Cannon to the hospital with Myers and myself on the running board. There were several explosions during this period.

Richard R. Davis

RICHARD R. DAVIS
Bell Inspector

C-E-R-T-I-F-I-C-A-T-I-O-N

TO WHOM IT MAY CONCERN

I, Mr. Herbert N. Hanson, Firefighter, GPC-6, Edwards AFB Fire Department, Edwards, California, do hereby make the following statement:

At approximately 1545 hour, 9 November 1951, while working as a crew member on fire truck #155, we were following the X-1 and the mother ship, B-50, down to the east end of the ramp. Nearing the end of the ramp, we stopped and waited for the Cleetrac to move the B-50 and X1 into position at the end of ramp facing west. After it was in place the crew chief told us to move into our location which was in front of the B-50 nose. With the help of another fireman, I pulled my side line to the left side of the X-1, and was standing about 4 feet from Cockpit door with my right hand on shut-off valve, ready to wash down. There was a man having a short conversation with fellow in cock-pit, as he turned to walk away a minor explosion took place in the fuselage of the X-1, flashing fire and yellow and white smoke appeared from seams and back of cockpit. I opened my water trying to protect man in cockpit from getting burned when second explosion of greater force took place, throwing me to ground and man in cockpit out. As I was making my way back to truck, more explosions took place, I stood on left side of truck behind iron ladder to protect myself from flying pieces about the same time ship stopped exploding, the other fire trucks arrived and we rolled back in and put out the fire.

After fire was extinguished I was sent to the hospital for treatment. I was kept in the hospital Friday night and released to go home at 8:40 A.M., Saturday morning.

Herbert N. Hanson
Fireman
Herbert N. Hanson

XE-1 ...

S T A T E M E N T

13 November 1951

I, Quinton C. Harvey, Jr., make the following statement:

The B-50 with the X-1 #3 stowed in the bomb bay was towed from the loading area at the west end of the ramp to the jettison area at the east end of the ramp with Joe on board making final check of the source, the first stage, and the peroxide pressurization systems. The airplane was turned so that the aft end of the B-50 and the aft end of the X-1 #3 were pointed toward the lake in a normal jettison manner. Martin Snyder, Russell Ringle and myself followed the airplane down in the radio carry-all. When the B-50 was turned in the jettison position, I noticed that the fire truck had stopped at a position which I considered to be too far away for safety purposes. I drove to the fire truck and instructed the truck captain to bring the fire truck within 30 feet from the nose of the B-50 and to lay the fire hoses down to either side of the X-1, so that during lox jettison it would be possible to wash the area clear under the aft section of the B-50. This was done immediately and I parked the radio carryall approximately 30 yards away from the intersection of the B-50 wing and the B-50 fuselage on the line bisecting the intersection of the wing and fuselage. I got out of the truck and started walking directly toward the X-1 cockpit. At a point approximately 15 feet from the cockpit I stopped as Joe gave me a signal that he was ready to start jettison procedure. I checked the area around the aft end of the X-1 and the B-50 and called the all-clear to Joe. He and Walt Myers were discussing the operation. They verified the all-clear and evidently had begun their lox tank pressurization procedure. At this time, I noticed Bill Means run around from the left hand side of the B-50 to the nose of the B-50 and to the X-1 cockpit. He stuck his head in the cockpit and was talking to Joe when the initial muffled explosion occurred. My glance was directed toward the area where it appeared that this initial explosion occurred. My conception of this initial explosion was that it was of a confined nature accompanied by a hissing of escaping gas followed immediately by lox vapor completely filling the forward bomb bay area. A fraction of a second later I noticed a yellow flame beginning to rise up in the X-1 center section. The interval of time from the initial explosion until the flame appeared, was of such a duration that my thoughts indicated that probably something had ruptured and that no further happenings would occur other than the rupture. When the flame appeared I turned and ran past the truck away from the airplane at approximately a 45° angle. As I turned and ran, there was a loud and violent explosion which showered glowing metal parts somewhat like a magnesium fire all around me. At approximately 50 to 60 yards from the airplane while running, and on the side away from the truck, I stopped and turned to see a person with a burned jacket getting in the pick up truck that was parked near the radio carryall. The truck drove off immediately and disappeared. I returned to the fire at this time. The fire equipment was arriving in force and I started counting people to determine whether or not everyone had been successful in leaving the area. There were many subsequent explosions. How many I am not sure.

Quinton C. Harvey Jr.

QUINTON C. HARVEY, JR.

I hereby certify that the liquid nitrogen in the Model L-500 tank at Edwards Air Force Base, Edwards, California was analyzed at 1030, 15 November 1951.

The results of the analysis are 99.90% in purity. At the time of the test, the purity of the liquid oxygen was analyzed and found to be 99.7% pure. After the above tests were conducted the apparatus used in analyzing the oxygen and nitrogen was checked against atmospheric air and the reading obtained showed 21% oxygen in the atmospheric air.

E. J. Kelly

EDWIN J. KELLY
Superintendent,
Linde Air Products
Division of Carbide and Carbon, Corp

1405 North Mission Road
Los Angeles, California

S T A T E M E N T

13 November 1951

I, William H. Means, Project Foreman, make the following statement:

After captive flight, with X-1 #3 aboard, the X-1 crew ran a series of tests to determine loss of source pressure. Results of the above tests indicated no malfunctioning of any valves or regulators and that the source system was normal.

At approximately 3:35 P.M. the B-50 was moved to the east end of the ramp to jettison liquid oxygen. Other fuels aboard the X-1 #3 was water alcohol mix. There was no hydrogen peroxide aboard.

After the B-50-6006 was positioned, the B-50 crew left the airplane. The following personnel were around the X-1 #3: Richard Davis, Bell Inspector, Walter Myers, Bell Technician, Joseph A. Cannon, Bell Test Pilot (in cockpit) and the writer.

The all-clear was given to Mr. Cannon to pressurize the lox tank preparatory to jettisoning the liquid oxygen. I walked to the left side of the X-1, and immediately noticed lox spillage, then walked forward to the cabin and tried to get Mr. Cannon's attention to spill the lox dome pressure and to vent the tank, as the lox fill adapter was in place. The lox filler cap was not on. I was unable to get Cannon's attention, so I rushed to the other side of the X-1 to inform Cannon of my findings, and as I was about to put my head inside the cockpit the first muffled explosion occurred. The writer immediately sought safety, by running a safe distance from the scene.

William H. Means

WILLIAM H. MEANS
Project Foreman
Bell Aircraft Corp.

S T A T E M E N T

8 November 1951

I, George W. Meckert, 2nd Lt., USAF, AO-2233199, Project Engineer assigned to Rocket Propellant Servicing Unit, make the following statement:

Because of the nature of the operation being performed, it was felt necessary to have qualified personnel on hand to monitor the jettisoning of the liquid oxygen. Mr. Stuart and myself accompanied the aircraft in order to provide such monitoring.

The aircraft was aimed upwind in order that the oxygen would not blow over the B-50. A fire truck was on hand, but initially was parked about 150 yards away from the aircraft. Mr. Stuart requested that the fire truck be brought closer to the aircraft and it was moved within 75 feet. Hoses were unwraveled and brought to either side of the B-50 and a pressure check for water was made. All airmen were out of the B-50, but many people were standing around the wings. Mr. Stuart and myself were about 20 feet away from the cockpit of the X-1 at a 45° angle to the right side. I heard the pilot of the X-1 say that he was going to close the vent valve and he hoped it would work. Mr. Means was standing right next to the cockpit. Right after the pilot said he would close the valve, I heard a pop and a hiss and this was followed by a large amount of white smoke emerging from the right side of the X-1. I grabbed Mr. Stuart's arm and we started running away from the aircraft. I saw Mr. Means start running about the same time. I stopped about 150 feet away and turned around and just then a loud explosion occurred showing yellow flame and black smoke. I started running again and stopped, this time about 500 feet away. While I was running, numerous smaller explosions occurred. I stopped the second time and saw the B-50 collapsing to the ground. Firemen were attempting to put the fire out.

George W. Meckert

GEORGE W. MECKERT
2nd Lt., USAF
Rocket Branch

STATEMENT

13 November 1951

I, Walter H. Myers, make the following statement:

I was at the cockpit of the X-1 #3 discussing the jettison procedure with our Mr. J. Cannon. He brought the lox tank pressure up to psig very slowly. I told Joe that I would check and make sure that everything was ready and personnel were clear, then we could go ahead with our jettison procedure.

At this time there was a dull explosion which seemed to be low, just aft of the cockpit and forward of the lox tank. I looked outside and aft of the cockpit and heard another sharp explosion. This was accompanied by a sheet of flame which knocked me down, or I stumbled. I ran from the ship and approximately 50 feet from the ship I turned and looked back. The ship was burning furiously accompanied by a series of sharp explosions. Joe was on the ground crawling away from the ship. Mr. Means and myself started the pick up truck. We got Joe into it and with Mr. Davis we proceeded to the Base Hospital.

Source Pressure - 3000
Time Approximately - 1605
Lox Tank Dome - Red Lined
First Stage Regulator - 415 to 425 psig
Lox Tank Pressure - 40 to 42 psig
First Explosion - Aft of fire wall, pilots' seat
Sound - Dull, no fire
Second Explosion - Very sharp, accompanied by flame. This flame appeared forward of the main wheel well and low. It seemed that flame also shot through the fire wall at the pilot's seat; each side of him, at seat level.

Walter H. Myers
WALTER H. MYERS

S T A T E M E N T 15 November 1951

I, Robert F. Olmstead, S/Sgt., AF 12111835, Assistant Crew Chief, make the following statement:

I was riding on the left wing of the B-50 down to the East end of the ramp. After we parked it, I walked down the fuselage out the aft section and walked on the right hand side of the aircraft. The first thing I heard sounded like a pump running. Then it was shut down once for a few seconds and then started up again. Then I saw yellowish white sparks coming from the top of the X-1. I turned around and ran away from it.

Robert F. Olmstead
ROBERT F. OLMSTEAD

S T A T E M E N T

13 November 1951

I, Russell W. Ringle, make the following statement:

On Friday, (9 November 1951) I pulled the C-22 generator to the West Hangar and left the generator and tug in the hangar, then rode to the east runway area in the radio carryall with Q. C. Harvey and Martin Snyder. We followed the B-50 to the area and contacted the fire truck as to their location during the lox jettison. I left the radio truck and went over to the pickup truck to get some of my tools and wrenches. I then started to walk to the X-1 #3 and the B-50. While I was in the vicinity and still about 150 feet from the X-1 #3 I heard the initial explosion. It was a dull thud, or sounded as though it were a contained explosion. The first fire that I noticed came from the right hand center section access door. The first explosion was followed in a few seconds by a larger and louder explosion. I started to run away from the X-1 #3 and the B-50, running toward the north side of the runway. I stopped there and turned back. I approached the B-50 from the northwest and the right hand side of the X-1 and the B-50. I noticed the bluish smoke and white hot sparks. This was similar to the smoke from the X-1 #D explosion. Everything in the center section of the B-50 was on fire by then and the nose section started to cave in. Additional fire equipment from the Base arrived and the fire was under control and out in what I would judge to be about 8 to 10 minutes from the first explosion.

RUSSELL W. RINGLE

Russell W. Ringle

S T A T E M E N T

15 November 1951

I, Richard A. Scheer, Pfc., AF 19430549, Mechanic, make the following statement:

I was on the top of the right wing of the B-50. I walked across the top of the wing, then across the top of the fuselage, down through the aft section and out of the fuselage. I walked under the wing to the front of the B-50 along the right side. I stood there for a minute or so and then saw yellowish white sparks and heard a dull contained explosion. Then I saw a bright blue flash on top of the X-1 by the shackle in the same spot as the sparks. Then I saw what I thought was liquid oxygen coming out of the airplane spreading across the ground. Then I saw the Bell men scattering and I did the same. As I was running away from the scene and was about 30 feet away, I turned and saw the second explosion. I stopped and turned around by the Flight D Engineering Shack and saw the last explosion that blew up everything; and the B-50 just seemed to squat down onto the X-1.

RICHARD A. SCHEER

S T A T E M E N T

November 12, 1951

I, Martin A. Snyder, make the following statement:

I was standing approximately 20 yards away from the B-50 on a line approximately 45° to the right of the airplane nose. I was not paying particular attention to the activities around the airplane since I was engaged in setting up the loudspeaker system in the radio carryall. I had thought that it would be useful during the jettison operation.

My first notice of the explosion was audio, in that I heard a dull thud. I looked toward the airplane and saw it burst into flame. I started running away from the scene but did glance over my shoulder a few times. Each time I saw another explosion. The explosions and accompanying flames were of a different nature each time. The early flames were white or light grey and the later flames, a fiery orange. I concluded at that moment that the X-1 fuel and liquid oxygen had ignited the B-50 fuel.

After the explosions had ceased and the fire-fighting equipment was in action, I moved in closer to the scene of action. At this time I was about 100 yards from the airplane. My immediate concern was for Joe Cannon, who I had last seen in the X-1 cockpit. I did not notice any other details of the action after this time since I joined other Bell personnel in trying to determine the whereabouts of Joe Cannon.

I do not think that my observations can be of any help since my thoughts were of self-preservation and hence I did not note any details. I cannot say how many explosions took place, how long the explosions persisted, nor make a statement concerning the location of the center of the first explosion.

Martin A. Snyder

MARTIN A. SNYDER

S T A T E M E N T

13 November 1951

I, Wendell F. Stuart, Civilian, Assistant Foreman, Rocket Propellant Unit, Rocket Branch, make the following statement:

Since the operation of jettisoning rocket propellants involve hazards and possible decontamination, Lt. Meckert and myself went along to witness this operation and to see that base policies and safety regulations were carried out. The B-50 and X-1 aircraft were taken to the extreme East end of the ramp and nose headed upwind to blow all vapors away from the aircraft. It was advised by myself that the Fire Department come within their range of the aircraft and unreel their hoses and see if proper operation of their equipment was in order. After this, Mr. Canon said, "Are we ready to start operations?" Everybody agreed, although at the same moment, Lt. Meckert and myself both agreed we thought there were too many personnel in the area for the operation. In an attempt to talk to Mr. Q. C. Harvey about the congestion of the area, he had gone around the nose of the B-50 to the left side of the X-1, apparently to witness a Liquid Oxygen leak. At the same moment, I witnessed a big cloud of white vapor in the bombay of the B-50 and at the same time, an explosion. Lt. Meckert grabbed my arm and hollered, "Let's go!" I ran approximately 400 feet and stopped, looked around and saw another large explosion and the collapse of the B-50. Approximately three or four minutes lapsed and I left the area and went directly to the Branch Office.

WENDELL F. STUART

Wendell F. Stuart

C-E-R-T-I-F-I-C-A-T-I-O-N

TO WHOM IT MAY CONCERN

I, Mr. C.P. Watson, Firefighter Crew Chief CFC-8, EAFB Fire Department Edwards, California, do hereby make the following statement.

At approximately 1545, hours, 9 November 1951, Fire Truck #155 with Crew of one driver, three Firefighters, and one Crew Chief was dispatched to standby on Bell X1 & B-50 located near lox pit.

Upon arrival at lox pit was immediately instructed by Bell X-1 Crew Chief to follow B-50 and Bell X-1 to east end of ramp for the purpose of unloading lox. B-50 with Bell-X-1 attached being toured by Cletrac.

Upon arrival at east end of ramp the same Crew Chief gave me instructions on our part of the procedure in unloading lox, which were-have water hose on each side of Bell-X-1 to wash down; Water hose was manned by two men on north side of ship and one man on the south side of ship and water line was charged immediately. My position at that time was approx. 8' from the nose of the Bell X-1-some person walked passed me and said something to some one in the Bell-X-1 and turned, walking away when the first explosion occured, second explosion flames shot out from both sides of the ship, both 1½ water lines was opened and the second visible fire explosion occured immediately, much bigger than the first one. I ordered the firemen to back out of their positions. At that time they were between the landing gear of the B-50 and the Bell X-1. The fire truck began to back away from both ships due to the danger of the men and the equipment and a series of explosions. One man was seen to tumble out of the flames on the north side of the Bell-X-1, clothing burning. One of the firemen standing with hose line on north side of ship was blown down on the second explosion (fireman was injured). The force of the explosion seem to be greater from the north side. The firemen, Bell-X-1 Crew and everyone around the ship left there as fast as they could. We were approx. 100' away when a big explosion occured, throwing small pieces of metal approx. 300' in all directions. Other fire equipment arrived by then with CO_2 & water. The fire was controlled and was extinguished.

Captain C.P. WATSON

C.P. Watson

The Aircraft Accident Investigating Board, appointed by Special Order #17, Headquarters, Edwards Air Force Base, Edwards, California, dated 24 January 1951, convened at 1400 on 20 November 1951 in the Conference Room, Edwards Air Force Base, Edwards, California.

Members present were:

Lt. Col. Walter L. Moore, Jr.
Lt. Col. Frank K. Everest
Major David M. Sharp
Major William A. Walker
Capt. James A. Bryant
Capt. William R. Coleman

Members absent were:

Col. Fred J. Ascani
Col. Howard C. Knapp

Presiding Officer:

Lt. Col. Walter L. Moore, Jr.

The meeting was called to order by the Presiding Officer and a brief description of the accident and investigation was given by the Accident Investigating Officer. The Presiding Officer and an Investigating Officer held the following discussion:

Q. Please indicate what we have done so far in the investigation of this accident.

A. We recovered a batch of various parts and fragments of various parts. After we disassembled the nose section and tail section of the B-50, we removed the X-1. We took what we could of the X-1 up to the hangar and conducted the rest of our investigation there. About every other day we had a board meeting of everyone concerned and discussed many ideas and theories. The final meeting was held yesterday.

Q. Indicate the damage to the engines and the parts of the B-50 that are worthwhile.

A. Four engines are usable and so are both outer wing panels. The tail, from the rear pressurized bulkhead aft, is serviceable. The center of heat was just around the center section of the X-1.

The Board Members held an open discussion on the known facts revealed by the investigation and considered various theories as to the cause of the accident. Then, three representatives from Bell Aircraft Corp. were brought in for questioning. They were: Mr. William Smith, Chief, Rocket Section; Quinton C. Harvey, Senior Flight Test Engineer; and Mark Haney, Field Test Director, Project Engineer on the X-1 #3.

Mr. Harvey gave a resume of the morning mission:

In this week preceding the accident, we had planned this captive flight which we conducted Friday morning. The purpose of this flight was to determine the jettison flow pattern from the airplane. The captive flight was normal. We were attempting to go through our procedures and made a normal take-off with the X-1 aboard the B-50. The X-1 had alcohol and water, liquid oxygen and distilled water in the peroxide system. We jettisoned our water and continued our climb. Our schedule called for top-off procedure which we did in the normal manner. Everything was satisfactory when we reached 18,000 feet and we lowered the pilot into the X-1. Immediately after he was in the airplane, he called the pressure as 2600 psi which was a little lower than we like to have it. One reason for this flight was to determine if the source pressure was sufficient. We lowered the door to the pilot and for some reason, he found it impossible to lock in place. There was a period of about five minutes that he was trying to latch the door. He called and said the source pressure had dropped to 200 psi and he would like to get out. It was impossible to jettison the fuel and liquid oxygen. We started to let down. During the letdown, I went through the lox top-off system again. On the way down, Joe (Joseph Cannon, pilot of the X-1) told me he had tripped the peroxide and fuel jettison switches with his elbow but he felt he turned them off immediately. The source pressure had dropped from 2600 to 200 psi. We felt that this 2600 psi was low when he got into the airplane, however 55 minutes had passed by from the time we left the pit till this time. We realised that we had a slight leak of 100 psi per hour in the aft nitrogen tube bundle which we felt wasn't high enough to be concerned with. We came back down to the ground and we proceeded on a program to determine what caused the depletion of the source system. We landed the airplane stowed with fuel and liquid oxygen aboard. We loaded this source system by stages and checked the source pressure by itself and there was nothing evident to show the large leak we had experienced in flight. We started loading at two thirty or three o'clock and the system was checked until the time we pushed the airplane down to the end of the ramp. Then we loaded the peroxide system and checked each of the three systems. We found no leaks and decided to make another captive flight on the next working day. We scheduled this flight for Tuesday since Monday was a holiday. We contacted the people here for storage in the hangar, made plans to jettison liquid oxygen and leave fuel on board. At about four o'clock, the airplane was towed down to the normal jettisoning area. We had a fire truck standing by. The whole jettisoning procedure was normal except that we had the X-1 still aboard the B-50. Joe Cannon was riding the X-1 on the way down. When we got down there, we had the fire captain move their trucks in closer and put the fire hoses out. We cleared the area and got the "OK" sign from Joe in the cockpit and then he started his procedure.

Q. Let us discuss a minute, this idea of jettisoning with the X-1 attached to the mother airplane. Had we done this before?

A. We have done this before. I talked to Rocket Branch about this and they felt that it was all right. Douglas Co. seemed to think it was all right as long as we had the fire trucks on hand. The advantage gained here is that the airplane would already be loaded for the captive flight which was to occur first thing Tuesday morning.

Q. What is the difference in weight, loaded and unloaded?

A. I guess about 8,000 pounds.

Q. With the X-1 attached to the mother ship, do you need source pressure to jettison liquid oxygen?

A. Yes sir.

Q. You had not used the B-50 to jettison liquid oxygen off the X-1, had you?

A. No sir, it had not been done.

Q. Did you ever arrive at a conclusion why the source pressure dropped to 2600?

A. We found that there was a small leak in the aft tube bundles. It measured about one cubic foot.

Q. Do you know where it was?

A. No, we figured it to be just in the tube bundles. There are six sections of coils in the aft tube bundles.

Q. Then this drop from 2600 to 200 psi occurred in a five minute period of time after the pilot inadvertently tripped the fuel and peroxide jettison switches?

A. Yes, combined with the leak and the fifty-five minutes of time that elapsed between loading until altitude was reached.

Q. Now, getting back to the ground operation itself, what happened just before the explosion?

A. The jettisoning area was cleared and the B-50 personnel were removed from the B-50. Fire hoses were layed out and firemen were standing by. I was about twelve feet from the cockpit. Joe looked at me and said he was ready to start the procedure. I called the "all clear" and he started the procedure. Almost immediately after he started his procedure, there was the initial confined explosion which drew my attention to the center section of the X-1.

Q. Are you familiar with the procedure he was going through at this time?

A. There was 3,000 psi in the source system. He had previously loaded up at the pit and had the peroxide tank serviced about 415 psi. He would have the battery switch and invertor on. Then, reaching up on the left side of the cockpit to the dome loading valve, he would dome load the liquid oxygen tank regulator to approximately 60 psi. He would do this slowly. While operating this dome load valve, he would watch this dome gage and also watch the tank pressure in the liquid oxygen system start to rise. The regulator stopped at the red line. He was watching it rise and at 42 psi, the initial explosion occurred. The explosion itself sounded as though something had ruptured, nothing more. It was a "thump" inside the airplane. There was considerable smoke vapor which began to rise from the center section. I wasn't too concerned till I saw flame starting in the center section. When flame started, I ran from the area. I got about twenty feet away from the airplane when there was quite a violent explosion which showered metal parts all around. I could hear something that sounded like shrapnel. A person with a burned jacket was getting into a pick up truck and they drove off and disappeared. By this time, more fire equipment was arriving. They proceeded to put out the fire. We were not sure at that time if Joe had been successful in getting out of the cockpit.

Q. Do you think that vapor you saw was liquid oxygen.

A. It appeared that way to me.

Q. Are any of you familiar about the liquid oxygen filler cap not being on?

A. After the plane returned to the ground, they disconnected the liquid oxygen top-off hose from the X-1. We left the liquid oxygen fill adapter installed.

Q. Do you think this could have had something to do with the initial explosion?

A. No, it would not because there is a check valve in there that prevents liquid oxygen from coming out of that fill adapter. There was an opening around the liquid oxygen fill adapter so that any liquid oxygen which could have leaked, (as was reported by one of the witnesses), would flow down between the liquid oxygen tank and the fuselage skin. It would fill that area with oxygen gas.

Q. Do you have any idea of the fuel which caused this explosion?

A. It may have been the hydraulic brake line or the packing material we had in there.

Q. Do you think that the filler cap not being on and oxygen being in that area would have anything to do with it?

A. I would say no. If we are going to look for the sources of vapor from the B-50 or alcohol vapors from the fuel tank of the X-1, I would say it could be possible.

Q. How about a spark from a radio?

A. There again, we would have to have the fuel vapors collected from somewhere. When they returned to the ground, they discovered water alcohol in the thrust chamber in the rocket engine that dripped, and in jettisoning, got an amount of water alcohol coming out from the thrust chamber. It could have run up along the bottom of the fuselage. However, everyone assures me they feel this was not possible. They noticed that the fuel had run about two feet to a fuselage bend and then dripped down there and did not continue to run forward.

Q. In the fuel jettisoning that occurred inadvertently, did that all go overboard?

A. Theoretically, it should have. It should have gone through the jettison tube out the back. It is difficult to see how any amount of fuel could have gotten up forward. Vapors could have worked their way forward but not to the extent, I don't believe, where they could have caused the explosion.

Q. Getting back to the tube coils, what was found.

A. We don't know how many of the tube coils failed at that time, nor do I know what it would sound like. The explosion did not sound as an explosion should sound.

Q. All that was necessary was fuel, oxygen, and a spark.

A. We felt that the leak being 100 psi per hour was not sufficient to cause us any concern. We also felt that if the tube bundle were to fail, it would have failed on fueling or at a tank pressurization.

At this point, photographs depicting the nitrogen source pressure coil bundles were discussed and the Bell representatives described the position and function of these coils. It was then concluded that these coils could not supply fuel to cause such an explosion.

Q. How about fire or vapors?

A. Even though we had a little fire, where would the fire come from to support this fuel explosion? There are no fuel lines going out. All fuel lines are in the aft pressure regulator in the aft section, all gas lines run toward the back.

Q. Was there any indication of fuel in the bombay?

A. One time when he was in the cockpit he claimed he smelled JP3.

Q. What systems or tanks in the X-1 were under pressure?

A. The fuel tank was not supposed to be under pressure. Someone had asked Joe to vent the tank. There is confirmative evidence that he knows the tank was vented.

Q. The fore and aft nitrogen tubes were pressurized. Maybe the fuel system was pressurized and the liquid oxygen tank and the peroxide tanks were not.

A. The peroxide tanks read "Zero". They remained at the last reading.

Q. Can you ascertain that one of the larger explosions occurred in the X-1?

A. The most severe fire damage is done on the top of the fuselage. At some time or other, there was an explosion in the aft tube bundle. There was an explosion in the liquid oxygen tank area. Then, there was also whatever scattered these tube coil fragments over the area. We know there was an explosion in the liquid oxygen tank.

Q. What in the liquid oxygen tank would have exploded?

A. Some feel that there might have been contamination in that liquid oxygen tank. The other thing is that one of the coils in the forward tube bundle failed. It is also my belief that a pressure wave of sufficient magnitude to cause these explosions could have been present. Also, two tubes off the bottom of the liquid oxygen tank were blown loose. The liquid oxygen tank itself was moved forward about one inch.

In the nitrogen system aboard the B-50, we found almost a double handful of impurity that appeared to be rust. There is no filter into the liquid oxygen system. We took some of the rust out of the top-off system of the B-50, tested it, and it was found to be neither explosive nor inflammable.

Q. Did the two liquid oxygen top-off tanks blow?

A. No sir.

Q. Was there any liquid in them at the time of the explosion?

A. I think they were empty.

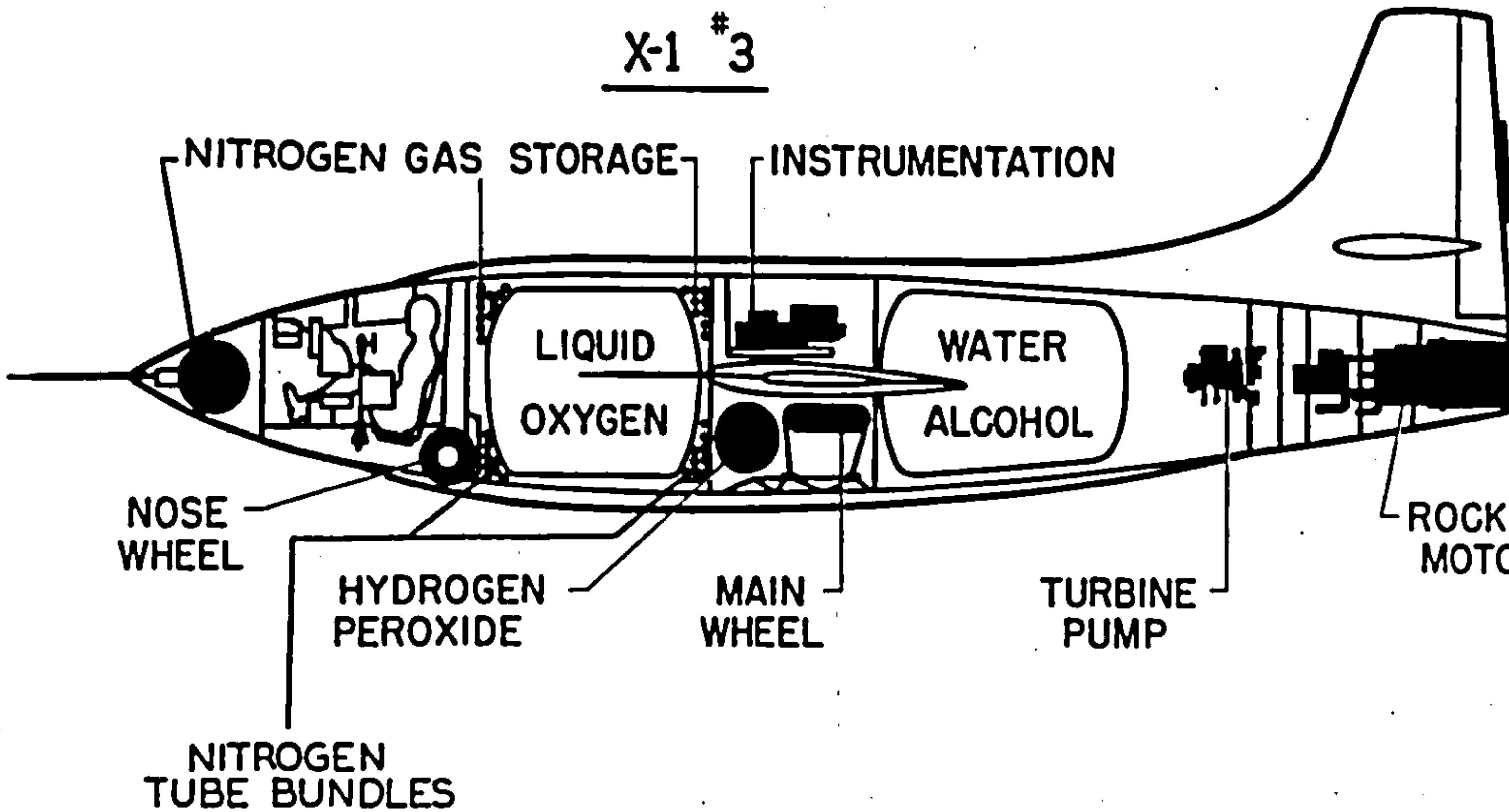
Q. In your opinion, can the possibility that some substance unknown to us was introduced into the liquid oxygen, reacting in an explosion, be ruled out completely?

A. I don't think that it can be ruled out completely. That possibility always exists.

The meeting adjourned at 1640 and was to reconvene at 0900 the following day, 21 November 1951, at which time the Board would discuss their findings and if possible, make some recommendations to prevent the recurrence of this type of accident.

William R. Coleman
WILLIAM R. COLEMAN
Captain, USAF
Recorder

X-1 #3



NITROGEN GAS STORAGE
INSTRUMENTATION
LIQUID OXYGEN
WATER ALCOHOL
NOSE WHEEL
HYDROGEN PEROXIDE
MAIN WHEEL
TURBINE PUMP
ROCKET MOTOR
NITROGEN TUBE BUNDLES

~~07/25/1956~~

&

~~05/09/1952~~

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~~03/25/1956~~

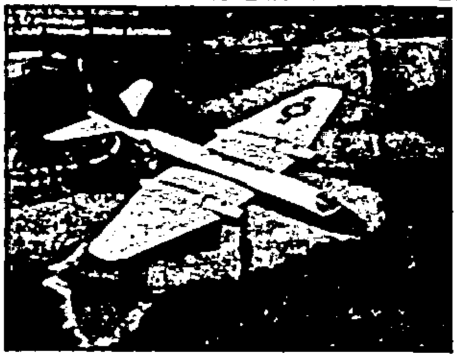
12/21/1951

B-57 Canberra

USAF Museum
Archives Gallery
1950s US Bombers

◄ Boeing B-56A
► Martin B-57A

English Electric "Canberra" B-57 Prototype



After the Korean Conflict began in June 1950, the USAF looked for a jet medium bomber to replace the aging Douglas B-26 "Invader" conducting night interdiction missions.

That same year, in September, the USAF issued a requirement for a jet bomber capable of cruising at 400 knots at 40,000. Additionally, because of the urgent need for the bomber, only existing prototype and production aircraft would be considered. Five aircraft were evaluated: the North American B-45 "Tornado", North American AJ-1 "Savage", Martin XB-51, Avro Canada CF-100 and the English Electric Canberra.

The B-45 was in service at the time of the evaluation, but was ultimately rejected because of poor maneuverability at low level. The AJ-1 was in service also (with the US Navy), but was rejected because it was too slow and lacked defensive armament. The CF-100 prototype was too small to carry the required bomb load and was eliminated from the competition.

The Martin XB-51 was a strong contender; it had a maximum speed of nearly 650 miles per hour and was highly maneuverable because of its small swept back wings. However, it lacked sufficient combat radius, endurance and bomb capacity.

The English Electric Canberra, initially designed in 1945, emerged as the clear favorite in the competition. The USAF arranged a loan of an RAF Canberra B Mk 2 (WD940) and the aircraft became the first jet aircraft to fly nonstop across the Atlantic Ocean without refueling. The flight began in Aldergrove, Northern Ireland on 21 February 1951 and terminated in Gander, Newfoundland. The flight was accomplished by a regular three man RAF Canberra crew and covered approximately 1,800 nautical miles in less than 5 hours.

The fly-off competition was held on 26 February and by early March, the Canberra was selected as the winner. Because English Electric wasn't able to supply aircraft to both the RAF and USAF quickly enough, Martin was selected as the prime contractor for construction of the aircraft under licensing agreements.

An initial contract for 250 aircraft to be built as B-57A was signed in late March and included the purchase of two RAF Canberra B Mk 2 aircraft. The second Canberra (WD940) was lost after it broke up during a flight test on 21 December 1951. The USAF flight test crew overstressed the wing during a test which resulted in the left outboard wing section breaking off.

Despite the crash, production plans for the B-57A proceeded and the first aircraft was rolled out of the Martin plant on 20 July 1953. The B-57A was very similar to the Canberra B Mk 2. The most significant changes were the addition of more powerful J65 jet engines and the

Crew: Four - Pilot, Copilot, Offensive Systems Operator (OSO) and Defensive Systems Operator (DSO)

PERFORMANCE
Maximum speed: 1,390 mph.
Cruising speed: 647 mph.
Range: 6,100 miles
Service Ceiling: 60,000 ft.

Rockwell International B-1A Photo Gallery

- In flight
- In flight
- In Flight Refueling - B-1A S/N 74-0159 refueled by Boeing KC-135A S/N 62-3527
- In flight - front view
- Just before landing

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USAF Museum Info — Driving Directions

12/21/51

The fly-off was held at Andrews AFB on February 26, and after a ten-minute display with Roland Beaumont at the controls, the Canberra was the clear favorite. On March 2, 1951, the Air Staff directed that the Air Materiel Command arrange for the domestic production of the Canberra. Since Martin had a considerable amount of experience with the XB-51, the Baltimore-based company was the contractor chosen to carry out the license production of the Canberra.

The Air Force decreed that the B-57 was to go directly into production, with relatively few changes from the Canberra B. Mk. 2 RAF version. A March 24, 1951 Letter Contract (AF 33(038)022617) was issued to the Martin Aircraft Company, which authorized the manufacture of 250 Canberras under license. The USAF designation would be B-57A, with the company designation being Martin Model 272. It was anticipated that 50 planes a month would be delivered by Martin between November 1952 and October 1953.

The license agreement between Martin and English Electric was concluded on April 3. This was the first foreign-designed military aircraft to be bought by the USA in 35 years, dating back to the S.E.5 and DH-4 of World War I vintage.

On July 1, Martin agreed to have 60 percent of the work on the B-57 performed by subcontractors. The principal subcontractors were Kaiser Products of Bristol, Pennsylvania which was to build the wings and special weapons bomb-bay doors, and the Hudson Motors Corporation of Detroit, Michigan which was responsible for the aft portions of the plane.

The B-57A was to be essentially identical to the Canberra B. Mk. 2. However, the Canberra B. Mk. 2 had been powered by a pair of Rolls-Royce Avon 101 turbojets, rated at 6500 lb.s.t. each, and it was agreed that the US version of the Canberra would be powered by two 7200 lb.s.t. Armstrong Siddeley Sapphire turbojets, which would be built under license by the Wright Aeronautical Corporation under the designation YJ65-W-1. Like the B. Mk. 2, the B-57A would lack any defensive armament, relying on its speed and maneuverability to evade interception.

Canberra B. Mk. 2 WD932 was allocated to Martin as its first pattern aircraft, and it was delivered to Baltimore in March of 1951. It was used for a series of extensive flying trials. The set of Canberra drawings arrived by air at the beginning of June 1951. In June, Martin requested a second Canberra and was allocated WD940. It set an official trans-Atlantic record during its delivery flight on August 31, 1951. The two planes WD940 and WD932 acquired USAF serial numbers (51-17352 and 51-17387 respectively), but they were carried in the USAF inventory as Canberras, not as B-57s.

Martin tested the first British Canberra from April to October 1951. The second British Canberra was flown only four hours, and then disassembled and shipped in pieces to Martin's main subcontractors.

On December 21, 1951, WD932 lost a wing during a 4.8g maneuver at 10,000 feet over Centerville, Maryland, on the Delmarva Peninsula. Both crew members ejected, but one of them was killed when his parachute failed to open. An investigation later showed that the cause of the accident was an incorrect use of the fuel load, with the forward fuselage tanks having been used first, making the aircraft tail heavy and causing it to be longitudinally unstable and pitch up in a tight turn, overstressing the wings.

The first production B-57A (52-1418) was rolled out of Martin's Middle River plant on July 20, 1953, and took off on its first flight that same day. The first flight was an uneventful 46-minute hop. The B-57A was externally almost identical to the Canberra B. Mk. 2 except that the navigator's window was repositioned aft of the cockpit on the starboard side, the windows on the port side of the fuselage being deleted. In addition, the pitot tube, which on the B. Mk. 2 was at the center of the glazed nose cone, was relocated beneath and aft of the glazed nose. The bomb bay was shortened and a cooling system air intake was added underneath each engine nacelle. The cockpit canopy was slightly modified to afford better visibility and to provide more room for the crew, which was reduced from three to only two. A pair of wing-tip fuel tanks were provided to increase the loiter time. The British clamshell-type bomb-bay doors were replaced by a Martin-developed rotating bomb bay door. Originally developed for the XB-51, this new rotary bomb bay door rotated 180 degrees and eliminated the drag caused by an opened bomb bay compartment during the bomb run.

The first B-57A underwent its official Air Force flight acceptance at the Middle River field on August 20. The first B-57A was accepted by the Air Force that same day, but the plane was immediately bailed back to Martin. USAF testing did not begin until December of 1953, when all the other B-57As were delivered.

The B-57As were used exclusively as test airframes for evaluation stability and control, airframe structures, and for tests of systems such as Shoran bombing, navigation and radio systems. They were not considered as being combat-ready.

The second of the eight B-57As (52-1419) was operated by the National Oceanic and Atmospheric Administration (NOAA) of the US Department of Commerce out of Miami International Airport. Operating under the civilian registration of N1005 and fitted with a large nose radome replacing the transparent nose-cone, it was used in the tracking of hurricanes in *Project Stormfury*. When it was retired by the NOAA, N1005 was acquired by the Gorge T. Baker Aviation School at Miami International Airport for flight training.

Serials of B-57A:

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52-1418/1425          Martin B-57A-MA
                              1418 transferred to NASA as 218 6-19-57
                              1419 transferred to Edwards AFB for stability
                                      tests, later operated by NOAA as
                                      N10005 for weather research, acquired
                                      by George T. Baker Aviation School at
                                      Miami Airport
                              1420 w/o 11-22-54 at Glenn L. Martin
                              1421 w/o 12-9-53 Bel Air, MD
                              1422 to Eglin APG for cold hangar tests
                              1423 to Wright Aeronautical Development
                                      Center 7-30-54
                              1424 w/o 2-22-58 California
                              1425 to MASDC in 1973
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Martin B-57 Canberra
Martin B-57 Canberra - Chapter 2: RB-57A Reconnaissance Version

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Joe Baugherjbaugher@worldnet.att.com
Maintained by Carl Pettypiece

12/21/51

Martin 272

B-57 Canberra Tactical Bomber

The twin-jet Canberra was developed for the RAF in the late 1940's by English Electric, Limited. In 1951 it was selected (in preference to the Martin XB-51 - see previous page) as a night-intruder bomber for service in the Korean War. The original intention was to procure Canberras directly from the British production line, but English Electric put RAF orders first. In the interest of speed, the Air Force ordered 250 Canberras from Martin instead, ordering the old B-26 Plant No. 2 at Middle River re-opened for the purpose. They to be built "as is," without extensive modification beyond the addition of forward-firing wing guns and American cockpit equipment. Two RAF Canberras were purchased and sent to the Martin factory as "dog ships."

Although there had been intense disappointment in Middle River over the cancellation of the innovative XB-51, Canberra contracts were to prove both lucrative and long-lasting. Initial production, however, involved a number of serious delays. Conversion of British drawings and specifications to American standards took time. There were also problems with subcontractors. Instead of the Rolls Royce Avon turbojets used in British Canberras, the U.S. Air Force decided to use more powerful J65's, American versions of the Armstrong Siddley Sapphire, licensed to Curtiss-Wright and built by their subcontractor Buick. The early products of this complex collaboration frequently failed to meet Air Force standards. Wing panels subcontracted to Kaiser were delivered late; that subcontract eventually had to be cancelled. Most seriously, one of Martin's British Canberras crashed on a test flight in December 1951. The Martin test engineer on the flight, unable to escape from his seat inside the fuselage, was killed. The resulting re-evaluation of the Canberra's safety caused still more delays. The Air Force was sufficiently concerned to order a competing plane from Douglas in February 1952: the Navy's twin-jet A3D Skywarrior which became the Air Force B-66.

In September 1951 Martin engineers had proposed to add elements of their XB-51 design to a "Super Canberra." This would have had swept wings, plus a T tail, larger cockpit, Shoran navigation system, and rotary bomb-bay. Unwilling to accept delay, the Air Force had turned it down, only to reconsider when the prototype crashed a few weeks later. Wright Field officials demanded that thirty-one specific design flaws be corrected, pointing out the the RAF had submitted a similar list to English Electric. Martin was authorized to install the rotary bomb-bay in all B-57's and to add the new cockpit, along with fuselage dive brakes and external weapons points, after the 75th plane. In compensation the total order was reduced from 250 to 177 planes. An immediate follow-on contract provided for a total of 240 of the improved models: 202 B-57B bombers plus 38 dual-control B-57C trainers.

The first Martin B-57A, almost indistinguishable from a British Canberra, did not fly until July 1953. With the war in Korea just ending, only eight were delivered as bombers; 67 were built as RB-57A tactical reconnaissance planes. The improved B-57B's and C's that followed differed most visibly in their long teardrop canopies, which offered more visibility and also easier ejection for the second crewman in an emergency. A Shoran navigation/bombing system and better radar were also included. The extra weight of the modifications reduced the Martin B-57's speed, range, and ceiling in comparison with the British Canberra, but they added combat capabilities. Further orders included two other models, the RB-57D reconnaissance plane with longer wings for high altitude, and B-57E target tug, capable of streaming targets as high as 30,000 (later 48,000) feet. Twenty of the former and 68 of the latter were

05/09/1952
03/25/1956

XB-51

3/25/56 05/09/52

eight 20-mm cannon in the nose, with 160 rpg. Up to 10,400 pounds of bombs could be carried, but the basic mission consisted of the delivery of 4000 pounds over a 475-mile radius.

In 1950, following the beginning of the Korean War, the USAF perceived a need for a night intruder bomber to replace the Douglas A-26 Invader. The XB-51 was entered in the contest, along with the North American B-45 Tornado and the North American AJ-1 Savage. Foreign entries included the Avro Canada CF-100, a twin-jet all-weather interceptor, and the English Electric Canberra. On December 15, 1950 a Senior Board of officers recommended that the XB-51 and the Canberra had the best potential as a night intruder. Although a relatively large aircraft, the XB-51 was highly maneuverable for its size. At low levels, it had a very satisfactory turning radius in the speed range of 280-310 IAS. However, its low limit load factor of 3.67 G severely limited its capability during tactical operations, and was generally considered unsatisfactory. The XB-51 was nearly a hundred knots faster than the Canberra at low level, its maximum speed of Mach 0.89 below 30,000 feet made interceptions of the XB-51 by aircraft such as the F-86 extremely difficult. However, the endurance of the XB-51 was much poorer than that of the Canberra, with the Canberra being able to loiter for 2 ½ hours over a target 780 nautical miles from its base. The XB-51 could loiter only one hour over a target 350 nautical miles from its base. Despite the prospect that improved jet engines would eventually be available, there was little prospect that the range and endurance of the XB-51 would improve sufficiently to meet the loiter time requirement. In addition, it was thought that the small outrigger wheels on the XB-51 might be troublesome at hastily-prepared forward air bases. In early 1951, a fly-off at Andrews AFB finally settled the issue, and the Canberra was declared the winner. On March 23, 1951, 250 examples of the Canberra were ordered under the designation B-57A.

The XB-51 program was canceled in November of 1951. However, Martin was not all that upset, since they were awarded the contract to build the B-57.

Flight tests with both prototypes continued after program cancellation. The second XB-51 (48-686) crashed on May 9, 1952 during low-level aerobatics over Edwards AFB, killing its pilot. The first prototype XB-51 continued on with various other test work. Extensive tests on high-speed bomb release were carried out, and the tail configuration, variable incidence wing, and bicycle-type landing gear provided much useful data. The XB-51 even starred in a movie -- the film *Toward the Unknown* starring William Holden in which it was assigned the spurious designation "Gilbert XF-120". The aircraft was totally destroyed on March 25, 1956 in a crash at Biggs Field, Texas.

Specification of Martin XB-51:

Powerplant:
  Three General Electric J47-GE-13 turbojets, each rated at 5200 lb.s.t.

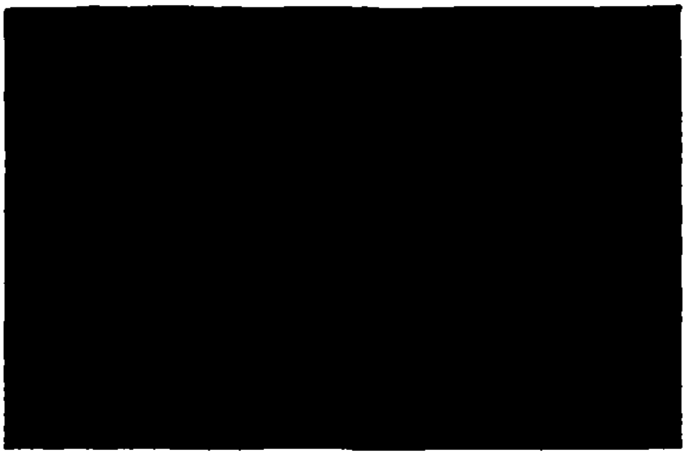
Performance:
  Maximum speed 645 mph at sea level. Cruising speed 532 mph, landing speed 153 mph. Service ceiling 40,500 feet. Initial climb rate 6980 feet per minute. Normal range 1075 miles, maximum range 1613 miles.

Weights:
  29,584 pounds empty, 55,923 pounds gross, 62,457 pounds maximum.

Dimensions:
  Wingspan 53 feet 1 inch, length 85 feet 1 inch, height 17 feet 4 inches, wing area 548 square feet.

Armament:
  Eight 20-mm cannon with total ammunition capacity of 1280 rounds. Normal bombload was four internal bombs of 1600 lb each or two external bombs of 2000 pounds each. Maximum bombload

XB-51 ---- 3/25/56
5/9/52



added to the T-tail to reduce buffet, as found necessary with similarly-designed aircraft of the period. Although the landing gear arrangement supposedly made take-off and landing operations easy, requiring no rotation or flare, pilots found ways to abuse the equipment and several landing incidents laid-up the bombers for gear repair and modifications. Martin performed the bulk of the development flight tests, turning the planes over to the USAF evaluation team in late 1950.

After the evaluation, the aircraft were used for further research testing at Edwards AFB. The USAF was particularly interested in investigating the high speed bombing performance of the planes, being able to release weapons at near-sonic speed without the bombs tumbling. Such testing continued until both machines were destroyed. The number 2 ship was lost and its pilot killed on 9 May, 1952, when the pilot failed to properly complete a low level aileron roll. The plane had flown 151 hours in 193 flights. The number 1 XB-51 was immortalized on film when it appeared as the "Gilbert Fighter" in the Warner Brothers movie *Toward the Unknown*. Unfortunately, this also led to the loss of the aircraft when it crashed on take-off in El Paso on 25 March, 1956, while on the way to Florida for filming, resulting in the deaths of both crew members. It had accumulated 432 flight hours in 453 flights. Both crashes were attributed to pilot error.

The competition for the production contract shaped up into a contest between the XB-51 and three other competitors. The Air Force pilots were enthusiastic in their praise for the XB-51 and recommended it for procurement, despite some performance deficiencies. However, in a controversial decision weighted toward political and economic factors, the English Electric Canberra was chosen. Remarkably, Martin was selected to build the British bomber under licens becoming the B-57, and made several important modific tions including the addition of its patented rotary bom bay. After another unsuccessful bid with the large P6l SeaMaster jet flying boat bomber, Martin never buil another plane of its own design.

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2. "*Attack!, The Story of the XB-51, Martin's Phanto Strike Ship!*", Walt Boyne, Airpower, Sentry Publication July 1978.

Thanks to the Air Force Flight Test Center History Offic Edwards AFB, California.

PHOTO 1
The first XB-51 is shown early in its test program with th crew entry hatch open forward of the front gear. The wing i set at 7.5° for take-off and landings, and the centerlin engine intake is open. The nose art is maroon with white out line on a grey field.

PHOTO 2
The XB-51 here utilizes four JATO bottles, burning for onl 14 seconds, providing an additional 4000 lbs. of thrust i take-off. Flaps and slats are extended and the aft gear an outriggers have already retracted. Note the three flap hinge below each wing.

PHOTO 3
In cruise the wing incidence is set at 3°, as shown here. Div brakes are installed just forward of the aft fuselage star an bars, here being closed. Also visible is the fluorescent orang painted on the outer wing panels and the lower surface of th forward nose which was applied late in the program.

PHOTO 4
The maintenance personnel provide scale reference. Note th bullet fairing on the T-tail, the open access panel for th number 2 engine and its closed intake. The unusual engin installation simplified maintenance access and reduce engine-out yawing moments. The braking parachute i housed in the fairing between the rudder and the af fuselage. Note the small navigator window just aft and below the shielded canopy.

05/09/1952
XB-51

Slow Roll

5-27

RESTRICTED (WHEN FILLED IN)

Radio 5-12

REPORT OF AF AIRCRAFT ACCIDENT

Use this form in accordance with AF Reg. 62-14 and AF Manual 62-5, "Aircraft Accident Investigators' Handbook." Fill in all spaces applicable. If additional space is needed, use additional sheet(s) and identify by proper section letter and subsection number.

Section A - GENERAL INFORMATION

1. Place of Accident: California, Kern, Edwards 1 Mile East
2. Nearest Airport Suitable for landing this plane — Distance and direction to accident: Edwards AFB 1¼ Mile East
3. Elevation above S.L. at accident scene: 2,285
4. Date of Accident: 9 May 52
5. Hour and Time Zone: 0641 PST
6. [X] Day [ ] Night [ ] Dawn [ ] Dusk
7. Tail Numbers of All Other Aircraft Involved: None
8. [X] Incident to Flight [ ] Not Incident to Flight
9. Classification of Accident: [X] Major [ ] Minor
10. Clearance: [ ] IFR [X] Local [X] VFR [ ] Other
From: To:
11. This was a: [ ] CAP Flight [ ] Air Reserve Flight [ ] ANG Flight [X] Other
12. [ ] Fire Occurred During Accident [X] Fire Occurred After Accident [ ] Fire Did Not Occur
13. Airfield of Last Takeoff: Edwards AFB
14. Duration of Flight Since Last Takeoff: 0:48
15. Mission of Flight: X-1
16. Activity Aircraft Was Engaged in Just Prior to Accident: Aileron roll to the right

Section B - AIRCRAFT

1. Aircraft No.: 46-686
2. Type, Model, Series and Block No.: XB-51
3. Organization Reporting Aircraft on AF-110 Report: Major Command: ARDC; Subcommand: AFFTC; AF Wing: —; Group Number and Type: —; Squadron or Unit: —; Base: Edwards AF Base
4. Technical Orders affecting this aircraft were not complied with at time of accident.

Section C - OPERATOR (Person at controls at time of accident)

1. Last Name: Lathrop; First Name: Neil; Middle Name: Hill; Grade: Major; Component: USAF; Serial No.: 10042A; Nationality and Race: USA W; Year of Birth: 1921

31 Yrs Old

2. Assigned Base: Edwards AFB; Major Command: ARDC; Subcommand: AFFTC; AF Wing: —; Group No. and Type: —; Squadron or Unit: —
3. Attached Base for Flying: —; Major Command: —; Subcommand: —; AF Wing: —; Group No. and Type: —; Squadron or Unit: —
4. Original Aeronautical Rating and Date Received: Pilot 29 April 1943
5. Present Aeronautical Rating and Date Received: Sr. Pilot 23 November 1950
6. Primary Duty Assignment: Chief, Flt Test Ops.

OPERATOR'S FLYING EXPERIENCE (Including Civilian)

7. Type of Instrument Card: Green; Expiration Date: 30Sep52
8. Total Pilot Hours: 3640:00
9. Total 1st Pilot Hours: 2752:00
10. 1st Pilot Hours Last 90 Days: 125:35
11. 1st Pilot Hours Last 30 Days: 43:45
12. 1st Pilot Hours This Model: XB-51 13:40
13. Other Pilot Hours This Model: :00
14. 1st Pilot Hours Last 90 Days This Model: 4:20
15. 1st Pilot Hours Last 30 Days This Model: :50
16. Total Time Spent in Air in Past 24 Hrs. Prior to Accident: 3:20
17. Last 90 Type and Model 1st Pilot Experience in Similar Aircraft: B-45 141:00; B-43 1:55; B-47 1:00
18. Was Operation on Instruments at Time of Accident Immediately Before? [X] No [ ] Yes [ ] Yes [ ] Hood [ ] Weather
If above answer is "Yes" or if accident occurred at night or during IFR weather or unknown conditions, fill in items below.
19. Total 1st Pilot Instrument Weather Hours
20. Total 1st Pilot Instrument Hood Hours
21. 1st Pilot Instrument (Weather and Hood) Hours Last 6 Months
22. 1st Pilot Instrument (Weather and Hood) Hours Last 90 Days
23. 1st Pilot Night Hours Last 6 Months
24. 1st Pilot Night Hours THIS MODEL Last 90 Days

Section D - PERSONNEL INVOLVED (Including operator and all other persons, whether in plane or not)

Duty at time of accident (1)	Name (Last name first) (2)	Type of Aero. Rating (3)	Serial No. (4)	Grade and Branch of Service (5)	Component (6)	Organizational Assignment (Command, Subcommand, Group Number and Type, Base) (7)	Fatal, Major, Minor, None, Missing (8)	Yes (9)	No (10)
P	Lathrop, Neil H.	Sr.P	10042A	Maj.USAF	USAF	ARDC, AFFTC, Edwards AFB, Calif.	Fatal		X

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Section E RATED PERSONNEL AT OTHER SET OF DUAL CONTROLS

FLYING EXPERIENCE Including Instructor

Section F DAMAGE

1. Describe briefly in general terms the extent of damage to the airplane, engines, and propellers.

Total destruction.

4

D6 0 ...

2. Check proper damage classification: None / Minor / Substantial / Destroyed X

3. X Plane or wreckage was returned to an AF base

Plane or wreckage was left at scene of accident

4. Is plane damaged beyond economical repair? X Yes No

5. If plane is to be repaired, give engineering officer's estimate of number of man-hours required to repair: N/A Man-hours

6. Was private property damaged? Yes X No

If "Yes" describe damage on separate sheet

7. Give below a complete, brief estimate of cost of this accident to the Air Force

Cost of damage to aircraft: Estimated	$4,500,000.00
Cost of damage to other Government property	$ —
Cost of damage to private property	$ —
Cost of injuries	$ 50,000.00
Cost other: Explain: Clean Up	$ 259.00
Total estimated cost of accident	$4,550,259.00

Section G SPECIAL EQUIPMENT

1. Check below items of special equipment which affected the accident.

Radio / Armament / De-Icers / Equipment for Clear Vision from Cockpit / Instruments / Fire Extinguishing Equipment in Plane / JATO

2. Describe briefly how the use, nonuse, misuse, or absence of special equipment affected the accident

Section H — WEATHER (At time and place of accident)

Ceiling	Visibility	Wind Direction and Velocity	Temp.	Dew Point	Other Weather Conditions
Clear	30	SW 8	64°	37°	None

If weather other than unfavorable wind conditions for takeoff, landing, or taxiing was a factor in the accident, attach statement of weather officer describing climatic conditions and how they probably contributed to accident.

Section I - CHECK LIST FOR ATTACHMENTS

X Form 1 | X Clearance | X Photographs | Form 14C
X Form 1A | Crew Members' Statements | X Form 14A | Form 14D
X List of T.O.'s Not C/W | X Witnesses' Statements | X Form 14B | Form 14E

X Bd. Proceedings, Flt. C..., Extract of Regs., Form F, T... Accident Rpt. List of pilots present ... Flying Safety Meeting

Section J – ACCIDENT TYPE
Check one accident type as "Primary." Check all others applicable as "Secondary."

Primary	Secondary	
		Ground or Water Loop
		Wingtip Landing
		Wheels-Up Landing
		Hard Landing
		Collapse or Retraction of Landing Gear
		Undershoot
		Overshoot
		Nose Up or Nose Over
		Collision With Other Aircraft
X		Collision With Ground XXXXXX
		Other Collisions
		Spin or Stall
		Fire on Ground on ground
X		Fire and Explosion XXXX
		Airframe Failure in Flight
		Abandoned Aircraft
		Prop or Jet Blast Accident
		Other (List):
		Undetermined

Section K – PHASE OF OPERATION
(Check only ONE)

	Taxiing Incident to Flight
	Take-Off
X	In Flight
	Landing
	On Ground
	Engine Running – Not Taxiing
	Ground Operations
	Undetermined

Section L – CONDITIONS AFFECTING ACCIDENT
(Check all applicable)

	Immediate Forced Landing
	Precautionary Landing
	Fuel Exhaustion
	Engine Stoppage
	Lost
	[illegible]
	Other (List):

Section M – VIOLATIONS
(Check all applicable)

	[illegible]
	[illegible]
	[illegible]
	[illegible]
	[illegible]
X	Other (List): Par. 12, AFR 60-16

Section N – CAUSE FACTOR ANALYSIS
Check one specific cause as "Primary." Check all others applicable as "Secondary." (see AFM 62-4 for definitions)

1. ERRORS OF AIR CREW

Primary	Secondary	
		Misused Power Plant or Power Plant Controls
		Misused Brakes and/or Flight Controls on Ground
X		Improper Use of Flight Controls in Air
		Exceeded Stress Limits of Aircraft
		Inattentive to Fuel Supply or Fuel Selector Valves
		Failed to Extend or Retract Landing Gear Properly
		Selected Unsuitable Terrain or Runway for Takeoff or Landing
		Failed To Compensate for Wind Conditions
X		Misjudged Distance
		Failed To Level Off Properly
		Failed To Observe Other Aircraft or Objects
		Failed To Maintain Adequate Flying Speed
		Became Lost (Weather systems or above)
		Continued VFR Flight Into Unfavorable Weather
		Improper Operation on Instrument Flight
		Operated Aircraft in Reckless Manner
		Made Inadequate Flight Preparations
		Attempted Flight Beyond Ability or Experience
		Failed To Use or Incorrectly Used Miscellaneous Equipment
		Other (List):

2. ERRORS OF OTHER PERSONNEL

		Aircraft Inadequately Maintained
		Aircraft Improperly Cleared for Flight
		Weather Incorrectly Forecast
		Improperly Operated Airways Facilities
		Improperly Supervised Training (Ground Personnel)
		Improperly Supervised Training (Flight Instructors and Flight Leaders)
		Other (List):

3. MATÉRIEL FAILURE – POWER PLANT

		Cooling System
		Lubricating System
		Fuel System
		[illegible]
		[illegible]
		[illegible]
		[illegible]
		[illegible]
		[illegible]
		[illegible]
		Undetermined

4. MATÉRIEL FAILURE – AIRFRAME

		[illegible]
		[illegible]
		[illegible]
		[illegible]
		Other
		Undetermined

5. MATÉRIEL FAILURE – LANDING GEAR

		Main Landing Gear
		Nose Wheel or Tail Wheel
		Landing Gear Position Indicator
		Brakes
		Tires
		Other
		Undetermined

6. MATÉRIEL FAILURE – EQUIPMENT AND ACCESSORIES

		Automatic Pilot
		Radio Equipment
		Electrical System
		Hydraulic System
		Oxygen or Pressurization System
		Safety Equipment
		Instruments
		Cockpit, Seat, Canopy, Fittings, Trim Tabs, Harness
		Armament
		Other

7. WEATHER

		Low Ceiling
		Smoke – Haze
		Rain – Fog
		Snow – Hail
		Icing Conditions
		Unfavorable Wind Conditions for Landing, Taxiing or Takeoff
		Turbulence in Flight
		Wind Shift
		Thunderstorms
		Downdraft – Updraft
		Other

8. LANDING AREA

		Wet
		Soft
		Snow
		Ice
		Rough
		Gravel
		Runway Too Short
		Other Hazards

9. GROUND EQUIPMENT

		[illegible]
		Airway Facilities
		[illegible]
		[illegible]
		Other

10. MISCELLANEOUS

		[illegible]
		[illegible]
		Other

11. UNDETERMINED

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Section O DESCRIPTION OF ACCIDENT

[illegible]

On 9 May 1952 at 0753 PST, XB-51, [illegible] took off from Edwards AFB on a functional test flight, escorted by a F-86 type aircraft. After approximately twenty (20) minutes of flight, the F-86 pilot was relieved of his duty as escort, and returned to Edwards AFB. The XB-51 pilot continued his mission for approximately ten (10) minutes longer, and then called the control tower for permission to make low altitude, high speed fly-bys, for the purpose of obtaining motion picture coverage of activities being conducted at the Air Force Flight Test Center. Permission was granted, and the pilot made his first pass from west to east. After the second and third passes were completed, a fourth pass, from east to west, was initiated. This pass was effected at a speed lower than that of the previous three passes, at an altitude approximately equal to that of the Edwards Control Tower. As the aircraft passed the west end of the ramp area, the pilot raised the nose of the XB-51 slightly, and attempted an aileron roll to the right. The roll appeared normal until the aircraft became inverted; then the nose dropped below the horizon. At this point, the aircraft appeared to "dish out" of the roll, striking the ground in a left-wing-low, slightly nose-down attitude. The crash was followed by an explosion and fire which resulted in total demolishment of the aircraft and death to the pilot.

As a result of reviewing all the evidence presented before the Aircraft Accident Investigation Board, which convened on 19 May 1952, the following findings are hereby submitted:

(1) It was determined that no earlier than a week prior to the accident, as a result of correspondence initiated by the Chief of Staff, USAF, and indorsed in turn by the Commanding General, ARDC, the subject of Flying Safety was stressed to all pilots of the Flight Test Operations Lab, by the Chief of that section. This meeting, which lasted approximately thirty (30) minutes, was attended by the pilot involved in subject accident. As a part of the general topic of Flying Safety, the subject of air discipline was discussed.

(2) No doubt exists in the minds of all members of the Aircraft Accident Board, that the communications from the Glenn L. Martin Co., concerning certain recommended restrictions on the XB-51, was brought to the attention of the pilot, not only eight (8) to ten (10) days prior to the date of the accident, but again on the morning of the accident, just before take-off. Further, testimony on record indicates that the pilot of the XB-51, in a radio transmission to the escort pilot, stated that he was restricted to a rate of climb not to exceed 5,000 feet per minute, thereby giving indication that he was familiar with subject communications. It was the conclusion of every member of the Board, however, that the deficiency concerning the main stays of the fuel tanks in the XB-51 was neither a direct or indirect factor contributing to this accident.

RECOMMENDATIONS for action to prevent similar accidents:

It is recommended that the provisions of paragraph 14d, Air Force Regulation 60-16 be re-emphasized and reiterated.

Section P—AUTHENTICATION (Each investigating board member must sign below)

1. Personnel Responsible for This Accident Have Been Offered Opportunity of Rebuttal [ ] No Rebuttal Rec'd [ ] Rebuttal Statements Attached

2. Personnel Responsible Not Available Because of [X] Death [ ] Further Injury [ ] Other (Explain) ______

Base Submitting Report: EDWARDS AIR FORCE BASE	Member (Name and Grade): for Walter L. Moore, Jr., Lt. Col. WALTER L. MOORE, JR., LT. COL.	Medical Officer (Name and Grade): Howard C. Knapp HOWARD C. KNAPP, COL.
President (Name and Grade): Fred J. Ascani FRED J. ASCANI, COL.	Aircraft Accident Officer (Name and Grade): James A. Bryant JAMES A. BRYANT, CAPT.	Recorder (Name and Grade): James A. Bryant JAMES A. BRYANT, CAPT.

[redacted]

(3) The Accident Board found no evidence of lack of proper supervision and established conclusively that personnel in a position of responsibility were totally unaware that a slow roll in close proximity to the ground, had been or was to be contemplated by the pilot of the XB-51. It may be added, however, that in anticipation of submitting a request for permission to perform a slow roll during the forthcoming Armed Forces Day Show, the pilot had informally discussed the subject maneuver with some of the other pilots assigned to the same organization. It was impossible, however, to establish, that the pilot of the XB-51 was, in fact, intending to execute a slow roll on this specific flight, as a result of these discussions.

(4) From reviewing all of the evidence available, including the motion picture film which was seen by all Accident Board members, it is concluded that the aircraft was in a mechanically suitable condition and that no structural failure or malfunction occurred prior to the initial contact of the aircraft with the ground.

(5) From all evidence submitted, it is the conclusion of the Accident Board, that only the photographer assigned to photographing this flight, and the pilot of subject flight, were aware prior to the flight, that a slow roll, in all probability would be attempted on the last high speed pass of the aircraft.

(6) The direct cause of subject accident is an aerobatic maneuver, described as an aileron roll which was initiated in close proximity to the ground, leaving inadequate altitude in which to recover from an inverted position.

RESTRICTED

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON

Office of The Inspector General, USAF
Norton Air Force Base
San Bernardino, California

27 May 1952

(Restricted) Report of Special Investigation of Major Aircraft Accident Involving XB-51, SN 46-686A at Edwards Air Force Base, California, on 9 May 1952

THE ACCIDENT

1. XB-51, SN 46-686A, assigned to the Air Force Flight Test Center, Edwards Air Force Base, California, took off on a local flight at 0753 PST, 9 May 1952. The purpose of the flight was to perform a functional test flight and to make low altitude passes for photographic purposes. The aircraft crashed on the west end of Edwards AFB at 0841 PST during a slow roll at low altitude. The pilot of the aircraft was fatally injured and the aircraft was destroyed by impact with the ground and the subsequent explosion.

CONCLUSIONS

2. It is concluded that:

a. The pilot deliberately attempted an unauthorized slow roll while making a low altitude pass across the field (see par 7).

b. Acrobatic maneuvers were not prescribed for the mission being flown (see par 12).

c. Prior to the flight the pilot of the aircraft had informed the photographer that he would make a slow roll on his fourth pass across the field (see par 11).

d. Supervisory personnel were not aware of the pilot's intention to slow roll the aircraft until after the accident occurred (see par 11).

SECURITY INFORMATION
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RECOMMENDATIONS

3. IT IS RECOMMENDED THAT THE COMMANDING GENERAL, AIR RESEARCH AND DEVELOPMENT COMMAND:

a. Insure that test flights and special purpose flights are not used as a medium for unauthorized, dangerous maneuvers (see pars 7 - 12).

ACTION TAKEN

4. Recommendation contained in paragraph 3 has been referred by letter to the Commanding General, Air Research and Development Command for action and reply.

HISTORY OF FLIGHT

5. XB-51, SN 46-686A, departed Edwards Air Force Base, at 0753 PST on a dual purpose mission. The first part of the mission was a functional test flight. The latter part of the flight was to be low altitude passes for a photographer to make moving pictures of the aircraft in flight. At approximately 0810 PST the pilot notified the control tower that the functional test flight was successfully completed. He then requested tower permission to make low altitude passes across the field for photographic purposes. Permission was granted and the XB-51 made three low altitude passes at an estimated speed of 500 knots. On the fourth pass the speed was estimated at 300 - 350 knots. The pass was made from east to west approximately "tower high". As the aircraft passed the tower, a slow roll to the right was started. During the last one-third of the slow roll, the aircraft "dished out" and struck the ground in an approximate forty degree, left wing low attitude. The aircraft disintegrated on impact with the ground and exploded as the fuselage struck the ground.

INVESTIGATION AND ANALYSIS

6. Investigation at the scene of the crash revealed that parts of the aircraft were strewn over an area of approximately two hundred yards wide and one-half mile beyond the first impact point. All leading edge slats were found slightly forward and to the left of the impact point. The slats were fairly intact indicating they came off of the wing immediately on impact of the left wing and prior to the explosion. The landing gear and parts of all engines were found almost a half-mile beyond the point of impact. Only small parts of the wings and fuselage section were found due to violence of the explosion.

7. Pictures of the three low altitude passes and the accident were obtained by a photographer using a movie camera, telephoto lens, and color film. A detailed study of the film in slow motion disclosed no malfunction

or failure of any part of the aircraft prior to impact. Gear and flaps were in the up position at time of impact. The film showed that almost immediately after passing the photographer, who was located near the control tower, the nose of the aircraft was raised and the aircraft started a slow roll to the right. The nose of the aircraft remained above the horizon until after the aircraft was inverted. Approximately two-thirds through the roll the nose dropped slightly. Passing through the three-fourths position of the roll, the nose dropped below the horizon. The latter part of the roll was similar to a barrel roll. As the roll reached a point of seven-eighths completion, the left wing struck the ground. As the left wing crumpled the right wing slats came off, followed by the right wing. As the fuselage struck the ground an explosion occurred. The film definitely showed that the slow roll was smooth and well executed to the point where the nose dropped, indicating that the aircraft was being flown through the maneuver by the pilot. If the roll had been inadvertently caused by a malfunction in the aircraft, it is likely that the maneuver would have appeared rough and jerky. It was also noted that the pilot told the photographer prior to the flight that he would make a slow roll on his fourth pass across the field, and the accident occurred on the fourth pass. Based on these factors it is apparent that the slow roll was executed by the pilot.

8. Review of the Form F, Weight and Balance Clearance, disclosed that MAC was well rearward on takeoff but within allowable limits. The local clearance form was properly made out with "Low Tower Passes" entered in remarks section.

9. Review of maintenance records including AF Form 1, Parts I and II, revealed no discrepancies which could have been a factor in the accident. One technical order was not complied with but was not considered to be a factor in the accident. Some difficulty had been encountered in the XB-51 with fuel cells collapsing. The Glenn L. Martin Company, in a telegram dated 25 April 1952, recommended the XB-51 be restricted to 5000 feet per minute rate of climb or descent, with no acrobatics until proper instrumentation could be installed. Edwards AFB engineers and Martin Aircraft technical representatives were of the opinion that this was not a factor in the accident.

10. Flight Test Laboratory supervisory personnel were interrogated in an attempt to determine the pilot's reason for slow rolling the aircraft at low altitude. They disclosed that the pilot was scheduled to fly the XB-51 during the Armed Forces Day celebration on 17 May 1952. During the discussion of the Air Show for Armed Forces Day, it was decided the pilot would do a slow roll in the XB-51. A maneuver of this kind would require a low altitude pass across the field, a pull up to a minimum of [illegible] feet and then a climbing slow roll.

11. Further interrogation of supervisory personnel revealed that a project had been established to make a film history of activities performed by the Flight Test Center. The pictures taken of the XB-51 flight were to be part of this film history. Prior to the XB-51 flight the pilot was requested by the film project officer to make several low altitude passes for photography purposes. The pilot then contacted the Edwards AFB Flight Safety Officer, who was acting Base Operations Officer, and discussed the low altitude passes with him. The pilot did not mention to the Flight Safety Officer or any other supervisory personnel that he intended to make a slow roll during the mission. Just prior to take-off the photographer contacted the pilot and briefed him on the position from which he would be taking the pictures. The pilot acknowledged and told the photographer that he would do a slow roll on the fourth low altitude pass. Just prior to making his fourth low altitude pass the pilot called on Test Frequency and stated that he would make a slow roll on the next pass. He did not state that the slow roll would be made at low altitude.

12. Paragraph 9, Air Force Flight Test Center Regulation 62-2, states, "there will be no acrobatic flying at any time, unless duly authorized by competent authority for scheduled aerial demonstration or in connection with approved flight test program". No AFFTC Regulation waives requirement for compliance with paragraph 14d AFR 60-16, which states " No pilot will perform acrobatic flight unless during the course of the maneuver, including the entry and recovery, the aircraft will at all times remain at an altitude of 1500 feet above the surrounding terrain". Interrogation of supervisory personnel revealed that AFFTC has no requirement for aircraft to perform acrobatics at low altitude in violation of paragraph 14d AFR 60-16.

13. The pilot of the aircraft was a well qualified test pilot. He was the Operations Officer for the Test Operation Laboratory, and the supervisor of other test pilots. He was familiar with Air Force and Air Force Flight Test Center Regulations. The pilot had performed missions of this kind previously in the XB 51 and other type aircraft. He was not briefed for this flight by supervisory personnel, as it was a normal routine mission. The pilot had approximately 3600 hours flying time including over 500 hours in jet aircraft. He had flown fairly similar planes, such as the B 43 and B 45. He had approximately 23 hours in the XB-51 since his original check out in December 1951. A completed questionnaire for the XB 51 was found in his flight record.

HEADQUARTERS
AIR FORCE FLIGHT TEST CENTER
EDWARDS AIR FORCE BASE
Edwards, California

FTDC 360.33 23 May 1952

SUBJECT: Major Aircraft Accident - XB-51, 46-686

TO: Commanding Officer
Hq, Air Force Flight Test Center
Edwards Air Force Base, California

In accordance with paragraph 48a, AF Regulation 62-14, transmitted herewith is AF Form 14, with pertinent attachments concerning accident of XB-51, 46-686 which occurred on 9 May 1952.

1 Incl.
AF Form 14
W/Attach

Fred J. Ascani
FRED J. ASCANI
Colonel, USAF
President, Aircraft Accident Investigation Board

If inclosures are withdrawn (or not attached) the classification of this correspondence will be cancelled in accordance with Par. 25E, AFR 205 1.

FTG(23May52) 1st Ind

Headquarters, Air Force Flight Test Center, Edwards Air Force Base, Edwards, California 23 May 1952

TO: Directorate of Flight Safety Research, Office of the Deputy Inspector General for Technical Inspection and Flight Safety Research, Norton Air Force Base, California

1. Transmitted herewith in accordance with paragraph 48a, AF Regulation 62-14, is Report of Major Aircraft Accident, involving XB-51, 46-686, which occurred on 9 May 1952.

2. The undersigned has personally reviewed this Report and concurs in the findings and recommendations of the Aircraft Accident Investigating Board. The motion picture film (classified CONFIDENTIAL) referred to within the report was forwarded under separate cover to the CO, ARDC, Baltimore, Maryland.

3. Although no violations of this type have been detected during the months before this accident and none since, stringent methods have

FTO, AFFTC, EAFB, Edwards, Calif., Subject: Major Aircraft Accident, XB-51, 46-686 (23 May 52)

been instituted to prevent any recurrence. These methods include analysis of individual pilots' histories, assignment of projects in accordance with capabilities exhibited in those histories, continuing analysis of "pilots' judgment" abilities, dissemination of applicable disciplinary policies, elimination of possible "accident prone" personnel, and re-assignment of duties whenever the facts indicate a possible gravitational trend toward laxity of flying discipline or deterioration in flying judgment.

J. S. Holtoner

J. S. HOLTONER
Colonel, USAF
Commanding

1 Incl: n/c

C O P Y

52-5-9-1

RESTRICTED
SECURITY INFORMATION

RDOOP-3

(17 June 1952)

SUBJECT: Major Aircraft Accident Involving XB-51, SN 46-686A That Occurred on 9 May 1952 at Edwards Air Force Base, Edwards, California

TO: Deputy Inspector General, USAF
Norton Air Force Base
San Bernardino
California

1. Reference is made to your letter dated 27 May 1952, subject: "Special Investigation of Major Aircraft Accident Involving XB-51, SN 46-686A, 9 May 1952," with attached special accident report.

2. In reviewing the report, it was apparent the seriousness of the findings necessitated that immediate action be taken to insure that accidents of similar nature do not occur. As a result of the accident, all ARDC installations have been directed to take the following action:

(a) The attached report be made a special subject at the next Flying Safety Meeting and freely discussed with pilot personnel.

(b) Appropriate measures be taken to insure that pilots fully understand the importance to the research and development program of the test mission and the aircraft equipment they are flying.

(c) Insure that test flights are not used as a medium for unauthorized dangerous maneuvers.

3. It was requested this headquarters be advised of action taken on the recommendations as outlined in Paragraphs 2a, b and c above.

RESTRICTED
SECURITY INFORMATION

C O P Y

1342

HQ ARDC RDOOF-3, Subject: Major Aircraft Accident Involving XB-15, SN 46-686A That Occurred on 9 May 1952 at Edwards Air Force Base, Edwards, California

4. This command will continue to wage an aggressive campaign to reduce personnel errors contributing to aircraft accidents through the medium of a strong aircraft accident prevention program.

FOR THE COMMANDING GENERAL:

ERNEST R. MANIERRE
Colonel, USAF
Asst. Deputy for Operations

Hq ARDC FTDC 360.33, Subj: Maj Acft Acdt, XB-51, 46-686

RDOOF-3 (2? May 52) 2d Ind

HQ AIR RESEARCH AND DEVELOPMENT COMMAND, Post Office Box 1395, Baltimore 3, Maryland 31 ... ...

TO: Director of Flight Safety Research, Office of Deputy Inspector General, Norton Air Force Base, California

1. This headquarters concurs in the findings and recommendations contained in the report.

2. In reviewing the report, it is apparent that stringent action is necessary to prevent the recurrence of similar type accidents. As a result of the accident, this headquarters has directed that all ARDC installations take the following action:

a. The report, subject: Special Investigation of Major Aircraft Accident Involving XB-51, SN 46-686, 9 May 52, prepared by the office of the Deputy Inspector General, Norton Air Force Base, California, be made a special subject at the next flying safety meeting and freely discussed with pilot personnel.

b. Appropriate measures be taken to insure that pilots fully understand the importance to the research and development program of the test mission and the aircraft equipment they are employing.

c. Insure that test flights are not used as media for unauthorized dangerous maneuvers.

d. This headquarters be advised of action taken on recommendations as outlined in the previous sub-paragraphs.

3. This headquarters will continue to wage an aggressive campaign to reduce personnel errors contributing to aircraft accidents through the medium of a strong aircraft accident prevention program.

4. No further action is contemplated.

FOR THE COMMANDING GENERAL:

1 Incl
w/d

[signature]
?. ?????
Brigadier General, USAF
Chief of Staff

STATEMENT

13 May 1952

The purpose of Major Lathrop's flight in the XB-51 was to perform a functional test flight. Upon completion of the functional test flight, in order to make maximum utilization of the aircraft, he was to accomplish several low altitude, highspeed passes in front of the tower in order that photographic coverage of the XB-51 could be obtained for a project activity report to be used at the next ARDC Commanders' Conference. Major Lathrop was not instructed to do any acrobatics, and a slow roll had not been included as part of the mission. Major Lathrop as Chief of the Flight Test Branch was familiar with all SOP's and AF Regulations.

Assigned test pilots of the Flight Test Operations Laboratory are responsible to conduct and fly one or more test programs on various projects. As test pilots they are responsible to insure that such programs are conducted in a safe manner. Further, they are responsible for monitoring and coordinating their individual projects with Maintenance and Flight Test Engineers involved.

The undersigned as Chief of the Flight Test Operations Laboratory monitors all programs, and at such times as there is any question on flight technique, he is the final word on how the test will be conducted. Prior to conducting any test programs, the pilots are required to be graduates of the Test Pilots School.

Frank K. Everest, Jr.
FRANK K. EVEREST, JR.
Lt. Colonel, USAF
Chief, Flight Test Operations
Laboratory

S T A T E M E N T

13 May 1952

I, Thomas H. Curtis, Captain, USAF, Service Number 17031A, age 28, assigned as Chief, Test Operations Branch, Flight Test Operations Laboratory, Edwards Air Force Base, Edwards, California, make the following statement:

On 9 May 1952 I was present for duty at Test Operations Branch, Flight Test Operations Laboratory. Approximately 20 minutes before the scheduled take-off time of XB-51 #46-686 I received a phone call from the Motion Picture Unit inquiring as to the status of the XB-51. I stated that the airplane would fly and requested that cameras be set up so as to obtain motion pictures of the airplane during low altitude high speed passes upon completion of the functional test flight. The purpose of the above was to obtain film to be utilized in a movie depicting AFFTC activities. I spoke to Major Lathrop concerning the above and requested he make approximately 4 passes over the cameras to obtain the desired film. At this time it was agreed that, in preparation of the intended air demonstration, subject passes would be timed from the point that the airplane began the fly-by until the time that the tower was passed. The purpose of this was to insure that adequate time be allocated to participating aircraft during the scheduled fly-bys of the air demonstration. Upon the completion of the functional test flight, I called Major Lathrop on the Flight Test radio to determine if he was ready to begin passes. An affirmative answer was obtained, and Major Lathrop proceeded to call Edwards tower on "Easy" channel, which was the assigned frequency for the passes. A call was made to Edwards tower at .10 miles west of the field, and the timing of the pass was begun immediately. The first pass was followed by a second pass from east to west. Before each pass was initiated, a call was made to Edwards tower, with no further calls being made to me. A third pass was completed from west to east. Immediately before beginning the fourth pass Major Lathrop called and stated, "I will slow down to 400 and do a roll." At that time I was called to the telephone, but cannot remember to whom I talked. I returned immediately to the radio approximately 2 minutes later and observed the aircraft flying by the East Hangar in an inverted position. I continued to observe the aircraft for approximately 40° of roll. Further view of the aircraft was obstructed by the West Hangar. The only transmission by the Flight Test radio and XB-51 #686 other than acknowledging entering of the pass was approximately 10 minutes before take-off, at which time I called Major Lathrop on the radio to ascertain if he was familiar with the latest letter concerning flight restrictions of the aircraft. It had not as yet been received by this Branch. Notification that such a letter existed had been received by the undersigned after Major Lathrop had departed for the scheduled take-off. I received an affirmative answer, and no further discussion was made.

T. H. CURTIS
Captain, USAF

S T A T E M E N T

13 May 1952

I, Raymond J. Vogel, Field Engineer with Glenn L. Martin Company, make the following statement:

On 9 May 1952, at 0753 PST, Maj. Lathrop took off to fly F.T.F. flight on XB-51, 46-686, and Capt. Nash was flying the chase airplane to check gear operation in flight. I, at Maj. Lathrop's request, along with Capt. Curtis of Flight Test Operations, stayed at Flight Test Operations where I could listen and answer any requests made by Maj. Lathrop. I heard Maj. Lathrop tell Capt. Nash that he, Maj. Lathrop, was going to drop gear. This was accomplished and Capt. Nash reported everything "O.K.". At 0810 PST, Maj. Lathrop called in that F.T.F. flight was satisfactory and that he was going to make some high speed runs over the field. At this time, I called Capt. Howells, Assistant Chief of Maintenance, and also Mr. Myers, Line Chief of Bomber Maintenance, and informed them that Maj. Lathrop had called in and said F.T.F. flight was satisfactory. Maj. Lathrop stated he was going to make these high speed runs at low altitude. At this time, I left Flight Test Operations to go on the line to observe the runs. Maj. Lathrop made three high speed runs at low altitudes over the field. On the fourth run, we observed approximately 100 feet off the west end of the runway, that Maj. Lathrop started to roll the airplane at an approximate altitude of 100 feet. He completed a three-quarter roll from right to left with the left wing tip making contact with the ground at 0841 PST. An explosion followed which resulted in complete disintegration of the airplane and the death of Maj. Lathrop.

I, R. J. Vogel, and Mr. William T. Starkey, Glenn L. Martin representatives, were eye witnesses to this crash. We did not, at any time, see anything leave the aircraft until after it came in contact with the ground. We feel that the movies that were taken of the run and passes will be self explanatory.

On this F.T.F. flight, Maj. Lathrop was going to check the aft left hand landing gear door which had come open on a previous flight. While waiting for the Base Sheet Metal Shop to repair the door, the crew made a 90-hour inspection. When a check of the low and high pressure fuel strainers was made, wood particles were found. Upon removal of the fuel cell access doors, it was noted that quite a few of the wood cell braces were broken. Complete fuel cells and braces were ordered from the G. L. Martin Co. to make repair on the airplane. This repair was accomplished and all inspections proved satisfactory.

A copy of Telegram MS-05093 (see attached copy), sent to the Commanding Officer, Air Force Flight Test Center, Edwards Air Force Base, was received by Mr. W. T. Starkey, G. L. Martin representative stationed at Edwards AFB. This telegram concerns telephone conversation between Maj. J. Colopy, WADC, and Mr. Mead and Mr. Kershaw of the G. L. Martin Co. Mr. Starkey informed Maj. Lathrop of this copy of the telegram the day after it was received and at that time, Maj. Lathrop did not know of the telegram or its contents. Maj. Lathrop requested that copies of this telegram be typed by his secretary, Mrs. Underwood. Mrs. Underwood made four (4) copies of this telegram and then returned the original to Mr. Starkey.

Raymond J. Vogel

RAYMOND J. VOGEL
Field Engineer
Glenn L. Martin Company

TELEGRAM

Refer to
530:MJC

MS-05093

To: Commanding Officer
AFFTC
Edwards Air Force Base
Edwards, California

April 25, 1952

Thru: USAF Plant Representative
The G. L. Martin Company

Subj: Failure, fuel tank stays, XB-51 serial 46-686

Ref: (a) Telcon. between Major J. Colopy, WADC, and Messrs Mead and Kershaw of the G. L. Martin Co., on 4-22-52.

Contractor believes failure due to excessive negative differential pressure between fuel tanks and fuel tank cavities. Placarded differential pressure gage installed forward of control column probably not functioning properly. Contractor suggests that airplane be temporarily placarded to 5,000 ft. per minute climb or descent maximum and restricted to no aerobatics until proper instrumentation can be installed.

THE GLENN L. MARTIN COMPANY

/s/ C. F. Bell, Manager
Service and Spares Department

MJC:rks

cc: Commanding General
WADC
Wright Patterson Air Force Base
Dayton, Ohio

Attention: Major J. W. Colopy, WCSWB

Certified true copy.

JAMES A. [illegible]
Captain, USAF
Chief
Flying Safety Office

STATEMENT

12 May 1952

I, Lee R. Embree (Civilian), motion picture cameraman in the Motion Picture Section of the Photographic Branch, make the following statement.

On the morning of 9 May 1952, I heard that the XB-51 was going to make a flight, so I contacted my unit chief and he in turn called Capt. Curtis to find out for certain whether or not the plane was going to fly. Capt. Curtis said that it was scheduled to fly, so my unit chief asked Capt. Curtis if it would be possible to shoot some motion pictures of the plane doing fly-bys similar to those we had already photographed of several other types of planes, for a motion picture being made to depict projects being conducted here at the Air Force Flight Test Center. Capt. Curtis said we could photograph it, and gave us the approximate take-off time. I came down to the flight line and since the plane was not quite ready to take off, we waited. I talked to Maj. Lathrop just before he climbed into the airplane. I introduced myself and told him who I was and asked him if Capt. Curtis had talked to him about us making motion pictures of the flight. Maj. Lathrop said that Capt. Curtis had talked to him and that everything was all right. I then asked him about the direction in which he was going to fly so that we could photograph the plane properly without the sun shining into the camera lens. Maj. Lathrop said he was going to make four (4) passes over the field, two (2) in each direction, and on the last pass, he was going to do a roll just after he passed the field. I said we would be sure to have the cameras shooting each time he made a pass in the direction away from the sun. That ended our conversation. I then proceeded down to a point on the taxi strip directly in front of the control tower. I set up my camera loaded with color film. I photographed the airplane as it made one or two passes, and once or twice, I tracked the plane but didn't actually have the camera running. On the fourth pass over the field, I picked him up in the view finder. I was using 152 mm. lens to give a more close-up view of the plane from the position where I was set up. As the plane passed over the field, I picked him up and followed him until the crash, and for several seconds after. While the camera was running and the plane had started to make the roll, I realized that I was having to tilt the camera lens down to keep the plane in the view finder, and realizing the plane was flying low to begin with, I felt sure that something was wrong. I thought to myself, he must be getting very close to the ground, and about the time the ground came into view in my view finder, the plane crashed. I then proceeded in the truck down to the scene of the crash and made additional short scenes of the wreckage.

L. R. Embree

LEE R. EMBREE
Motion Picture Cameraman
Photographic Branch

S T A T E M E N T

15 May 1952

I, Andrew M. Smolcynski, S/Sgt., USAF, AF-13284649, Senior Control Tower Operator on duty at the time of accident of XB-51, 46-686, certify the following statement to be true to the best of my knowledge:

At approximately 0838 PST, at the request of aircraft 686, I cleared subject aircraft for a low pass for photo purposes. After clearing 686 for this pass, no other radio contact was made between the tower and aircraft. During the time I maintained control of the tower, no radio contacts, other than that mentioned above, were made with 686, any other aircraft, or any ground station; but prior to the final two passes, I overheard "Easy" Channel, (Flight Test Operations), request 686 to make the passes at tower height.

I witnessed aircraft 686 make the final two passes at tower altitude, and also witnessed the resulting crash at 0841 PST.

Andrew M Smolcynski
ANDREW M. SMOLCYNSKI
S/Sgt., USAF
AF-13284649

S T A T E M E N T

13 May 1952

I, Vergil C. Givens, Capt., USAF, 16824A, make the following statement:

I observed the XB-51, 46-686 make the following tower fly-bys between 0930 and 0945 PDST on the morning of 9 May 1952:

1. A high speed pass at approximately 100 feet from west to east, parallel to the runway. The pass was observed from the time the aircraft passed the west end of the runway until the aircraft passed the control tower. I could not estimate the speed on this pass.

2. A high speed pass from east to west, parallel to the runway and at approximately 75 feet. The pass was entered from a left turn from about two miles from the east end of the runway, and was maintained level until about one mile past the west end of the runway when a slightly climbing shallow turn to the right was started. It is estimated that the airspeed was between 500 and 600 knots.

3. A high speed pass from west to east, parallel to the runway and at approximately 75 feet. The pass was entered from a slightly diving (10°) left turn about two miles from the west end of the runway and was maintained level until approximately one mile past the east end of the runway when a gentle, slightly climbing turn to the left was started. It is estimated that the airspeed was slightly lower than on the previous pass and was about 500 knots.

4. A moderately fast pass from east to west, parallel to the runway and at approximately 75 feet. The pass was entered from a shallow left turn about two miles from the east end of the runway and maintained level until just in front of the East Hangar. The speed on the level portion was about three-fourths of that on the previous passes, or approximately 400 knots.

As the aircraft passed the East Hangar, a slight pullup of about 20° was made and at about 100 feet, the aircraft began to roll to the right. The nose began to drop as the aircraft approached the inverted position and the aircraft was approximately level as it passed through the inverted position. The nose began to drop slightly and the aircraft began to "dish out" of the roll as it passed through the three-quarter point. The aircraft struck the ground at about 20° nose down and in a left bank of about 30°. The contact with the ground was followed by an explosion and resultant pillar of smoke and flame.

Vergil C. Givens

VERGIL C. GIVENS
Captain, USAF
16824A

S T A T E M E N T

21 May 1952

I, Robert L. Northrup, Major, USAF, 7176A, hereby make the following statement concerning accident of aircraft XB-51, 46-686, which occurred on 9 May 1952:

On the evening preceding the accident, Maj. Lathrop and I held a conversation concerning his part in the anticipated Armed Forces Day Show.

Throughout the entire conversation, Maj. Lathrop made no mention of his contemplated flight for the following day, therefore, I had no knowledge whatsoever that he was scheduled to fly the XB-51 on 9 May 1952.

I did not witness any portion of this flight or the crash that followed.

Robert L. Northrup

ROBERT L. NORTHRUP
Major, USAF
7176A

The Aircraft Accident Investigation Board, appointed by Special Orders #17, Headquarters, Edwards Air Force Base, California, dated 24 January 1951, convened at 0830 hours on 19 May 1952 in the Division Conference Room, Edwards AFB, to discuss the accident of aircraft XB-51, 46-686, which occurred on 9 May 1952.

Members present were:

Col. Howard C. Knapp	(Flight Surgeon)
Lt. Col. Frank K. Everest	(Chief, Flight Test Operations Lab)
Lt. Col. Walter L. Moore, Jr.	(Asst. Chief, Flight Test and Development Division)
Maj. David M. Sharp	(Chief, Aircraft Maintenance Lab)
Capt. James A. Bryant	(Flying Safety and Aircraft Accident Investigating Officer)

Members absent:

Capt. William R. Coleman	(Chief, Flight Operations)

Presiding Officer:

Col. Fred J. Ascani	(Chief, Flight Test and Development Division)

The meeting was called to order by the Presiding Officer and the following information was offered for the record:

A motion picture film of the entire accident, from the initiation of the roll, until contact of the aircraft with the ground and some seconds thereafter, was obtained coincidental with the original intention of obtaining film coverage of this aircraft, to be used in a consolidated film for the benefit of a forthcoming Command presentation of the projects being conducted at the Air Force Flight Test Center. All members of the Aircraft Accident Investigation Board, present on this date, signified that they had seen subject film.

It might be well to mention at this time, that Maj. Neil H. Lathrop, the pilot of XB-51, 46-686, had completed thirteen hours and forty minutes (13:40) flying time in this aircraft, more than that of any other pilot at the Air Force Flight Test Center. Of all the pilots assigned to AFFTC, Maj. Lathrop was considered the best qualified in the XB-51. Examination of Maj. Lathrop's records indicated that he had completed the XB-51 questionnaire.

1ST WITNESS: Mr. Raymond J. Vogel, Field Engineer of the Glenn L. Martin Company, (Manufacturer of XB-51), assigned to Edwards AFB.

Q. We appreciate your appearing before this Accident Board, and although the evidence is quite indicative as to what may have led to the cause of this accident, we are interested in obtaining any and all information available to preclude recurrence of a similar accident. First of all, how long have you been associated with this aircraft, since its inception? By that, I don't mean this particular aircraft, I mean the model XB-51.

A. Since 1948.

Q. In other words, approximately four (4) years?

A. Yes sir.

Q. Were you engaged quite actively in connection with the aircraft and in following its performance? During the period of your association with this airplane, had you ever before witnessed a similar performance, with the exception of the crash, of course, that may have been accomplished by any other pilot in this aircraft?

A. Not at that low altitude or at that speed.

Q. Could you describe one or two performances you may have observed in the past, stating facts concerning altitude, speed, etc?

A. There were several demonstrations conducted at 600 feet. Speed was kept at about 350, a roll started, nose up.

Q. Please describe for us, the performance of the aircraft throughout the roll from this point of view; on previous performances, did it appear to roll with relatively little loss of altitude, or was this a typical slow roll?

A. All the rolls that I watched, and according to the pilots' comments, used very little altitude.

Q. Are you familiar with the manner in which this roll was performed? A good number of the witnesses estimated the altitude at which he came over the field to "dish out" of the roll. Would you say that these other performances you observed included the same apparent "dish out", or not?

A. When Maj. Lathrop started to roll the airplane, I knew then that he would never make it. He was flying too slowly at too low of an altitude.

Q. What is your estimate of his speed?

A. In one of my statements, I said 275 MPH.

Q. Do you know the rate of roll for 40C?

A. I can't see that any pilot would hold it at that rate of speed, that is, 275. We did not get too much data on these different phases, we were more interested in the performance of the airplane.

At this point, Lt. Col. Everest, Chief of Flight Test Operations Lab interrupted:

"During a pilots' meeting several weeks prior to the accident, I discussed with them, the fact that various airplanes have a different maximum rate of roll at various airspeeds. Each airplane has its own intermediate speed from which the maximum rate of roll is determined. Maj. Lathrop indicated interest in this, and was observed, by myself, to be studying Performance of Stability data previously tested on the XP-51, probably to determine the XP-51's best speed for maximum rate of roll."

Continuing with Mr. Vogel's testimony:

Q. Were you very well acquainted with the pilot, Maj. Lathrop?

A. Yes sir, very close.

Q. I presume you had various discussions with him concerning the aircraft, its performance, etc.?

A. Yes sir.

Q. Did you talk with Maj. Lathrop just before the flight which ended in this crash?

A. The only time I talked with him that day, was on our way out to the airplane. I went up to the cockpit with him. He said he was going to make a few high speed passes and asked that I stay in contact with him so I could answer any questions he might ask. We pulled out the pins, locked the door, and then I went up to Flight Test Operations.

Q. At any time just prior to take-off, did Maj. Lathrop mention to you, any intention to roll the aircraft?

A. No sir, he did not.

Q. Now, about the receipt of certain information from the contractor, the Glenn L. Martin Co., concerning a fuel cell deficiency which it was believed was caused by negative pressures resulting in partial splintering of several of the wood braces in the fuel cells; as I understand it, you had received this information here at the AFFTC.

A. Yes sir. On April 25, there was a copy of that telegram sent here to the base. It recommended that no acrobatics be performed and that the rate of climb be held at 5,000 feet per minute. A copy was sent to WADC, Maj. Colopy, and a copy to Mr. William Starkey, CIM Representative.

Q. Could you tell us the circumstances surrounding your passing along this information to Maj. Lathrop?

A. On April 29, Mr. Starkey took his copy over to Maj. Lathrop and discussed with him, the differential pressures of tank cavities. Maj. Lathrop then requested his secretary to make four copies and stated that he was not aware of this telegram that was sent to Headquarters. The original copy was then returned to Mr. Starkey.

Q. I am interested in determining the results of any discussions you may have had with Maj. Lathrop concerning this deficiency. Had you discussed the situation with him?

A. When I got back from the plant, I asked Mr. Starkey if he went over this telegram with Maj. Lathrop and he said that Maj. Lathrop was well aware of it.

Q. Not just prior to take-off for this flight, though?

A. No sir. We talked about what was breaking the braces in the fuel cells before the letter came, and then when I went back to the factory, we had a meeting. That is when we sent out the letter.

Q. Was it your opinion, or the opinion of Mr. Starkey, that this was a rather serious deficiency?

A. No sir.

Q. Did Maj. Lathrop ask you for an expert opinion on the seriousness of such a deficiency?

A. No sir.

Q. When did you return from the factory? How many days were you here before the accident?

A. I came back on Tuesday and the accident was on Friday.

Q. During that time, you had no discussion with Maj. Lathrop?

A. No sir.

Q. Was Mr. Starkey here during that period of time?

A. Yes sir.

Q. Was he here when the accident occurred?

A. Yes sir.

Q. Do you know if he had any discussion with Maj. Lathrop concerning the seriousness of this deficiency?

A. We discussed very thoroughly, the rate of climb and differential pressures, the main thing being pull-outs. That is why they sent that letter stating that until further instrumentation of the tanks could be accomplished, no acrobatics were to be performed.

Q. Was there any structural or control deficiency which may have caused or led to the crash?

A. I would say no, sir. I observed the entire accident and I don't think there was anything inferior in the airplane at all.

Q. Then any question of a malfunction can be ruled out as being a cause of this accident?

A. Yes sir. Maj. Lathrop was very cautious and went over the airplane with us quite often. He asked a lot of questions and we talked with him almost every day about the performance of this airplane.

At this point, Col. Knapp, the Medical Officer, inquires:

Q. You stated that on the morning of the day of the accident, you talked to Maj. Lathrop. Did you observe anything that might indicate that he was in anything other than good general health?

A. No sir. He was just as happy as he always was.

Q. You've been around many other flights; did he seem perfectly capable and alert?

A. He sure was, sir.

2ND WITNESS: Mr. Lee R. Embree, civilian, motion picture photographer assigned to the Photographic Branch at Edwards AFB.

Q. We have your statement here, Mr. Embree, and the portion of it that we are most concerned with, is your discussion with Maj. Lathrop just before he went into the aircraft and took off. We would like you to try to recall, to the best of your knowledge and ability, in as much detail as possible; specifically what conversation was held between you and Maj. Lathrop just prior to his flight.

A. When I first went out to the plane, I saw that they were having some difficulty with one of the engines, so I waited in the carry-all until the plane was ready. Maj. Lathrop came up to the plane, so I went over to him, told him who I was, and asked him if Capt. Curtis had contacted him regarding the taking of motion pictures of the XB-51 flight for a film which was being made for the Air Force Flight Test Center. Maj. Lathrop said, "Capt. Curtis talked to me about it and all arrangements have been made. It is all right to take the pictures." I said that was fine, and asked him in which direction he would be flying over the field for the purpose of determining the location and direction we were to photograph. This was about ten o'clock in the morning and we didn't want to photograph with the sun shining in the lenses. Maj. Lathrop said, "I will make four (4) passes over the field. Two (2) in each direction. At the end of the last pass over the field, I will roll the airplane over." I said that would be fine and we would have our cameras ready to photograph the passes over the field. That ended my conversation with Maj. Lathrop.

Q. Did he tell you of the direction in which he would roll the aircraft?

A. He did not say in what direction he would roll, but he did say that it would be just after he passed the field.

Q. At the time he made that statement to you, did you not consider this to be an unusual maneuver?

A. Not unusual, because I had heard that they had done that before in the same airplane. Not knowing what altitude he would be flying, I did not consider it unusual.

Q. In your own mind, what did you consider his altitude might be, for the purpose of lining up your camera?

A. For the purpose of our camera . . . actually I don't know what altitude I would have in mind.

Q. Where did you set up your camera?

A. I had it set up so that I could tilt it when necessary.

Q. We all have seen the film which you took during this accident, and I would like to ask you something to determine whether or not my assumption is correct. It appeared to me as though you had the camera pointed to the southwest and started up your camera before the aircraft entered your view finder.

A. That is correct.

Q. Then, it is logical to assume that on this last pass, you did not pick up the aircraft at the beginning of the pass, but had the camera ready for the maneuver.

A. That is correct. In the previous passes that I photographed, once or twice I did not run the camera, I just followed the aircraft. I was testing this lens; it was a 152 mm. lens. I had this particular lens on the camera because he said he would roll the airplane at the end of the field, and I knew that the 1" lens, the one we normally use, would make the airplane look very small.

Q. At any time during this last pass, did you vary your camera angle from its original position?

A. Yes sir. I could, of course, see the airplane approaching from the opposite direction, so I could judge pretty well where he was going to be.

Q. Did you get any part of the last pass before he came abreast of you? Did you get any of his approach?

A. No sir.

Q. Did you "pan" at any time during his last pass before you started your camera?

A. I did not "pan" in the true sense of the word, but I did have to move the camera.

Q. At what point?

A. After the airplane passed in front of me.

Q. The initial scene shows the camera in a fairly fixed position, showing nothing but blue sky, and all of a sudden, the airplane appears. It didn't seem as though there was any camera movement at all until the airplane appeared.

A. The airplane was flying in a straight line and I did not have the camera set exactly, so I had to vary a little, which would show clear sky.

Q. The conversation you had with Maj. Lathrop prior to his entering the aircraft - was this the only discussion you had ever had with him concerning flying this aircraft?

A. Yes sir. In fact, I had never met the Major before. I didn't know for sure who he was.

Q. In this program you are conducting to make films depicting the activities here at the AFFTC, had you taken any pictures of any similar situation?

A. Yes sir.

Q. Which ones?

A. I think the F-86, F-84D, B-47, and X-5. I think that is all, sir.

Q. Do you have any rolls in any of those films?

A. No sir, just straight flying.

Q. Had you discussed with any other pilots, rolling the aircraft, or just fly-bys?

A. I did not talk to any of the pilots who had made any of these flights because Capt. Curtis was acting as liaison officer and all the arrangements were made at Flight Test Operations. Capt. Curtis came up to our Lab and discussed the brief schedule that he had written up which had been approved to shoot various scenes.

The Medical Officer inquires:

Q. As you have just indicated, you talked to Maj. Lathrop on the morning of the day of the accident. As near as you could tell, was Maj. Lathrop in good physical condition?

A. He appeared to be.

Q. Alert mentally?

A. He appeared to be. Nothing seemed unusual or abnormal.

3RD WITNESS: Vergil C. Givens, Capt., USAF, 16824A, Assigned to Flight Test Operations Lab, Flight Test Operations Branch, as an experimental flight test pilot.

Q. We have your statement here concerning the accident, but it is my understanding that you are responsible for maintaining the files, in which, among other things, all data concerning the XB-51 is included. Is that correct?

A. I am Unit Security Classification Officer and I do have access to the safe. However, filing the information is not my responsibility.

Q. I have been lead to understand that you may have had some discussion with Maj. Lathrop that would give you reason to believe that he was aware of the most recent correspondence concerning the restrictions to be placed on the XB-51.

A. On the afternoon of the 8th of May, Maj. Lathrop asked me to get from the safe the next morning, the Flight Limitations of the XB-51. I did so, and gave it to him at approximately 0730. This was a letter from the Martin Co., addressed to the attention of Maj. Lathrop. I don't recall its contents exactly.

Q. Had you seen it previously?

A. Yes sir.

Q. Could you identify its contents to correlate this particular correspondence with the one I had in mind?

A. It is a letter on the Flight Limitations of the XB-51.

Q. Are you aware of its contents?

A. Not sufficiently to testify on it, sir. It gave some speed limitations at various altitudes, I had not seen a telegram similar to the text of the one you have here until after the accident. But it is my understanding that the telegram was already in the office.

Q. Can you enlarge on this discussion you had with Maj. Lathrop the afternoon before the accident?

A. I had just run an inventory on the safe and so he thought I would know exactly where the data was.

Q. To the best of your ability, can you possibly give us, in the first person, exactly what yours and Maj. Lathrop's comments were?

A. I can't remember the exact conversation. He asked me to remove from the safe, and give to him the next morning, the letter concerning the Flight Limitations of the XB-51.

Q. Did he say anything further?

A. No, he did not, nor did he tell me why he wanted it.

Q. He just made a one statement address?

A. Yes sir. I removed it on the very day of the accident.

Q. Did you give it to him the following morning, the morning of the 9th of May?

A. Yes sir.

Q. What was your conversation with him when you gave him the letter?

A. I just handed it to him. I believe he read it and later he handed it back and I checked it back into the safe.

Q. Were you standing there while he read it?

A. Not all of it, sir.

Q. Where were you at the time of the accident?

A. I was standing with Col. Prentiss and Mr. Yancey, just at the corner of the parking lot between the East and West Hangars. On the one pass, I estimated his speed at 500 - 600 knots, just about a .9 mach number. The next pass was slightly slower because the sound did not reach us until a longer period after the aircraft had passed. The third pass was about three-fourths of the speed of the previous pass. I checked the mach no. to be about .85 or .9.

Q. On the morning of the 9th, the day of the accident, in your dealings with Maj. Lathrop in handing him this correspondence, did Maj. Lathrop's attitude and conduct appear to be normal in every respect?

A. Yes sir.

Q. Did he appear to be nervous or worried about anything?

A. No sir.

Q. Did you overhear any conversation concerning any unusual maneuvers to be made on this flight?

A. No sir.

4TH WITNESS: MR. William T. Starkey, Field Representative of the Glenn L. Martin Co., Baltimore, Md., assigned to Edwards Air Force Base.

Q. A point has arisen from our interviews on which we would like additional information, and we understand that you may be the individual who can enlighten us. It concerns a certain communication which was initiated by the Glenn L. Martin Co., recommending avoidance of the performance of certain maneuvers on this aircraft. Are you familiar with this correspondence?

A. Yes sir, I received a copy of the telegram.

Q. When?

A. It was dated the 25th of April, so I would say we received it three days later, because it was sent Air Mail. I would say we got it the 28th.

Q. Approximately a week or week and a half before the accident. Did this come to you directly?

A. Yes sir, it was addressed to me.

Q. Would you tell us what you did with that correspondence?

A. It has been a rule with Mr. Vogel and myself to inform Maj. Lathrop of all our correspondence that pertains to the airplane. I received it at my home address one evening after work and the next day, I showed it to Maj. Lathrop. At that time, he made the statement that he had not seen it. I think it was about the 29th of April. He had his secretary make four copies.

Q. Did you and Maj. Lathrop have a discussion at that time?

A. We talked it over.

Q. Could you give us, to the best of your ability, the contents of that conversation?

A. He asked me if the differential pressure gage was in working order on the airplane and I told him that it was. I remember Maj. Horn telling me that the differential pressure gage was operating, but I did not notice if it was.

Q. Did you discuss anything further? Did you discuss the effect of this deficiency on the aircraft?

A. We talked over the fact that there wasn't any particular danger and how we had happened to find out that the braces were broken by finding particles of wood in the strainers.

Q. Did you consider this deficiency as amounting to any particular seriousness or importance?

A. Being interested in the airplane, I am interested in anything that would go wrong.

Q. At the time you showed the telegram to Maj. Lathrop and while you were discussing it, what were his comments concerning the maximum rate of climb or descent not to exceed 5,000 feet per minute, and no acrobatics?

A. We read it over and Maj. Lathrop, of course, understood it. He said that he would watch from there on out.

Q. Did he indicate to you, from his attitude or comments, whether he considered this to be a serious deficiency?

A. He did not seem to consider it a serious deficiency.

Q. He was aware of the communication and what it recommended, but as far as you observed, he was going to fly the aircraft and had no cause to be alarmed?

A. Yes sir.

Q. Had you had any subsequent conversation with Maj. Lathrop prior to the accident?

A. No, I did not. Almost all the times that I would go to see Maj. Lathrop, you just couldn't make contact with him.

Q. Where were you at the time of the accident?

A. On the edge of the ramp.

Q. Did you talk with Maj. Lathrop while he was standing at the airplane before he took off?

A. Just to say, "Good Morning".

Q. No other conversation?

A. No sir.

Q. Did you know what his flight program contained for that flight?

A. No sir.

Q. Up until the accident actually occurred, were you aware of any intentions to roll the aircraft?

A. No sir, I was not.

Q. Then, it was a complete surprise to you when the aircraft rolled?

A. Yes, it was a surprise.

Q. Had you ever had any conversation with Maj. Lathrop on rolling the aircraft at close proximity to the ground?

A. No sir.

Q. Had you ever had any conversation with him concerning rolling the aircraft at all?

A. No sir.

Q. In your opinion, although the message states that no acrobatics should be performed, would a roll have any effect on collapsing the fuel tanks?

A. No, in my opinion, it would not.

Q. Did you discuss that with him?

A. No sir.

Q. This correspondence concerning the restrictions placed on the aircraft had been discussed with the pilot approximately eight (8) to twelve (12) days before the accident. Do you verify that, Mr. Starkey?

A. Yes sir.

5TH WITNESS: Andrew M. Smolcynski, S/Sgt., USAF, AF-13284649, Senior Control Tower Operator on duty at the time of accident of XB-51, 46-686.

Q. I would like to ask you, sergeant, if preliminary arrangements had been made with you, as tower operator, concerning the program to be followed during the flight of the XB-51 that resulted in the crash.

A. I was briefed that the aircraft was making low passes at approximately tower height.

Q. When were you advised of these circumstances?

A. When I came up to relieve the tower operator on duty on the 9th of May at approximately 0835.

Q. Who passed this information on to you. . . that the aircraft was going to make low passes?

A. A/2C Knuth. He was the senior operator on duty.

Q. Do you know where he got that information?

A. No sir, I can't say exactly, but I imagine he got it from Base Operations.

Q. Do you have an established SOP for controlling traffic during maneuvers which are other than those normally involved when entering the traffic pattern for a landing?

A. No sir.

Q. In your instructions, isn't there any information advising you of the procedure to be followed when any unusual maneuvers are involved?

A. No sir, we don't have an operating procedure for that.

Q. You have something which makes you responsible for controlling traffic.

A. Yes sir. When an aircraft is going to do any maneuvers, he has to call in for clearance, and if circumstances permit, he will be cleared.

Q. In what form do you have those instructions? Are they in an SOP?

A. They are in our SOP.

Q. Is there any particular time that the aircraft must call in for such a clearance?

A. Yes sir. He would call anywhere from three (3) to ten (10) miles out.

Q. In this particular accident, did the pilot call in requesting authority for each high speed pass?

A. Yes sir.

Q. You were aware of his location at all times, with respect to the traffic?

A. Yes sir.

Q. Could you indicate, to the best of your knowledge and ability, exactly what his transmission was prior to each pass?

A. I was on duty only for the last two passes. At the first pass, he said, "Edwards Tower, this is 686 requesting clearance for pass from west to east." We gave him clearance. The second time, he said the same thing, except it was from east to west.

Q. On what frequency was this transmission?

A. "Easy" Channel.

Q. Is this your test frequency?

A. Yes sir.

Q. Were you monitoring this test frequency from the tower?

A. Yes sir.

Q. Was his last transmission loud and clear?

A. Yes sir.

Q. Were there any other transmissions being made on any other frequency during that time?

A. No sir.

Q. If he had said more, would you have been able to hear it all right?

A. Yes sir.

Q. Were there no comments heard at the start or during his slow roll? Approximately how many seconds before he initiated his last pass was his communication with you made?

A. Approximately two or three minutes. It seemed that long because we were looking for him.

Q. Could you see him when he made contact with you.

A. No sir. Coming east to west across the lake, approximately five miles out, was the first we saw of him.

Q. Is it possible that he could have made another transmission before or after his last pass and you may not have heard it?

A. There could have been another one.

Q. You were monitoring "Easy" Channel. You didn't have it turned down?

A. No sir.

Q. As far as you were concerned, you were totally unaware that any acrobatics were going to be performed ?

A. Yes sir.

Q. Was anyone else in the tower with you at that time?

A. Yes sir.

Q. I am sure that he was not aware that any acrobatics were to be performed.

A. Yes sir.

Q. In your opinion, did the last pass appear to be as fast as the preceding three passes?

A. I only saw two passes and they seemed to be about the same speed.

Q. Had you been informed as to who was the pilot of the aircraft?

A. No, I did not know who it was until after the accident.

Q. Did you follow it through until the crash?

A. Yes sir.

Q. Being in the tower, you probably had the best vantage point to determine the altitude at the time of the pass. Can you give a good estimate as to how high he was?

A. He passed at approximately fifty (50) feet, just about even with the tower.

Q. What is the approximate altitude of the tower?

A. Forty-two (42) or forty-three (43) feet to the base of the tower. He was just about level.

6TH WITNESS: Capt. James S. Nash, 17025A, assigned to Flight Test Operations Branch as a flight test pilot.

Q. Your name is included in the statement of one of the witnesses as that of the pilot who escorted the XB-51 during the earlier portion of the flight that resulted in the crash. We don't have a statement from you, however, we would like to ask you some questions concerning your association with this aircraft during the flight. Would you please tell us, for the record, the circumstances concerning your escorting the XB-51. . . . times, altitudes, speeds, when you left the XB-51, and where you were after you left the XB-51. Were you assigned specifically to escort the XB-51?

A. Yes, sir, I was. I was assigned as escort officer of the XB-51. I was briefed to escort the aircraft from take-off to investigate the action of the gear and to fly with the aircraft at high speed to determine whether any of the gear doors would suck down in flight. I was also briefed to stay with the XB-51 and investigate the extension of the gear at altitude and to observe the action of the bomb bay doors at high speed. I took off in F-86 type aircraft and investigated the aircraft after take-off. The landing gear appeared to function properly and the XB-51 pilot was so informed. The XB-51 was flown at an altitude of approximately 6,000 feet and accelerated to a speed of approximately .9 Mach number in a shallow dive. He dived from approximately 6,000 feet to 5,000 feet over a fifteen mile flight course. I checked with the pilot of the XB-51 and told him that the aircraft appeared to be functioning properly. The aircraft was then flown to an altitude of about 9,000 feet. The XB-51 pilot stated that the climb would not be abrupt since he was limited to a rate of climb of 5,000 feet per minute.

Q. He did make that comment to you?

A. Yes sir, over the air. At approximately 230 MPH, he extended the gear. I investigated the landing gear extension and told the pilot that everything appeared normal. The XB-51 pilot then retracted the gear and the aircraft appeared normal with gear doors in place. The XB-51 was then accelerated to approximately .87 mach number at 8,000 feet and the bomb bay doors were actuated. When the bomb bay doors were actuated, I observed a "streamer" of vapor coming from the leading edge of the door. I notified the XB-51 pilot of this, and the bomb bay doors were actuated; opened and closed for the second time.

Q. When did you observe this vapor stream?

A. When the doors were in the initial stage of being opened.

Q. It appeared again on the second actuation?

A. Yes sir.

Q. Was it consistent or momentary?

A. It was momentary. At that time, the pilot of the XB-51 instructed me that I was relieved of the duty as escort pilot and that I could return to Edwards AFB.

Q. Can you recall his exact words?

A. I believe he said, "That will be all, Slade". That's my name!

Q. What did you do then?

A. I called the Edwards Tower and asked them, since they were conducting motion picture photography, if they were desirous of any pictures of the F-86 and they said that they would like to have me make some motion picture runs past the camera if I had adequate fuel. I made two camera runs and landed at Edwards AFB.

Q. Did it strike you as being at all peculiar, Capt. Nash, that since you were assigned to escort the XB-51, you were relieved from that duty before following through on the way into the traffic pattern before leaving the aircraft?

A. No sir, it did not, because I was assigned specifically to observe the aircraft under two conditions.... the aircraft gear extension and also the aircraft at high speed. However, during my briefing prior to the flight, I was not told that I would be relieved from that assignment.

Q. Had you had any conversation with Maj. Lathrop, in flight, concerning his further actions during this flight?

A. No sir, I did not, except at the time of dismissal, he stated that he would be in to the field very shortly. I can't remember the exact time, but it struck my mind that he was going to make some passes and that it would be some time before he would return to the base. That is the specific reason why I asked if they wanted motion picture coverage of my aircraft, because I estimated he would not be in the pattern for about ten (10) minutes.

Q. Had you had any previous conversation with Maj. Lathrop concerning rolling the aircraft?

A. Well, sir, I can't remember a specific incident when it was discussed.

Q. Specifically in connection with this flight?

A. Yes sir. I had overheard conversation discussing whether or not his part in the Air Show would be to perform a roll. But I did not hear discussion as to whether he should or should not do so. I had heard him say that he was desirous of rolling the aircraft for the Armed Forces Day Program.

Q. Had you entered into, or overheard any conversation concerning rolling this aircraft during this flight which ended in the crash?

A. None whatsoever.

Q. All during the flight, for the period of time you were escorting Maj. Lathrop, did he appear to be in a normal frame of mind? Was his behavior or conduct in variance with that which he always possessed?

A. Yes sir, I would say his conduct and frame of mind was normal, to the best of my knowledge.

Q. Were you on the ground, had you already landed when he was making his passes?

A. Yes sir. I had landed and returned to Flight Test Operations. I did not observe the accident.

Q. Where were you at the time of the accident?

A. Up in Flight Test Operations. I was discussing the F-86D program with North American tech. reps.

Q. Were you in a position to overhear radio transmissions on the radio set in that office?

A. Yes sir.

Q. Did you overhear any radio transmissions?

A. No sir.

Q. At the time of your contact with the XB-51 in the air, did Maj. Lathrop indicate any malfunctions?

A. No sir. As I recall, he transmitted over X-Ray Roger Peter radio that the aircraft appeared to be in acceptable flying condition.

The Presiding Officer interrogates the Medical Officer:

Q. "Col. Knapp, do you verify that you are thoroughly convinced, to the best of your knowledge, that Maj. Lathrop's mental and physical condition was entirely normal on the day of the accident?"

A. "I am so convinced".

The meeting was adjourned at 1200 hours, 19 May 1952.

JAMES A. BRYANT
Captain, USAF
Recorder

08/27/1952

Viscount

08/27/52

AviationSafetyNetwork
Accident Description

Home
- sign guestbook
- view guestbook
- editorial
- what's new?

Accident reports
Accident specials
CVR / FDR
Database
Mailing list
News
Other sites
Pictures
Publications
Safety issues
Statistics

Forum
E-mail
About ASN...

Accident description

Date:	**27.08.1952**
Type:	Vickers 630 Viscount
Operator:	Ministry of Supply
Registration:	G-AHRF
C/n:	1
Year built:	1948
Crew:	0 fatalities / 5 on board
Passengers:	0 fatalities / 0 on board
Total:	0 fatalities / 5 on board
Location:	Khartoum; nr (Sudan)
Phase:	Landing
Nature:	Test
Flight:	Khartoum - Khartoum (Flightnumber)

Remarks:
The Vickers 630 Viscount prototype aircraft was being used in tropical climate tests in Khartoum. Following one of these testflights the right hand maingear leg collapsed. It appeared that the light alloy machined bracket securing the right hand maingear radius rod to the rear spar had failed and the bolt pinning the radius rod to the bracket was broken.

Source:

[disclaimer]

08/29/1952

N84-26677
08/29/52

Structures Dept. Note No. Acc.248

March, 1953

ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH

Note on an Accident to the Boulton Paul 120 VT 951 Delta Aircraft

Prepared by: Winfried Braun
Approved by: D.T. Jones

R.A.E. Ref: Structures M/11183/WB

N84-26677
(RAE-Struct-Acc-248) NOTE ON AN ACCIDENT TO THE BOULTON PAUL 120 VT 951 DELTA AIRCRAFT (Royal Aircraft Establishment) 12 p HC A02
00/03 Unclas 92801

SUMMARY

This note gives an account of an investigation into an accident to the Prototype Boulton Paul Delta Aircraft 120, VT 951. The port elevon broke off in flight and the cause of the detachment was flutter involving the elevon-tab or the wing, elevon and tab. Examination of the wreckage showed a lack of stiffness in the tab control mechanism.

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1 Introduction

On 29th August, 1952, the port elevon of the Boulton Paul 120 Delta aircraft broke off in flight. The pilot was able to fly the aircraft for some time after the failure, but, due to difficulty in control at low speeds decided not to attempt a landing. He abandoned the aircraft by the ejection seat and escaped without serious injury. The aircraft crashed and was for the most part destroyed by fire.

2 Circumstances of the accident

Tests were being made during the flight to find the effects of sharp kicks to port and starboard on the rudder bar. After these tests had been done without incident up to a speed of 425 knots I.A.S., the pilot increased speed. In a slight dive at 450 knots (the highest speed reached by the aircraft) at approximately 4,000 ft, he heard a very intense buzz and saw the tab indicator flicker, but felt no buffeting in the control column or rudder bar. The aircraft was provided with powered controls. Before he was able to decrease speed he heard a loud bang from the rear and the aircraft commenced to roll to port. By application of aileron and rudder the pilot succeeded in regaining control and flew from Southampton to Boscombe Down intending to attempt a landing. However, finding that adequate control could not be maintained at low speeds, he abandoned the aircraft by the ejector seat. The pilot's report is given in Appendix I.

3 Wreckage examination

3.1 The port elevon

All the port elevon mass-balance weights except one had broken off (Fig.1 and 2). The one weight which remained was attached at the end of the outboard elevon tip. Further inboard the weights had detached by tearing out the rivets; still further inboard and at the inner part of the elevon the weights had detached (together with some of the local skin) and at the inboard end of the elevon they had broken away together with part of the torque tube and the nose of the elevon.

3.2 The elevon, which is in two parts connected by a universal joint, separated from the wing at the five hinged attachments. Evidence of damage done to the elevon by interference with a wing rib shows that the elevon had deflected up through a large angle (i.e. greater than 60°) while it was still attached to the wing.

3.3 The elevon tab was creased along its whole length on the lower surface (Fig.3). This shows that the tab had been forced downwards against the elevon trailing edge. The angle achieved by the tab when the damage was produced must have been about 45° down.

3.4 The tab operating lever broke away from the tab due to fracture of the tab skin around the point of attachment. (Fig.4 and 5). This fracture must have occurred after the formation of the crease in the tab, as the small detached portion of skin was creased in a manner continuous with the crease in the remainder of the tab. Furthermore, damage in the form of a crack which is associated with the creasing continues from the fractured portion of skin across the line of separation of the tab skin (Fig.5). The tab surface around the fracture and the tab rib at this point show evidence of severe hammering by the end of the separating rod. The end of the lever shows corresponding hammering marks and the lever is bent in compression (Fig.4).

3.5 Significant evidence was found in the elevon tab operating mechanism. The tab is moved by a rod which is operated by a balance lever controlled both manually and electrically (for automatic trimming) through screw jacks. The manual operation is for trimming only and is done through jack A (Fig.6) while the automatic electrical operation is initiated by the torque applied to the elevon. If this torque exceeds a specified value (23 lb ft in this instance) a micro-switch is actuated and an electric motor brings jack B into play and moves the tab in order to decrease the elevon torque. Both jacks are mounted side by side on the wing spar and one point of attachment of the jack ram to the balance lever acts as a fulcrum for the lever when the other jack ram is in operation. The connection between the manual operation jack and the balance lever is made by an articulated link so that movement of the balance lever does not tend to force the jacks towards or away from each other. Evidence of excessive movement of the link was found in the form of a smear on the balance lever (Fig.7 and 8). This suggests that the linkage was not sufficiently rigid.

3.6 The main wreckage

The main wreckage of the aircraft, which was found at Cholderton Park near Boscombe Down, had been badly damaged by impact with the ground and by fire. Since it was known that the primary failure was in the port elevon, examination of the main wreckage was confined to those features which might throw some light on this failure.

3.7 The port elevon torque shaft was broken at the flange (Fig.9). This failure was found to be secondary, that is induced by the failure of the elevon. A failure of the rod from the hydraulic booster to the operating lever of the torque tube seems also to be secondary and due to impact, as it is a bending failure (Fig.10).

3.8 The starboard elevon showed no failures similar to those of the port elevon; in particular there were no signs of a failure of the attachment of the tab control to the tab and no indication of a crease in the tab (Fig.11).

3.9 The failure of the pitot tube is significant. This tube, which projects from the leading edge of the port wing, was broken into three parts. The fractures indicate that the tube was subjected to repeated up and down bending. The pilot reported that the tube failed at the time when the elevon broke away.

4 Discussion of the cause of the accident

4.1 The strength of the tab

There can be little doubt that the accident was due to flutter either of the wing-elevon-tab system or the elevon tab system. The detachment of the elevon mass-balance weights in the air and the manner in which they detached indicates violent movement of the elevon about its hinge and the crease along the tab shows that the tab was forced violently against the elevon. The large elevon and tab angles attained when the failure occurred are also indications of flutter: such large angles cannot be attained under steady aerodynamic loads but require inertia forces. The failure of the pitot tube shows that bending or torsional vibration of the wing also occurred.

4.2 It has been suggested that the flutter may have occurred as a result of prior detachment of the tab from its operating lever under steady aerodynamic loads. This suggestion cannot be supported, however, as the attachment has an ample margin of strength under aerodynamic loads. Assuming that the full power of the electric motor is applied to move the tab the torque on the tab is estimated to be 162 lb ft and calculations show that the strength of the tab, and its control rod, is more than adequate to carry a load 1.5 times this amount.

4.3 A test done at the firm before the accident showed that the tab could withstand the proof load (factor 1.0) with no signs of damage, and a test done after the accident showed that the tab could also withstand the ultimate design value, that is 1.5 times the proof load. This test loaded the operating lever in tension.

4.4 The test was repeated to load the operating rod in compression. Failure occurred at 235 lb ft (= 1.45 proof load) by buckling of the rib supporting the operating lever attachment. The failure was similar to that in the wreckage. However, the aerodynamic load necessary to produce this failure at the speed when the accident occurred (450 knots I.A.S.) would correspond to a tab normal coefficient of $c_n = 0.88$, and this value cannot be realised, even for full deflections in the most adverse direction. The possibility of failure by steady aerodynamic load must therefore be rejected.

4.5 Tab control mechanism

The presence of the smear described above in the tab operating linkage suggests a lack of stiffness in the linkage and it also seems likely that the lack of stiffness contributed to the flutter. The linkage was tested to find the load required to effect the movement necessary to produce the smear, and it was found that a load less than one fifth of the design load (corresponding to a tab normal coefficient of $c_n = 0.09$ at the speed of the accident) produced the movement. Some movement was produced at a considerably lower load than this. The linkage tested was not significantly damaged by the crash and it must be presumed that the low stiffness was present before the accident. The stiffness was much lower than was present on the linkage in the firm's test specimens (see above). In that instance no movement was apparent until a load of 1.36 times the design load was applied.

4.6 Flutter investigations

A theoretical investigation into the flutter speed had been made by the R.A.E. for the first prototype, the P.111 aircraft, and that investigation indicated that there was no risk of flutter of the wing or elevon at speeds up to a value beyond the design diving speed. As the P.120 aircraft had the same design of wing, elevon and tab as the first prototype, it was assumed that the P.120 aircraft had the same flutter characteristics. The first prototype had been flown at speeds beyond that at which the accident occurred without any indication of flutter.

4.7 The flutter calculations had omitted tab considerations entirely, as the tab backlash was small (20 min) and the tab control was irreversible. After the accident a resonance test was done at the firm. This showed that the natural frequency of the tab was rather low (40 c.p.s.) and indicated that tab deflections should not be omitted in the calculation.

4.8 The flutter calculations are being repeated at the R.A.E., taking into account possible movement of the tab and the natural frequencies as measured, but the result shows again that no flutter should occur at the speed when the accident occurred. Even on the assumption of a natural frequency of zero for the tab (the case with no stiffness of the tab control, i.e. a loose tab) the calculations indicate only a mild form of flutter over the speed range of 100-200 knots at the elevon natural frequency. However, the hammer marks on the tab show that flutter of the tab must have occurred after the detachment of the operating lever and the theoretical estimates with respect to a free tab must in this instance be discounted.

Attention is being given to the effect of flexibility of the elevon mass balance attachments. In accordance with normal practice the original calculations did not take this into account but it seems possible that this feature may affect the flutter characteristics.

5 Remedial measures

It seems unlikely that the association of low stiffness in the tab control with flutter was fortuitous and this suggests that the remedy lies in improvement of the control mechanism. As the flutter characteristics of the aircraft are not fully understood, however, it cannot be concluded that this is the sole remedy. In addition to an improvement in the mechanism, which consists of stiffening the mounting and removing the articulated link, the following modifications are being considered for the P.111 aircraft.

(a) A reduction in the tab chord (from 6.55 ins to 4.37 ins).

(b) Provision of 60% mass balance for the tab.

(c) An increase in the inboard elevon mass balance from 57% to 96% and a stiffening of the mass balance attachments.

6 Conclusion

The accident was due to flutter of the elevon-tab combination or the wing-elevon-tab and there are indications that a lack of stiffness in the tab control mechanism was contributory to the onset of flutter. The mechanism is to be modified and in addition, as the flutter characteristics are not fully understood, other modifications recommended for the avoidance of flutter are to be embodied.

APPENDIX I

Pilot's Accident Report

P.120 (Delta) - V.T.951

A normal take-off was carried out and the aircraft climbed away to 5,000 ft, on a heading of 240° (M). A series of vibrograph tests was then carried out.

These tests consisted of making sharp kicks on the rudder bar at the following speeds:-

350, 375, 400 and 425 knots I.A.S.

These tests were completed for kicks both to port and to starboard. There appeared to be no indication of flutter or of anything other than normal oscillations resulting from kicking the rudder.

A gentle turn was then made and a course taken up which led over Southampton at 5,000 ft. As these tests had to be repeated at 450 knots I.A.S. on the next flight, it was decided to increase speed from 425 knots to 450 knots as this was the fastest speed the aircraft had ever reached. Throttle was not used to increase speed, the aircraft being put into a very slight dive. At approximately 4,000 ft and a speed of 450 knots a very intense "buzz" became apparent and it was noticed that the electric tab indicator was flickering violently. No buffet was felt on the rudder bar or the control column. The throttle was closed immediately but before the dive brakes could be operated there was a very loud bang from the rear end and the aircraft commenced to roll to port. After completing two rolls full starboard aileron was being used. This starboard aileron decreased the rate of roll but the spring feel appeared to have no effect. Full starboard rudder was then applied and held for the rest of the flight.

It was immediately noticed that there was no airspeed indicating and visual investigation through the port window showed that the pitot head was at an angle of approximately 45° to the line of flight and that the first foot of the pitot head was bent back flush with the remainder of the tube.

It was decided at this juncture, to select manual control, to remove the spring feel and to alter the tailplane setting. With engine on, full starboard rudder, control column hard forward and 45° to starboard the best tailplane setting was -6°. This allowed a slow climb away to 12,000 ft.

When the aircraft had settled down on the climb it was noticed that the wing skin immediately forward of the outboard section of the port elevon had lifted approximately 4 ins. Boscombe Tower were immediately informed by R/T of the damage known and also that an attempt would be made to return to base. The wire recorder was then switched on.

At 12,000 ft some investigation was then carried out, it was discovered that if power was reduced, the control column moved or starboard rudder taken off the port wing would immediately drop. To maintain reasonably level flight the elevon desynns were reaching between 5° + 6° down.

After some difficulty 11,000 ft was obtained directly over Boscombe Down. Height was then reduced very gradually but great difficulty was

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found in keeping up the port wing. At approximately 6,000 ft over Salisbury Plain the aircraft became increasingly difficult to handle and it was decided to eject. On jettisoning the hood, however, the aircraft appeared to settle again in level flight. It was then possible to see the full port wing and Boscombe Tower were then informed that approximately 2 ft of the wing surface immediately ahead of the outer port elevon had lifted. The aircraft by this time was proceeding in a wide gradual turn to starboard and losing height. The test pad and scarf were thrown overboard.

Thoughts were then given to attempting a belly landing on Boscombe Down airfield but this idea was discarded on reaching a height of approximately 3,000 ft when, due to the rough air at this height, violent lateral oscillations occurred. The control column was centralised and the feet removed from the rudder pedals. The port wing immediately commenced to drop and ejection seat action was immediately taken, the seat leaving the aircraft with approximately 60° of bank to port.

Once clear of the aircraft the seat carried out various tumbling and spinning gyrations. By mistake the parachute rip chord was pulled instead of the pilot's seat release harness. This was immediately rectified, the seat fell away and the parachute opened.

Immediately after the parachute opening jerk a very rough landing was accomplished through trees.

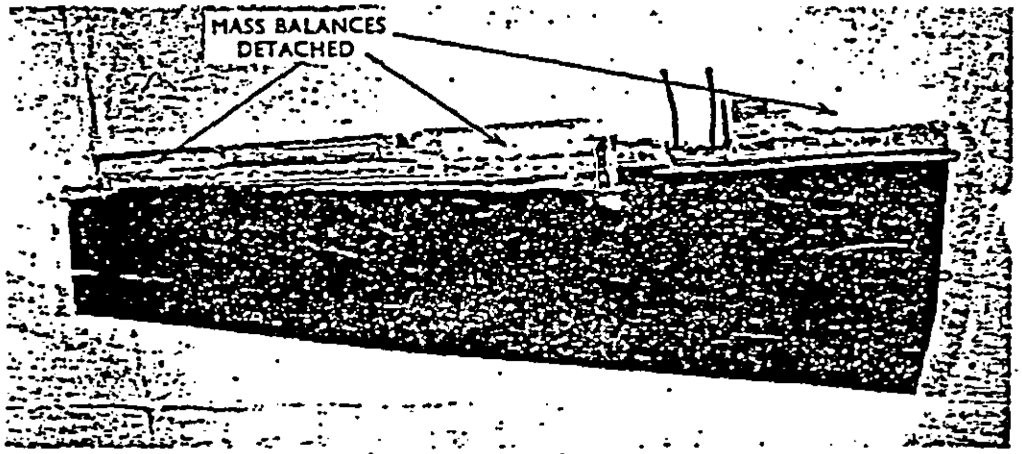

FIG.1. PORT OUTER ELEVON, UPPER SURFACE, SHOWING POINTS OF DETACHMENT OF MASS BALANCE WEIGHTS

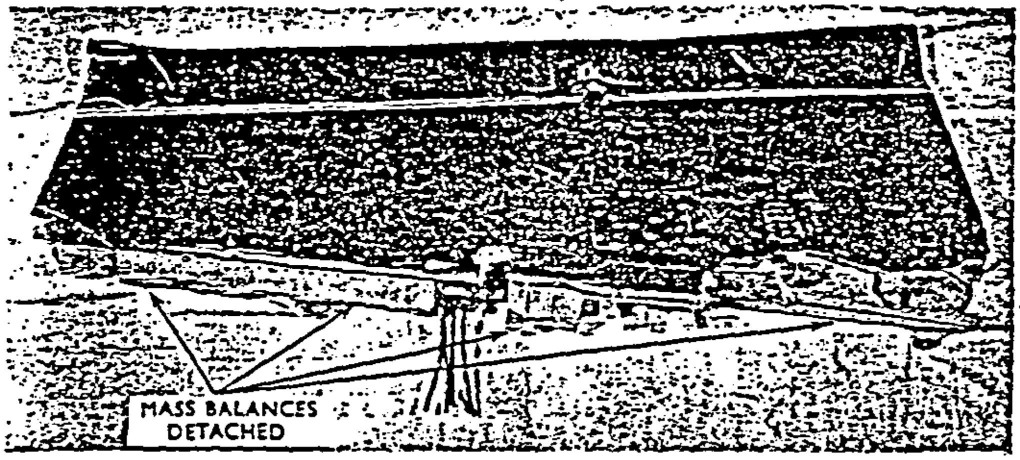

FIG.2. PORT INNER ELEVON, LOWER SURFACE. SHOWING DETACHMENT OF BALANCE WEIGHTS

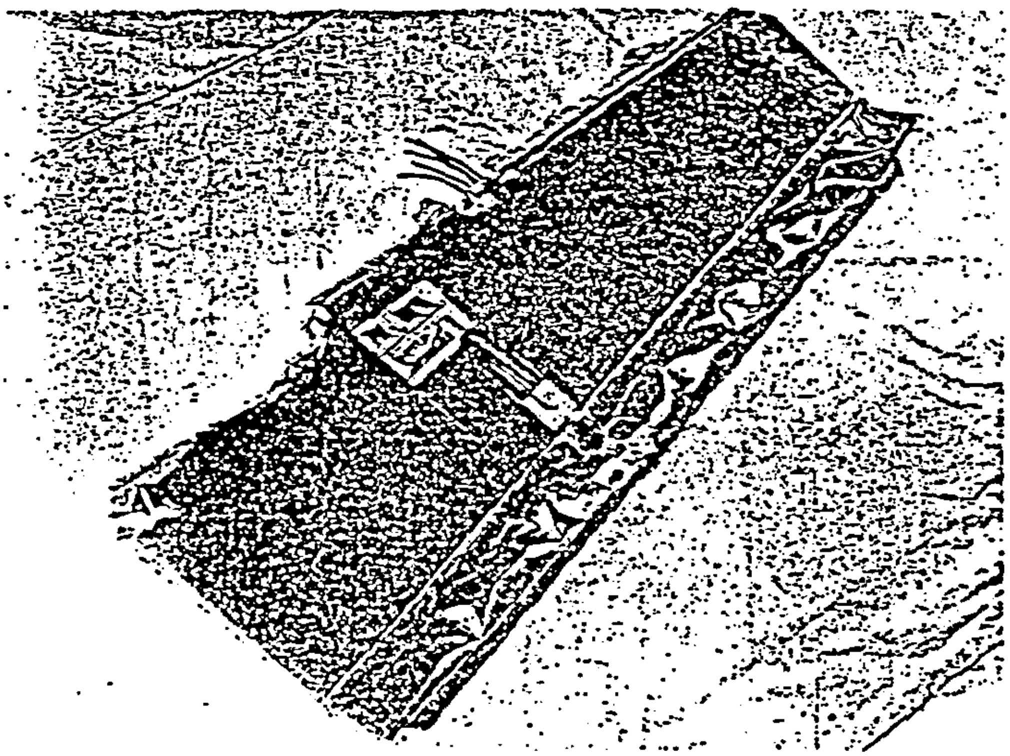

FIG.3. PORT INNER ELEVON, LOWER SURFACE. SHOWING THE CREASE ALONG THE TAB

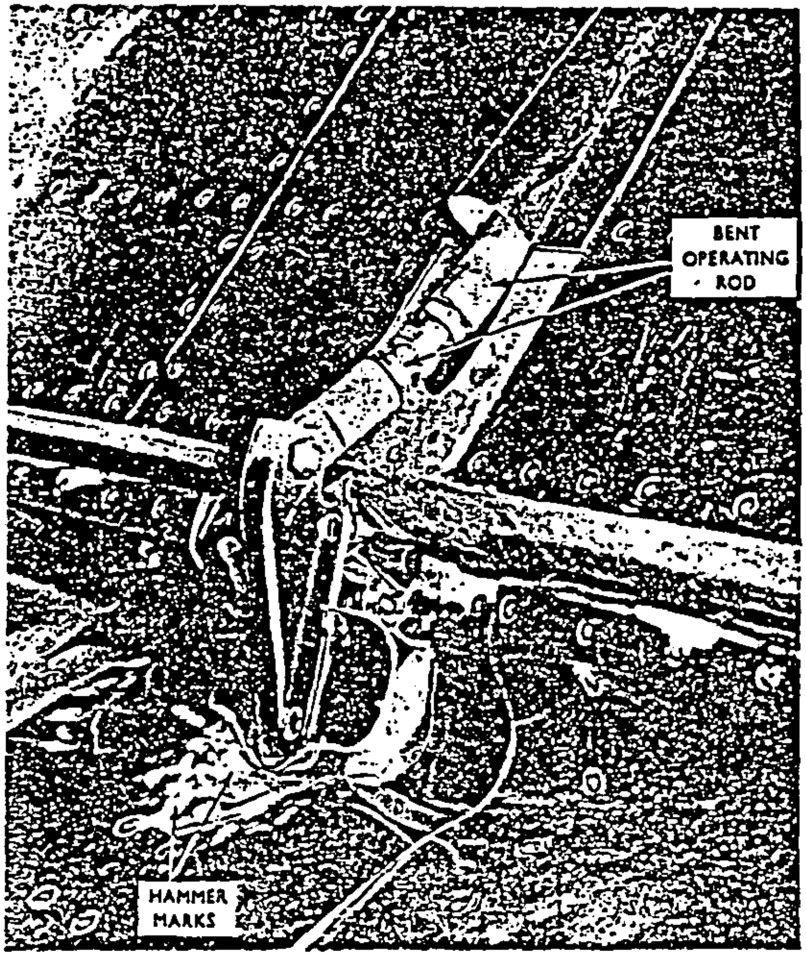

FIG.4. DETACHMENT OF TAB OPERATING LEVER

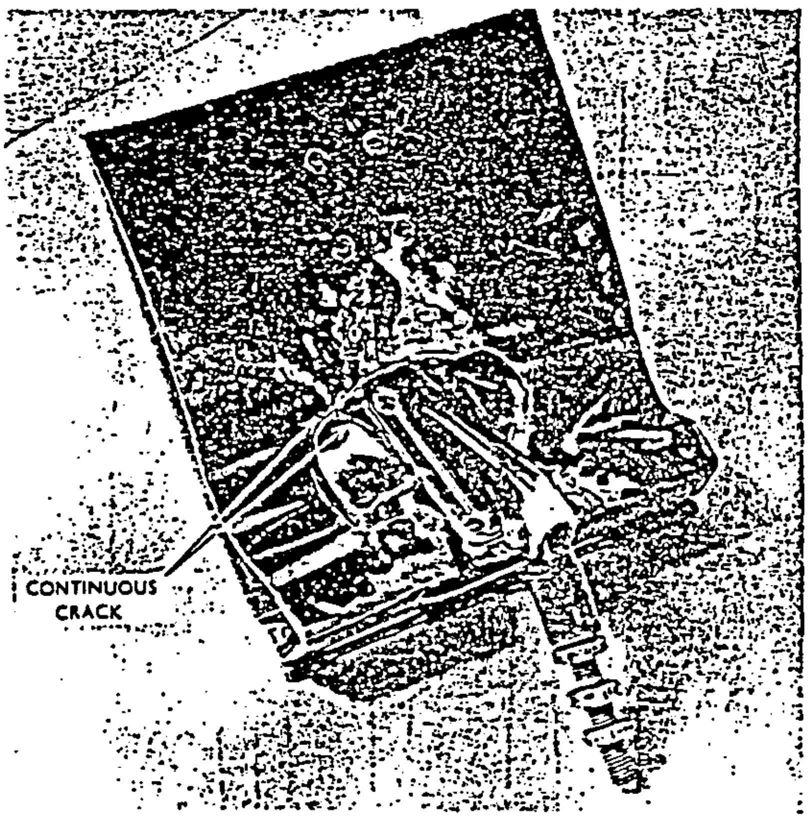

FIG.5. FAILURE OF THE PORT TAB OPERATING LEVER ATTACHMENT

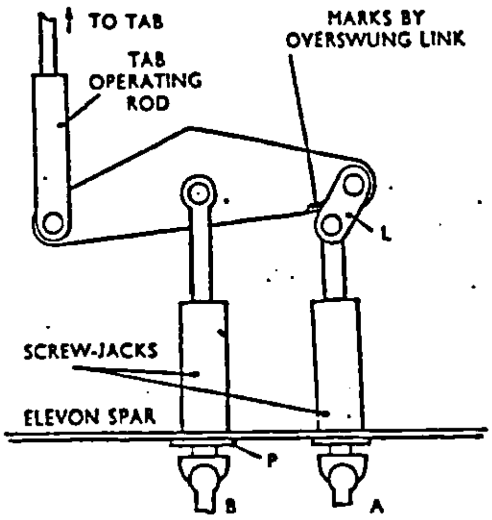

FIG.6. TAB CONTROL CIRCUIT IN THE ELEVON (DIAGRAMMATIC)

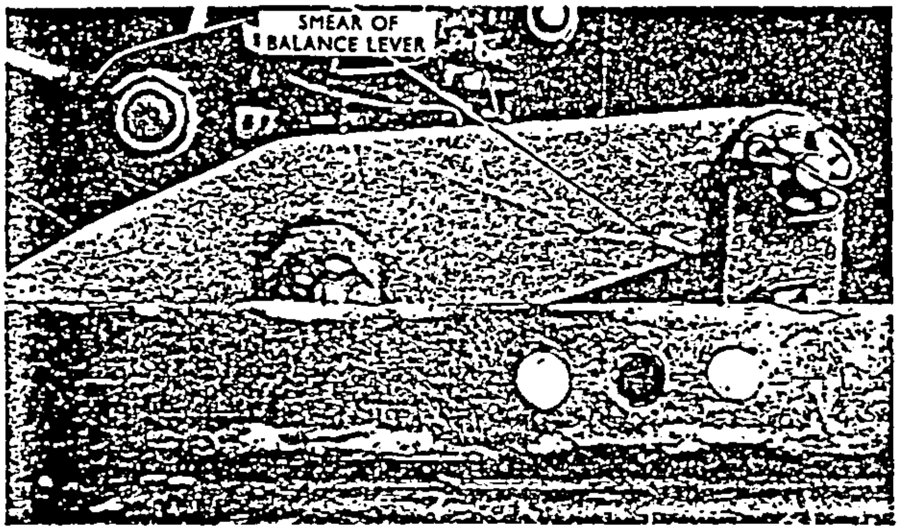

FIG.7. EVIDENCE OF EXCESSIVE MOVEMENT IN CONTROL MECHANISM (LOWER SURFACE)

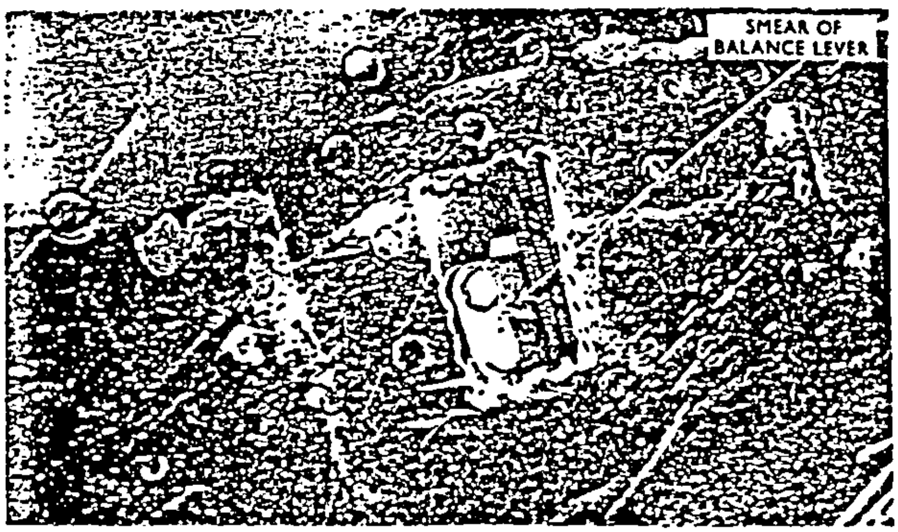

FIG.8. EVIDENCE OF EXCESSIVE MOVEMENT IN CONTROL MECHANISM (UPPER SURFACE)

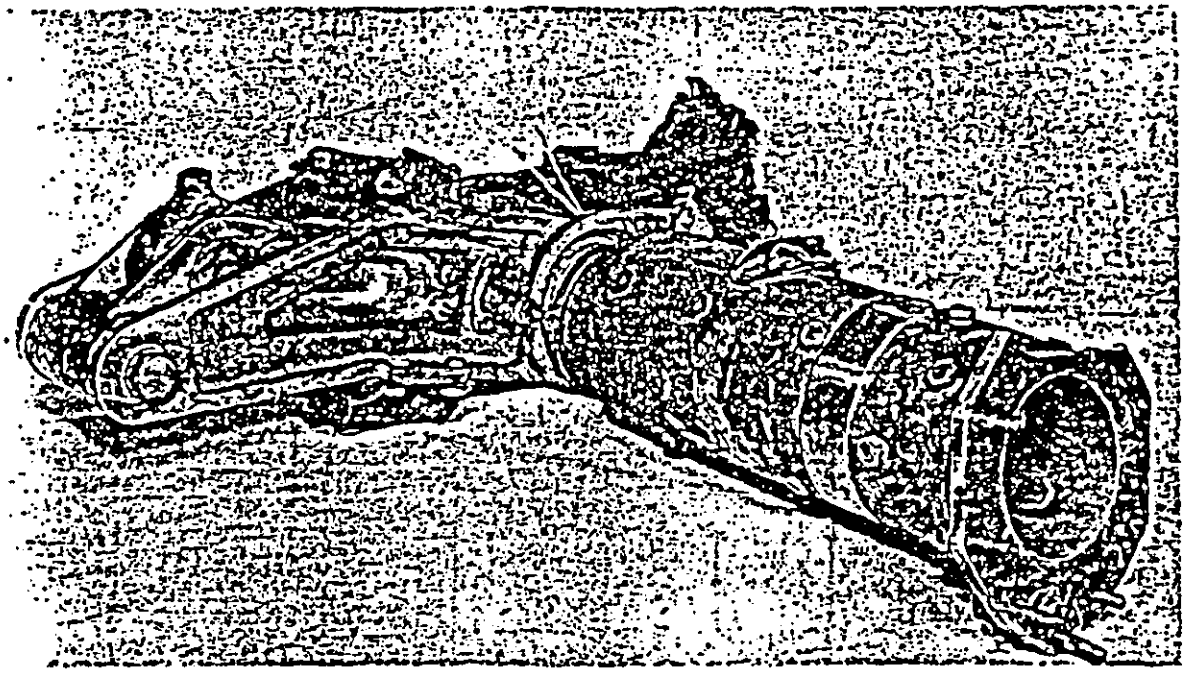

FIG.9. PORT ELEVON TORQUE SHAFT SHOWING BROKEN FLANGE

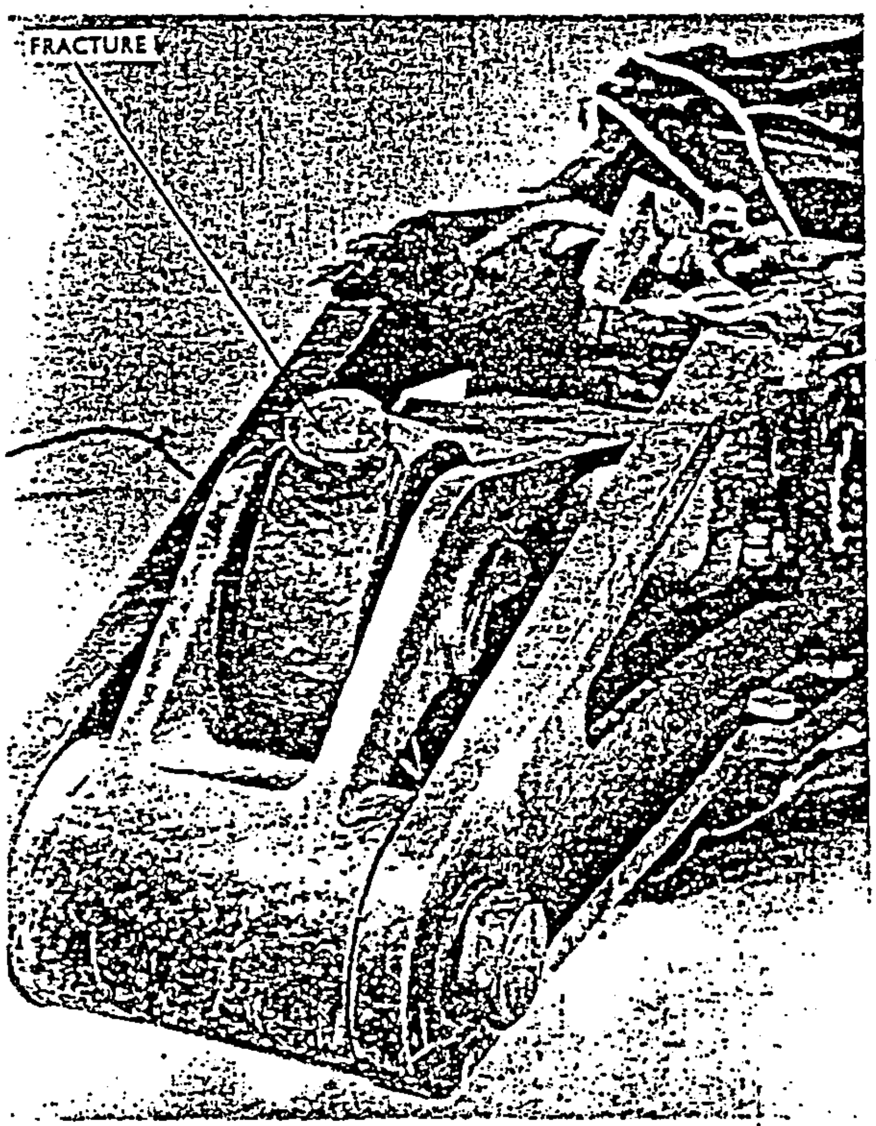

FIG.10. FAILURE OF THE OPERATING LEVER TO THE PORT ELEVON TORQUE SHAFT

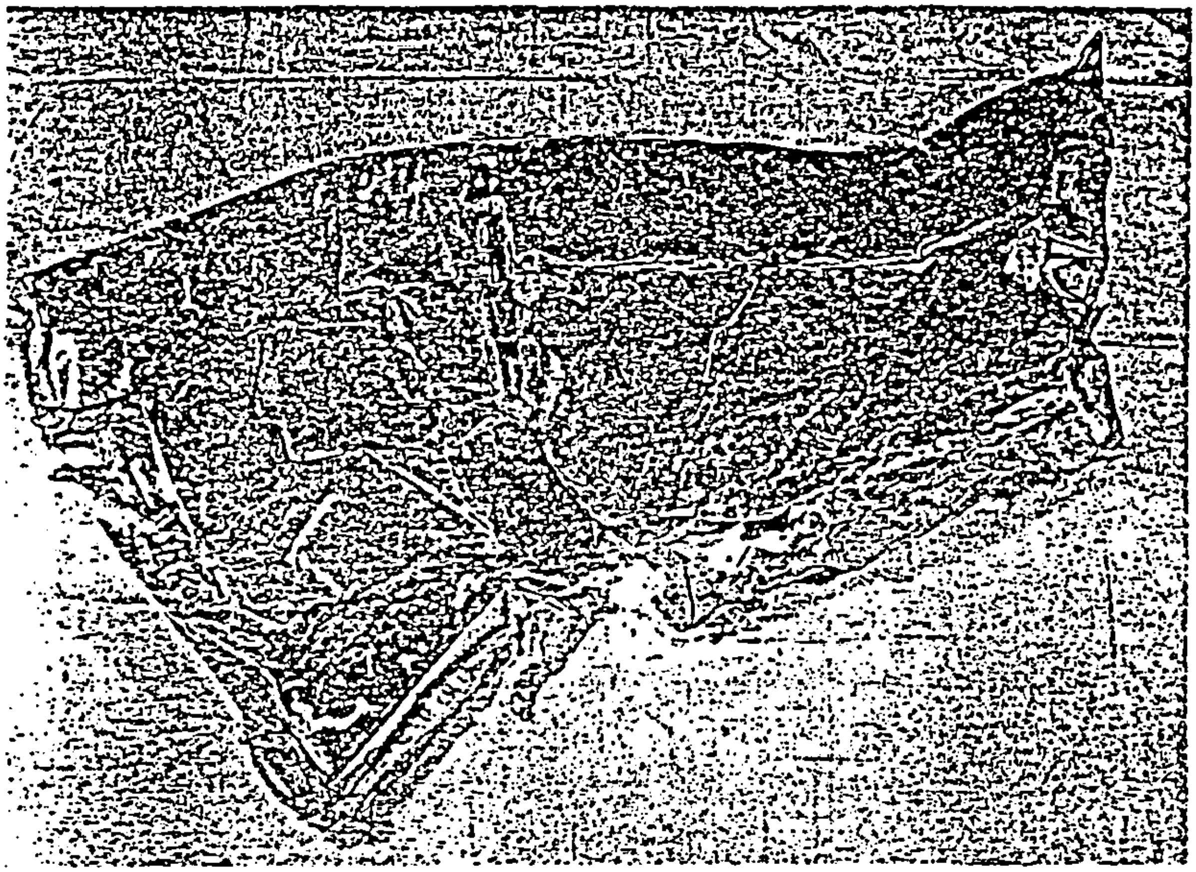

FIG.11. STARBOARD INNER ELEVON SHOWING FAILURES BY IMPACT ONLY

8/7/1952
3/18/1954

F3H Demon

McDonnell XF3H-1 Demon

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3/18/54

Last revised December 25, 1999

The McDonnell F3H Demon had its origin in a Request for Proposal issued by the US Navy Bureau of Aeronautics on May 21, 1948 for a carrier-based interceptor. In the RFP, the Navy was looking for a carrier-based interceptor with a performance equal or superior to that of the most advanced land-based fighters then entering service.

The F3H design effort at McDonnell was led by Richard Deagen. At that time, the Navy was pushing the Westinghouse-designed afterburning J40 turbojet as the powerplant of choice for its next generation of advanced warplanes. Yielding to Navy pressure, McDonnell departed from its previous design philosophy of using twin-engined configurations and decided to adopt a single J40 as the powerplant for its entry, which was designated Model 58 by the company. The Model 58 called for a single-engine, single-seat day fighter with lateral air intakes and a 45-degree sweptback wing and tail surfaces.

Eleven competitors submitted designs in response to the RFP, among them being McDonnell's Model 58. In December of 1948, the McDonnell design was declared the winner of the competition, and on January 3, 1949 an initial Letter of Intent was issued covering the initial design. The designation XF3H-1 was assigned.

The competing Douglas design called for a delta-winged carrier-based aircraft. It was also to be powered by the J40 engine. It came in second in the competition, and was deemed sufficiently promising that the Navy issued a contract for two prototypes under the designation XF4D-1.

A mockup of the XF3H-1 was inspected between July 13 and 15, 1949. Following some redesign in order to save weight, two XF3H-1s were ordered on September 30, 1949.

The F3H had originally been proposed strictly as a day fighter. While the XF3H-1 prototypes were under construction, the Navy changed its mind and directed that production versions of the Demon be designed as general-purpose all-weather fighters. The designation of this production version was to be F3H-1N.

A modified F3H-1N mockup incorporating these changes was inspected in July of 1951. Work on the two prototypes was not affected, as they were seen simply as aerodynamic test vehicles rather than operational test aircraft. However, the sudden change in direction

8/7/52
3/18/54

did delay the Demon program significantly.

In the summer of 1951, the first XF3H-1 (BuNo 125444) was finally ready for its first flight. Since the intended 9200 lb.s.t. afterburning Westinghouse J40-WE-8 was not yet available for installation, a non-afterburning 5600 lb.s.t. XJ40-WE-6 was fitted in its place. The XF3H-1 took off on its maiden flight on August 7, 1951, Robert M. Edholm being at the controls. The second prototype (BuNo 125445) followed in January of 1952.

The J40 turbojet proved to be totally unreliable during flight testing. In August of 1952, the first prototype was damaged in a landing accident following an inflight engine failure. Both prototypes were temporarily grounded on two occasions because of engine problems. In addition, early flight testing turned up problems with poor forward visibility, an excessively-slow roll rate, and inadequate lateral stability. A redesign of the nose section on production models cured the visibilty problem. The roll rate problem was cured by moving the ailerons further inboard, with a corresponding decrease in the length and area of the trailing-edge flaps. The lateral stability was improved by removing the wing fence from each outboard wing panel. An autopilot was added.

The second prototype was fitted with a 10,500 lb.s.t. afterburning J40-WE-8 in January of 1953. This engine did not prove to be any more reliable than the non-afterburning WE-6. This aircraft was used for preliminary evaluation tests at the Naval Air Test Center at Patuxent, Maryland beginning in August of 1953. In October of 1953, the second XF3H-1 was used for initial carrier trials aboard the USS *Coral Sea* (CVA-43). These trials were fairly successful, but there were some problems with low visibility during carrier approach and landing.

The first XF3H-1 was lost in a crash on March 18, 1954, following an inflight engine explosion. The second prototype was permanently grounded shortly thereafter. It was later shipped to the Naval Air Development Center at Johnsville, Pennsylvania to be used in barrier engagement tests.

Serials of XF3H-1:

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125444/125445           McDonnell XF3H-1 Demon
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Sources:

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1. United States Military Aircraft Since 1909, Gordon Swanborough and Peter M. Bowers, Smithsonian, 1989.

2. The American Fighter, Enzo Angelucci and Peter Bowers, Orion, 1987.

09/?/1952

Xβ-86

09/ 152

channel. However, the facts soon became common knowledge throughout the aviation community--the June 14, 1948 issue of *Aviation Week* published an article revealing that the XP-86 had gone supersonic.

The XP-86 could go supersonic in a dive with only a moderate and manageable tendency to nose-up, although below 25,000 feet there was a tendency to roll which made it unwise to stay supersonic for very long. Production Sabres were limited to Mach 0.95 below 25,000 feet for safety reasons because of this roll tendency.

XP-86 number 45-59597 was officially delivered to the USAF on November 30, 1948. By that time, its designation had been changed to XF-86.

Phase II flight tests (those flown by USAF pilots) began in early December of 1947. . An Allison-built J35-A-5 rated at 4000 lbs of static thrust was installed for USAF tests. The second and third XP-86 prototypes (45-59598 and 45-59599 joined the test program in early 1948. There were different from the first prototype as well as being different from each other in several respects. Nos 1 and 2 had different fuel gauges, a stall warning system built into the control stick, a bypass for emergency operation of the hydraulic boost system, and hydraulically-actuated leading-edge slat locks. The number 3 prototype was the only one of the three to have fully-automatic leading-edge slats that opened at 135 mph. Nos. 2 and 3 had SCR-695-B IFF beacons and carried the AN/ARN-6 radio compass set.

For the second and third prototypes, the ventral brake was eliminated, and the two rear-opening side fuselage brakes were replaced by brakes which had hinges at the front and opened out and down. These air brakes were adopted for production aircraft.

Prototype number 3 was the only one to be fitted with armament. The armament of six 0.50-inch M3 machine guns were mounted in blocks of three on either side of the cockpit. Ammunition bays were installed in the bottom of the fuselage underneath the gun bay, with as many as 300 rounds per gun. The guns were aimed by a Mk 18 gyroscopic gunsight with manual ranging.

In June of 1948, the new US Air Force redesignated all Pursuit aircraft as Fighter aircraft, changing the prefix from P to F. Thus the XP-86 became the XF-86. XP-86 number one was officially delivered to the USAF on November 30, 1948. The three prototypes remained in various test and evaluation roles well into the 1950s, and were unofficially referred to as YP-86s. The number 1 prototype crashed in September of 1952 after logging 241 flying hours, whereas numbers 2 and 3 were finally retired from service in April of 1953.

Specifications of the XP-86:

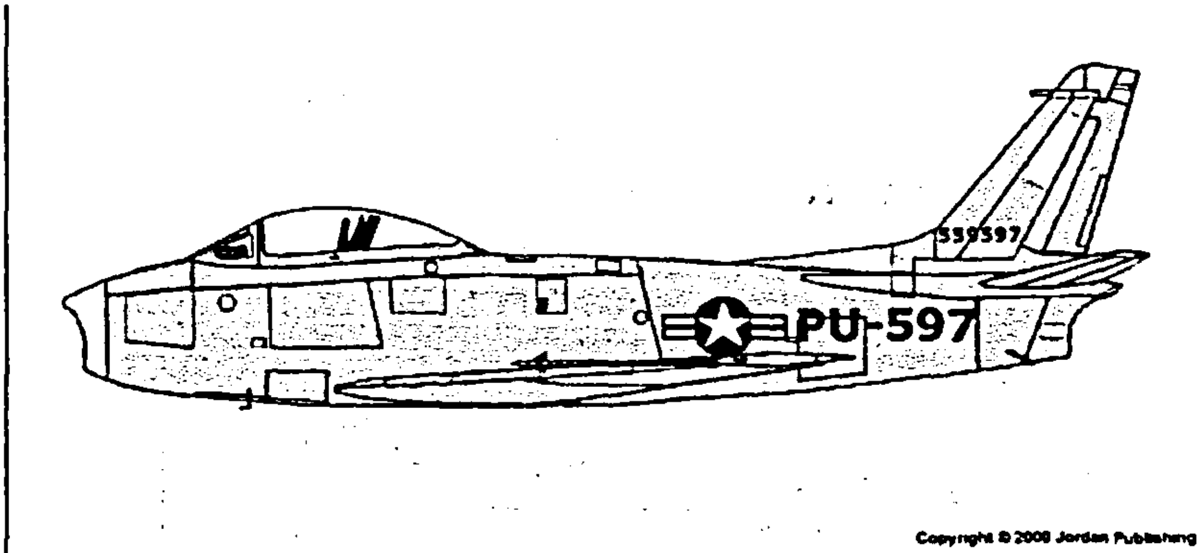
Test pilot George "Wheaties" Welch took the XP-86 up into the air for the first time on October 1, 1947. The flight went well until it came time to lower the landing gear and come in for a landing. Welch found to his shock that the nosewheel wouldn't come down all the way. After spending forty minutes in fruitless attempts to shake the nosewheel down into place, Welch finally brought the plane in for a nose-high landing. Fortunately, the impact of the main wheels jolted the nosewheel into place, and the aircraft rolled safely to a stop. The swept-wing XP-86 had made its first flight.

The maximum speed of the XP-86 was over 650 mph, 75 mph faster than anything else in service at the time. With the bubble canopy, the pilot's field of vision was excellent. The noise and vibration levels were considerably lower than those of other jet-powered aircraft. However, the J35 engine did not produce enough thrust, and the XP-86 could only climb at 4000 feet per minute. However, since production P-86As were to be powered by the 5000 lb.s.t. General Electric J47, no one was too worried.

On October 16, 1947, the USAF gave final approval to the Fixed Price contract for 33 P-86As, plus they authorized 190 P-86Bs. The P-86B was to be a strengthened P-86A for rough-field operations.

There is actually a possibility that the XP-86 rather than the Bell XS-1 might have been the first aircraft to achieve supersonic flight. During some of his early flight tests, George Welch reported that he had encountered some rather unusual fluctuations in his airspeed and altitude indicators during high speed dives, which might mean that he had exceeded the speed of sound. However, at that time, North American had no way of calibrating airspeed indicators into the transonic range, so they were not sure just how fast Welch had gone. On October 14, 1947, Chuck Yeager exceeded Mach 1 in the XS-1. Although the event was kept secret from the general public, North American test crews heard about this feat via the grapevine and persuaded NACA to use its equipment to track the XP-86 in a high-speed dive to see if there was a possibility that the XP-86 could also go supersonic. This test was done on October 19, five days after Yeager's flight, in which George Welch was tracked at Mach 1.02. The tests were flown again on October 21 with the same results. Since Welch had been performing the very same flight patterns in tests before October 14, there is the possibility that he, not Chuck Yeager, might have been first to exceed the speed of sound.

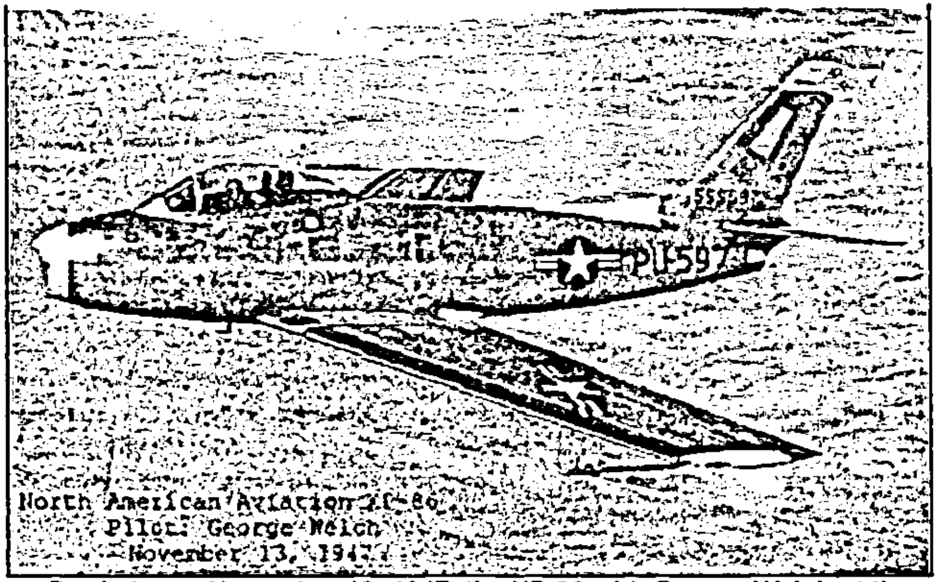
In any case, the fact that the XP-86 had exceeded the speed of sound was immediately classified, and remained so for several months afterward. In May of 1948, the world was informed that George Welch had exceeded Mach 1.0 in the XP-86, becoming the first "aircraft" to do so (an aircraft being defined as a vehicle that takes off and lands under its own power). The date was set as April 26, 1948. This flight did actually take place, but George Welch was not the pilot. In fact, it was a British pilot who was checking out the XP-86 who inadvertently broadcasted that he had exceeded Mach 1 over an open radio



North American XP-86 circa November 13, 1947

A solution was worked out that included North American sitting on the story until the Air Force felt it was safe to issue a press release. This would allow Symington to get the maximum mileage out of the XS-1 and Yeager. Then, when it was politically safe, the world would be informed of the Sabre punching through the mythical barrier. True to his word, Kindelburger kept the story under wraps. In June of 1948, a press release announced that the XP-86, piloted by George Welch had broken the sound barrier on April 26th.

Bell's XS-1 was designed specifically to break the sound barrier. However, the technology of the XS-1



Flying over Rogers Dry Lake on November 13, 1947, the XP-86 with George Welch at the controls would be officially measured at Mach 1.04 by NACA's Radar Theodolite. The tremendous speed of the Sabre had the potential to cause the Air Force great embarrassment.

Easing off power, Welch scanned the sky looking for Chilton's P-82. He spotted what he at first thought was Chilton. Then he realized that the plane had more than two engines. It was a B-29, a mothership, lumbering to altitude with the XS-1 in its belly. Slightly behind, on either side were the P-80s of chase pilots Hoover and Frost. It dawned on him that his shock wave might have hit the big bomber. If it had, there was no doubt that everyone aboard would have gotten the message, loud and clear. Finding Chilton, Welch headed back to the base. The landing gear came down as advertised and George greased it in like the pro he was. A few minutes later, after shutting down and climbing out, Welch heard a distant ba-boom. A check of his watch indicated 10:30 AM. Attaining a speed of Mach 1.06, Yeager had finally done it.

That night there would be no celebrating at Pancho's. The Air Force had clamped a secrecy lid on Yeager's flight. The party was held at several of the pilot's houses. A drunken Yeager managed to crash his motorcycle in a knucklehead display of derring-do. Of course, Pancho's was open for business, and the North American gang had gathered for a few drinks. Pancho was walking on air, her darling boy having blasted the Fly Inn with a boom that broke some large windows on the east side of the building. Major General Joseph Swing (an old friend from the war) was on hand and asked Welch about the two separate booms. The first was extremely loud, the second, 15 minutes later, was far more subdued. Welch suggested that it came from a V-2 rocket out of White Sands. General Swing knew otherwise. Swing had earned a tremendous reputation for his leading an airborne operation that freed over 2,000 American POWs from a Japanese camp on Luzon. Swing's reputation and his close friendship with General Eisenhower would come into play later.

The Fury Series

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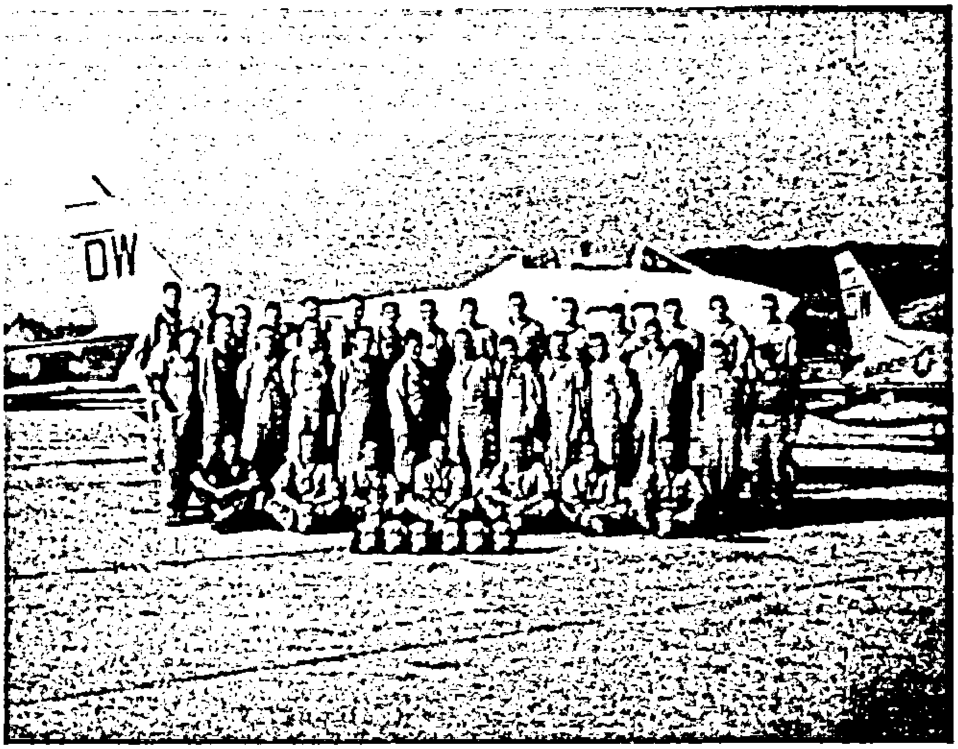
FJ- Fury Series
Link 1



VMF-251 early 1958 Roosevelt Roads, PR
Photo Courtesy of Steve Albright

The last of the naval Furies was the FJ-4. Some people argue that the FJ-4 was in fact the best version of the entire F-86 Sabre/FJ Fury series. The FJ-4 contained so many changes that at first glance it seemed to have very little relationship to the XP-86 that had first flown back in 1947. However, when one looks a little closer, the family ancestry is apparent.

The FJ-4 began its life in June 1953 as company project NA-208 which called for two prototypes and as company project NA-209 which was the production version. On October 16, the Navy issued a contract for 132 examples under the designation FJ-4. On June 26, 1954, the Navy added 45 more FJ-4s. Serials were 139279 and 139280 for the NA-208 prototypes, and 139281/139323 and 139424/139530 for the NA-209 production run.

The Navy had pinned its hopes for a high-performance carrier-based fighter on the McDonnell F3H-1N Demon, which was powered by the afterburning Westinghouse J40 turbojet. Unfortunately, the J40 engine turned out to be a total disaster. The J40 was never able to deliver its full promised power output, and it proved to be totally unreliable. A rash of F3H-1N flight test accidents was traced to in-flight failures of the J40 engine. The problems with the J40 engine proved to be insoluble, eventually forcing Westinghouse out of the jet engine manufacturing business altogether. The failure of the J40 project doomed many Navy combat aircraft projects of that era which depended on this engine. In particular, problems with the J40 caused the F3H-1N to be deemed totally unacceptable by the Navy.

04/24/1953

F-84/ B-29
Coupled flight

4/24/53

B-29 to F-84 Coupled-Flight FT Accident

In 1950 the USAF initiated a secret effort to increase the effectiveness of its long-range bomber force whereby a fighter would be coupled to each wing tip during cruise to and from the target. The concept could also be used to increase the operating radius of said fighters. The effort was known as "Project MX1016" and progressed slowly. In 1953 a catastrophic FT accident occurred in which one of the two modified F-84s and the B-29 mother ship were both lost, together with the F-84 pilot and all five crewmembers aboard the B-29.

The accident report has recently been made available and examined. The editor believes it contains multiple lessons learned still applicable to today's technology aircraft. The accident documentation contains differing views of the cause and appropriate corrective actions that provide strong food for thought and discussion.

The effort had reached a point where the two F-84s were fitted with experimental autopilots built by the Westinghouse Co. One F-84 was fitted with a "variable gain" box for inflight changes. Electrical power for the autopilot was to be provided by the B-29, and the documentation "implies" (but is not clear) that the control/computations were also to be provided by the B-29. The conclusion is that there was to be an integrated B-29/dual F-84 autopilot system. It is interesting that the machine guns had to be removed to provide space for the autopilot components. The coupling system was a two point structural attachment scheme with an electrical connector coupler. An emergency release system was part of the coupling scheme with disconnects by either pilot, and by signals from switches sensing relative position of the F-84.

Some 100 couplings had been made and about 25hours of towed flight conducted in the previous phases. About 11 couplings had been made in this phase with 1 to 2 hours of towed flight. The plan for this flight was that F-84 #661 (with variable gain box) was to couple to right wing, F-84 #641 was to couple to left wing for drag symmetry, and #661 was to conduct autopilot checkout and engagement. On previous flight, #641 had engaged autopilot while coupled on left wing and experienced rapid LWD roll. The AP was disconnected and AC returned to normal coupled attitude. The emergency release system did not fully cycle and release the F-84 as intended. Troubleshooting was conducted on the ground. A "pot" (associated with the autopilot) on an cam was replaced. The emergency release system was reported to have functioned properly. Due to "pitch trim' not being to be balanced out, some resistors were removed from autopilot trim circuit.

Subject flight was launched just past 4PM with accident occurring at 5:47EST. Formation was SE bound over Peconic Bay LI, NY at 20K ft.. #661 coupled to RH wing per plan, #641 did not couple per plan. No mention as to why. #661 could not engage AP as could not receive power from B-29. After about 30min #661 disconnected and then #641 coupled to LH wing. Pilot of #641 engaged roll channel of AP with some small erratic operation. Pilot then engaged whole AP (could not separate pitch channel). No mention as to why plan was deviated from. #641 immediately pitched up and rolled rapidly right to about 30deg. Roll continued as lesser rate. Aft coupling latch disengaged but fwd did not. Fwd latch "lance" did not retract and caused failure of B-29 fwd wing spar about 5ft in from tip. F-84 continued roll and struck top of B-29 wing near inbd end of aileron while inverted.

B-29 entered LH spiral. "Bail out" call was heard approx 8 sec later. Large portion of LH outer wing then failed, with LH spin following. During descent empennage and RH outer wing separated from AC. No parachutes were used.

Upon striking the B-29 wing, part of the F-84 nose section separated. #641 then performed series of split-s maneuvers and stalls. Some level of control was evident as AC made circle over town of Southhampton, Long Island at about 1000ft. The AC crashed in a nominal wings level attitude just outside the town. Fire ensued, the pilot was found in the cockpit.

The accident report states that the accident was caused by unknown malfunctions of the autopilot and emergency release system. Three recommendations are made: (1) continue investigations into exact cause of malfunctions; (2) equip AC "engaged in hazardous experimental missions" with "rapid escape equipment of ejection type"; (3) "Missions of this nature be performed over areas allocated for that purpose because of sparse population"....

This effort was managed by the WPAFB Air Development center, conducted by the Republic Aircraft from their facility at Farmingdale LI, with major participation by the Westinghouse Electronics organization. The documentation states the F-84 pilots had been with program for an extended time, perhaps from the beginning. The two B-29 pilots were relatively new, having been with the program for the past five flights.

A letter of transmittal from the WPAFB ADC is critical of the report and points to several aspects not addressed. It does not accept a statement pertaining to the autopilot that " a complete operational check was completed by...." prior to the flight as the B-29 and F-84 were not coupled together for said check. Also the emergency escape system had some sort of "jig" to be used in ground checks which was not used in the troubleshooting of the problem on the previous flight. It states these were considered standard procedures, and severely faults the republic and Westinghouse personnel. In addition the letter states the WADC project engineer onsite at Republic had stated he wanted only the F-84 with the variable gain box to be used to engage the autopilot system, but that the Westinghouse project engineer did not agree with that. The letter also points out the emergency release system had a two second delay built in beyond the nominal one second actuation time. Said delay had been requested to be removed by WADC but this had not been done. The documentation states there had been a successful emergency uncoupling inflight earlier in the program, but before removal of the pitch limit switches.

The report states that WADC required the B-29 to be flown unpressurized for these flights, but that there was evidence it was had been flown pressurized for the last three flights. Also there were "quick release" blisters available to provide faster egress but these were not installed. These items are mentioned in conjunction with recommendation to install ejection type features.

So, many questions can be raised from the above information:

1) Why was the test plan not followed - why did #641 not couple for symmetry, why did #641 couple on its own and conduct autopilot tests?
2) Why was the WADC project officer's directive not followed? What authority did he have? Who had what authority?
3) Why was a complete ground functional test of the autopilot with B-29 and F-84 coupled not done – as inferred? Were the "standard procedures" documented?
4) Since the emergency release system did not function properly on the previous flight, why did the test crew accept the findings of the ground test that everthing functioned properly (the famous "unable to duplicate" of today)?
5) A two second delay on the emergency release system for such a situation seems incredible (on the surface). What was the reasoning? What was it protecting against? Why was the WADC input ignored?
6) Why was the WADC directive on unpressurized flight not followed? Was it just verbal? No reference to any documented command media is made.
7) Why was the coupling made over land headed for the populated area of Long Island's south shore (the famous "Hamptons")?

Critiquing is easy. As in every event, the context of the times must be considered. This was a hot period of the cold war. The Korea conflict was raging. The USSR had exploded its own Atomic bomb and was about to explode its H-bomb. The USAF long range bombers were seen as America's primary self defense weapon. The Second World war had only ended 8 years earlier. These men were participating in a secret effort meant to increase or preserve America's ability to prevent nuclear war.

The letter of tramsmittal was signed by the legendary Albert Boyd, then nearing the end of his great career. The directness of his language is evident. It must have been a real treat to have worked for him and gotten 90 degrees to his view of things.

Dave Houle
11/01

04/24/53

Republic P-84B/F-84B Thunderjet

Last revised October 16, 1999

The P-84B was the first production version of the Thunderjet. An initial contract approved in January 1946 had called for 15 pre-production YP-84As and 85 production P-84Bs.

The engine of the P-84B was a 4000 lb. st. Allison J35-A-15C, the same as that of the YP-84A. The P-84B differed from the YP-84A service test aircraft in having an ejector seat for the pilot. It had a radio compass, and new M-3 machine guns to replace the six M-2 guns.

New orders in June of 1947 added 141 more P-84Bs to the contracts. These covered production blocks 21 and beyond. In these aircraft, the machine gun armament was supplemented by retractable launchers for eight 5-inch rockets mounted underneath the wings outboard of the landing gear.

Delivery of the P-84B began in the summer of 1947 to the 14th Fighter Group at Dow Field. The last P-84B was delivered in February of 1948.

The designation of the P-84B was changed to F-84B on June 11, 1948.

80 obsolete F-84Bs were transferred to the US Navy during the 1950s, where they were used as target drones. These aircraft were redesignated F-84KX, and were given the BuAer numbers 142269/142348.

Two F-84Bs (46-641 and 46-661) were used in experiments in which they were attached to the wingtips of a modified EB-29A. It was hoped that this would help to increase the range of jet escort fighters, enabling them to be towed by bombers into the combat area and released when needed. However, this three-plane combination crashed during a test flight on April 24, 1953, and the project was abandoned shortly thereafter as being much too dangerous for aircrews.

Specification of the P-84B:

One Allison J35-A-15C, 4000 lb.st. Performance: Maximum speed 587 mph at 4000 feet.

5-18

RESTRICTED (WHEN FILLED IN)

II-4-47

REPORT OF AF AIRCRAFT ACCIDENT

Use this form in accordance with AF Reg. 62-14 and AF Manual 62-5, "Aircraft Accident Investigators' Handbook." Fill in all spaces applicable. If additional space is needed, use additional sheet(s) and identify by proper section letter and subsection number.

22103 — Section A—GENERAL INFORMATION — 4409-18

1. Place of Accident: State, county, nearest town—Distance and direction to accident: N.Y., Suffolk, Great Peconic Bay

2. Nearest Airport suitable for landing this plane—Distance and direction to accident: Suffolk County

SECRET SECURITY INFO

3. Elevation above m.s.l. at accident scene: 0

4. Date of Accident: 24 Apr 53

5. Hour and Time Zone: 1747 EST

6. ☒ Day ☐ Dawn

Accident No.: 53-4-24-1 / 12-641

☐ Incident to Flight ☐ Not Incident to Flight

8. Classification of Accident: ☒ Major ☐ Minor

10. Clearance: ☐ IFR ☒ Local ☐ VFR ☐ Other

If Other— From: To:

11. This was a: ☐ CAP Flight ☐ Air Reserve Flight ☐ ANG Flight ☒ Other

12. ☐ Fire Occurred Before Accident ☒ Fire Occurred After Accident ☐ Fire Did Not Occur

13. Airfield of Last Takeoff: Republic Aviation Corp.

14. Duration of Flight Since Last Takeoff: 1:32

15. Mission of Flight (Use Form 1 Symbol): X-8

16. Activity Aircraft Was Engaged in Just Prior to Accident: Classified Project MX1016

Section B—AIRCRAFT

1. Aircraft No.: 44-62093

2. Type, Model, Series and Block No.: EB29-A

3. Organization Reporting Aircraft on AF-110 Report — Major Command: ARDC (Baltimore) RDC — Subcommand: WADC WRD — AF Wing: Supplied to contractor, Republic Aviation Corporation as government furnished property.

Group Number and Type — Squadron or Unit — Base: 2853

4. ___ Technical Orders affecting this aircraft were not complied with at time of accident. (List number and title of these T. O.'s on separate sheet.)

Section C—OPERATOR (Person at controls at time of accident)

1. Last Name (Jr., II, etc.)	First Name	Middle Name	Grade	Component	Serial No.	Nationality and Race	Year of Birth
Vapenick	James	J.	Capt	AFRES	AO-840881	US White	1925

2. Assigned Base	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit
Wright Patt. AFB	ARDC	WADC	Directorate of Flt & All Weather Testing	Flt Ops Br.	Bomber Ops Section

3. Attached Base for Flying	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit
Republic Aviation Corp. Farmingdale N.Y.	ARDC RDC	WADC WRD	Same		

4. Original Aeronautical Rating and Date Received	5. Present Aeronautical Rating and Date Received	6. Primary Duty Assignment
Pilot 1 Feb 45	Senior Pilot 28 Jan 53	Pilot

OPERATOR'S FLYING EXPERIENCE (Including Civilian)

Item	Hours
7. Type of Instrument Card: Green — Expiration Date: 1 Jan 54	
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours	2665:35
9. Total 1st Pilot Hours	1760:35
10. 1st Pilot Hours Last 90 Days	53:25
11. 1st Pilot Hours Last 30 Days	20:25
12. 1st Pilot Hours This Model (B-25, F-51, etc.)	227:25
13. Other Pilot Hours (CP, C, SC) This Model	227:00
14. 1st Pilot Hours Last 90 Days This Model	12:20
15. 1st Pilot Hours Last 30 Days This Model	9:05
16. Total Time Spent in Air During 24 Hrs. Prior to Accident	1:30

17. List by Type and Model 1st Pilot Experience in Similar Aircraft (e.g., B-36, 50 hrs.):

18. Was Operator on Instruments at Time of Accident or Immediately Before? ☒ No ☐ Unk ☐ Yes: ☐ Hood ☐ Weather

If above answer is "Yes" or if accident occurred at night or during IFR weather or unknown conditions, fill in items below.

Item	Hours
19. Total 1st Pilot Instrument Weather Hours	N/A
20. Total 1st Pilot Instrument Hood Hours	N/A
21. 1st Pilot Instrument (Weather and Hood) Hours Last 6 Months	N/A
22. 1st Pilot Instrument (Weather and Hood) Hours Last 60 Days	N/A
23. 1st Pilot Night Hours Last 6 Months	N/A
24. 1st Pilot Night Hours THIS MODEL Last 60 Days	N/A

Section D—PERSONNEL INVOLVED (including operator and all other persons, whether in plane or not)

Duty at time of accident (1)	Name (Last name first) (2)	Type of Aero. Rating (Symbol) (3)	Serial No. (4)	Grade and Branch of Service (5)	Component (See AFM 62-5) (6)	Organizational Assignment—Command, Subcommand, Group Number and Type, Base (7)	Fatal, Major, Minor, None, Missing (8)	Parachute Used Yes (9)	Parachute Used No (10)
06 P	Vapenick, James J.	SP	AO-840881	Capt USAF	AFRES	ARDC, WADC	Mis		x
02 CP	McClanahan, Herbert C. Jr	P	AO-735625	Capt USAF	AFRES	Same	Mis		x
15 E	Shaffer, Don Dill	E	AF35084377	M/Sgt USAF	USAF	Same	Mis		x
40 CH	Clarkson, John R.	E	AF33210759	T/Sgt USAF	USAF	Same	Mis		x
44 CE	Schampp Claude	E	AF6193534	M/Sgt USAF	USAF	Same	Ftl		x

CLASSIFICATION CANCELED OR CHANGED
TO ___
BY AUTHORITY OF OAR 205-1 par 3.9c
BY ___ DATE 19 Oct 57

SECRET SECURITY INFO.

AF Form 14 — 1 JUN 49 — Previous editions are obsolete. Replaces AF Form 14A, 1 Jan 44, which is obsolete.

RESTRICTED (WHEN FILLED IN)

RESTRICTED (WHEN FILLED IN)

Section E—DESCRIPTION OF ACCIDENT

Tell in narrative form, in as much detail as necessary, everything that is known about the accident. Make certain that items checked on reverse side are justified by this narrative. If fire was involved in accident, explain in detail its origin and progress and steps taken to extinguish it.

B-29 and two F-84's were engaged in obtaining performance data on project MX 1016. Pilot in third F-84 acted as observer. F-84, 48-661 remained coupled on right wing of B-29 for approx. one half hour without operating auto-pilot (remote flight control system) because of failure to receive auto-pilot power from B-29. 48-661 un-coupled and F-84 48-641 coupled to left wing of B-29.

After remaining coupled for approx. twenty minutes during which time F-84 power remained reduced and aircraft was trimmed, Major Davis, the pilot of 641 readied the auto-pilot, checked all circuitry and tested the aileron (roll) portion of the A-P. This test was satisfactory although roll control was slightly erratic.

Next, Major Davis engaged the complete A-P, intending to engage only momentarily.

At this time the two aircraft were on a SE course over Peconic Bay, Long Island, N.Y. at 20,000' with tail wind. Time 1747E, 24 Apr 53.

Immediately upon engaging of the A-P, 641, simultaneously pitched-up and rolled rapidly to the right for approx. 30 degrees of roll. Aft latch opened sometime during this period. 641 continued to roll to the right at a decreased rate. Lance broke off in the receiver during this period. (Wing tip with receiver and lance not yet recovered).

The front spar of the B-29 left wing suffered a severe compression failure, 63 inches inboard from tip, during initial pitch-up of the 641.

641 struck the wing in an inverted position severely damaging the B-29 outer wing and knocking the nose section off the F-84.

B-29 started turn to left. 8 seconds later pilot gave command "prepare to bail out". Shortly thereafter, the left outer wing disintegrated spreading parts over about 12 square miles. B-29 entered a spin to left. Subsequently the empenage and right outer-wing left the aircraft.

B-29 struck water of Peconic Bay and exploded 53 seconds after impact with F-84. No parachutes were used. Five crew men were aboard.

F-84 performed series of split-S manuevers and stalled several times. Each time recovery was affected. Major Davis apparently had at least partial control (no radio, no boost, aft C.G.) of 641 and from eyewitness accounts probably tried to crash land in unpopulated area. 641 flew level around town of Southampton for 450 degrees of turn at 1000 feet. Finally it stalled and crashed north of the town and burned after severe impact. Pilot killed instantly on impact. Fire destroyed A/C but was shortly brought under control. Non-use, attempted use or failure of ejection system cannot be determined.

Elapsed time between impact with B-29 and impact with ground was 2 minutes 26 seconds. Both other F-84's returned to Farmingdale without incident.

CLASSIFICATION CANCELLED OR CHANGED TO ______ BY AUTHORITY OF 27R2c5-1 Nov 39a

RECOMMENDATIONS for action to prevent similar accidents:

1. That representatives of Wright Air Development Center, Republic Aviation Corp and the Westinghouse Corporation, continue the investigation to determine the exact nature of the malfunction which caused the accident.

2. That aircraft which are engaged in hazardous experimental missions should be modified by installing rapid - escape equipment of the ejection type.

3. That missions of this nature be performed over areas allocated for that purpose because of sparse population or other reason.

Section F—AUTHENTICATION (Each investigating board member must sign below)

1. ☐ Personnel Responsible for This Accident Have Been Offered Opportunity of Rebuttal; ☒ No Rebuttal Rec'd ☐ Rebuttal Statement(s) Attached

2. Personnel Responsible Not Available Because of: ☒ Death; ☐ Critical Injury; ☐ Other (Explain) ______

Base Submitting Report	Member (Name and Grade)	Medical Officer (Name and Grade)
CO 519th Air Defense Group Suffolk County AFB Westhampton Beach, LI, NY	WELDON S. DECK, MAJOR	Richard R. Beach 1st Lt RICHARD R. BEACH, 1ST LT.
President (Name and Grade)	**Aircraft Accident Officer (Name and Grade)**	**Member (Name and Grade)**
Henry A. Dietrick HENRY A. DIETRICK, MAJOR	Franklin B. Love FRANKLIN B. LOVE, CAPTAIN	Charles S. Turner CHARLES S. TURNER, MAJOR

RESTRICTED (WHEN FILLED IN)

Section E—RATED PERSONNEL AT OTHER SET OF DUAL CONTROLS (Instructor, Copilot, etc.)

1. Last Name (Jr., II, etc.)	First Name	Middle Name	Grade	Component	Serial No.	Nationality and Race	Year of Birth
McClanahan	Herbert	C Jr.	Capt	AFRES	AO-735625	US White	1923

2. Assigned Base	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit
Wright Patt. AFB	ARDC	WADC	Same	Flt Ops Branch	Development Engineering Sec:

3. Attached Base for Flying	Major Command	Subcommand		Group No. and Type	Squadron or Unit
Republic Aviation Corp.	ARDC	WADC	Director of Flt & All Weather Testing	Same	Same

4. Original Aeronautical Rating and Date Received	5. Present Aeronautical Rating and Date Received	6. Primary Duty Assignment
Pilot 4 Jan 43	Same	Pilot

FLYING EXPERIENCE (Including Civilian)

Item	Entry
7. Type of Instrument Card / Expiration Date	White / 5 May 53
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours	1337:05
9. Total 1st Pilot Hours	822:45
10. Total Hours, ☐ IP ☒ CP ☐ C (Check applicable one)	299:20
11. Pilot Hours Last 90 Days	71:30
12. 1st Pilot Hours Last 90 Days	41:05
13. Hours Last 90 Days, ☐ IP ☒ CP ☐ C	30:25
14. Pilot Hours Last 30 Days	12:25
15. Total Pilot Hours This Model (B-25, F-51, etc.)	B-29 22:05
16. 1st Pilot Hours This Model	B-29 22:05
17. Hours This Model, ☐ IP ☒ CP ☐ C	0
18. Total Pilot Hours This Model Last 90 Days	16:05
19. 1st Pilot Hours This Model Last 90 Days	16:05
20. Hours This Model Last 90 Days, ☐ IP ☒ CP ☐ C	0

21. List by Type and Model: ☐ IP ☒ CP ☐ C Experience in Similar Aircraft (e. g., B-36, IP, 50 hrs.)

B-50 none, B-17 unk, C-54 unk

Fill in items below if Instrument and Night Experience of Operator was listed in Section C

Item	Entry
22. Total 1st Pilot Instrument Weather Hours	N/A
23. Total 1st Pilot Instrument Hood Hours	N/A
24. 1st Pilot Instrument (Weather and Hood) Hrs. Last 6 Months	N/A
25. 1st Pilot Instrument (Weather and Hood) Hrs. Last 60 Days	N/A
26. Total Pilot Night Hours Last 6 Months	N/A
27. 1st Pilot Night Hours Last 6 Months	N/A
28. Night Hours Last 6 Mos., ☐ IP ☐ CP ☐ C	N/A
29. Total Pilot Night Hours This Model Last 60 Days	N/A
30. 1st Pilot Night Hours This Model Last 60 Days	N/A
31. Night Hrs. This Model Last 60 Days, ☐ IP ☐ CP ☐ C	N/A

Section F—DAMAGE

1. Describe Briefly in General Terms the Extent of Damage to the Airplane, Engines, and Propellers.

Aircraft destroyed.
Remarks: Date of last posting to form 5, both P and CP 11 Apr 53

X4

D-676,511

2. Check Proper Damage Classification: None ☐ Minor ☐ Substantial ☐ Destroyed ☒

3. ☒ Plane or Wreckage Was Returned to an AF Base
☐ Plane or Wreckage Was Left at Scene of Accident

4. Is Plane Damaged Beyond Economical Repair? ☒ Yes ☐ No

5. If Plane Is To Be Repaired, Give Engineering Officer's Estimate of Number of Man-Hours Required for Repair: N/A Man-Hrs.

6. Was Private Property Damaged? ☐ Yes ☒ No
If "Yes," Describe Damages on Separate Sheet.

7. Give below a considered estimate of cost of this accident to the Air Force:

Cost of Damage to Aircraft	$
Cost of Damage to Other Government Property	$
Cost of Damage to Private Property	$
Cost of Injuries	— $
Cost—Other (Explain)	$
Total Estimated Cost of Accident	$

Section G—SPECIAL EQUIPMENT

1. Check items of special equipment which affected the accident.

☐ Radios ☐ Armament ☐ De-Icers ☐ Equipment for Clear Vision From Cockpit
☐ Instruments ☐ Fire Extinguishing Equipment in Plane ☐ JATO ☒ Classified test Equip.

2. Describe Briefly How the Use, Nonuse, Misuse, or Absence of Special Equipment Affected the Accident

Reference files on project MX1016. Malfunction of this Equipment is indicated.

CLASSIFICATION CANCELED OR CHANGED
TO ________
BY ________ DATE ________

Section H—WEATHER (At time and place of accident)

Ceiling	Visibility	Wind Direction and Velocity	Temp.	Dew Point	Other Weather Conditions
25,000 Ø	15	24 11	55+	44	

If weather other than unfavorable wind conditions for takeoff, landing, or taxiing was a factor in the accident, attach statement of weather officer describing climatic conditions and how they probably contributed to accident.

Section I—CHECK LIST FOR ATTACHMENTS

☐ Form 1 ☒ Clearance ☒ Photographs ☐ Form 14C
☐ Form 1A ☐ Crew Members' Statements ☒ Form 14A ☐ Form 14D
☐ List of T.O.'s Not C/W ☒ Witnesses' Statements ☒ Form 14B ☐ Form 14E
☒ See table of contents

Section J—ACCIDENT TYPE

Check one accident type as "Primary." Check all others applicable as "Secondary."

Primary	Secondary	
		Ground or Water Loop
		Wheels-Up Landing
		Wheels-Up Landing
		Hard Landing
		Collapse or Retraction of Landing Gear
		Undershoot
		Overshoot
		Nose Up or Nose Over
X		Collision With Other Aircraft
	X	Collision With Ground or Water
		Other Collisions
		Spin or Stall
		Fire on Ground
		Fire and/or Explosion in Air
		Airframe Failure in Flight
		Abandoned Aircraft
		Prop or Jet Blast Accident
		Other (List):
		Undetermined

Section K—PHASE OF OPERATION

(Check only ONE)

	Taxiing Incident to Flight
	Take-Off
X	In Flight
	Landing
	Go Around
	Engine Running—Not Taxiing
	Ground Operations
	Undetermined

Section L—CONDITIONS AFFECTING ACCIDENT

(Check all applicable)

	Immediate Forced Landing
	Precautionary Landing
	Fuel Exhaustion
	Engine Stoppage
	Lost
	Pertinent T.O.'s Not Complied With
X	Other (List): Testing of experimental equipment

Section M—VIOLATIONS*

(Check all applicable)

	Improper Taxiing Procedure
	Failure To Use Checklist
	Unauthorized Low Flying
	Instrument Flying on VFR Clearance
	Unauthorized Formation
	Other (List):

Section N—CAUSE FACTOR ANALYSIS

Check one specific cause as "Primary." Check all others applicable as "Secondary." (See AFM 62-6 for definitions)

Primary	Secondary	1. ERRORS OF AIR CREW
		Misused Power Plant or Power Plant Controls
		Misused Brakes and/or Flight Controls on Ground
		Improper [illegible]
		[illegible]
		Inattentive [illegible]
		Selected [illegible]
		Failed to Extend or Retract Landing Gear Properly
		Selected Unsuitable Terrain or Runway for Takeoff or Landing
		Failed To Compensate for Wind Conditions
		Misjudged Distance
		Failed To Level Off Properly
		Failed To Observe Other Aircraft or Objects
		Failed To Maintain Adequate Flying Speed
		Became Lost (Weather average or above)
		Continued VFR Flight Into Unfavorable Weather
		Improper Operation on Authorized Instrument Flight
		Operated Aircraft in Reckless Manner
		Made Inadequate Flight Preparations
		Attempted Flight Beyond Ability or Experience
		Failed To Use or Incorrectly Used Miscellaneous Equipment
		Other (List):

Primary	Secondary	2. ERRORS OF OTHER PERSONNEL
		Aircraft Inadequately Maintained
		Aircraft Improperly Cleared for Flight
		Weather Incorrectly Forecast
		Improperly Operated Arpt/Airway Facilities
		Improperly Supervised Training (Ground Personnel)
		Improperly Supervised Training (Flight Instructors and Flight Leaders)
		Other (List):

Primary	Secondary	3. MATÉRIEL FAILURE—POWER PLANT
		Cooling System
		Lubricating System
		Fuel System
		Engine Structure (Includes All Engine)
		Engine Control System
		Propeller and Propeller Accessories
		Supercharger (Reciprocating Engine only)
		Ignition System
		Engine Accessories
		Other:
		Undetermined

Primary	Secondary	4. MATÉRIEL FAILURE—AIR FRAME
		Flight Control System
		Wings, Rotors, and Flaps
		Cowling and Fairing
		[illegible]
		Undetermined

Primary	Secondary	5. MATÉRIEL FAILURE—LANDING GEAR
		Main Landing Gear
		Nose Wheel or Tail Wheel
		Landing Gear Position Indicators
		[illegible]
		Tires
		Other:
		Undetermined

Primary	Secondary	6. MATÉRIEL FAILURE—EQUIPMENT AND ACCESSORIES
		Automatic Pilot
		Radio Equipment
		Electrical System
		Hydraulic System
		Oxygen or Pressurization System
		Safety Equipment
		Instruments
		Cockpit, Seat, Canopy, Fittings, Doors, Hatches
		Armament
X		Other: Malfunction of Exper-imental equip

Primary	Secondary	7. WEATHER
		Low Ceiling
		Smoke—Haze
		Rain—Fog
		Snow—Hail
		Icing Conditions
		Unfavorable Wind Conditions for Landing, Taxiing, or Takeoff
		Turbulence in Flight
		Winds Aloft
		Thunderstorms
		Downdraft—Updraft
		Other:

Primary	Secondary	8. LANDING AREA
		Wet
		Soft
		Snow
		[illegible]
		Rough
		Glassy
		[illegible]
		Other Hazard:

Primary	Secondary	9. GROUND EQUIPMENT
		Airport Facilities
		Airway Facilities
		Arresting Devices
		Launching Devices
		Other:

Primary	Secondary	10. MISCELLANEOUS
		Bird in Flight Path
		Shot-Off Target in Flight Path
		Other:
		Undetermined

SECRET SECURITY INFO.

CLASSIFICATION CANCELLED OR CHANGED

BY AUTHORITY OF

19 Dec 58

SECRET SECURITY INFO.

RESTRICTED (WHEN FILLED IN)

RESTRICTED (WHEN FILLED IN)

Section O—DESCRIPTION OF ACCIDENT

Tell in narrative form, in as much detail as necessary, everything that is known about the accident. Make certain that items checked on reverse side are justified by this narrative. If fire was involved in accident, explain in detail its origin and progress and steps taken to extinguish it.

B-29 and two F-84's were engaged in obtaining performance data on project MX1016. Pilot in third F-84 acted as obsever. F-84, 48-661 remained coupled on right wing of B-29 for approx. one half hour without operating auto-pilot (remote flight control system) because of failure to recieve auto-pilot power from B-29. 48-661 un-coupled and F-84 48-641 coupled to left wing of B-29.

After remaining coupled for approx. twenty minutes during which time F-84 power remained reduced and aircraft was trimmed, Major Davis the pilot of 641 readied the auto-pilot, Checked all circuitry and tested the aileron (roll) portion of the A-P. This test was satisfactory although roll control was slightly erratic.

Next, Major Davis engaged the complete A-P, intending to engage only momentarily.

At this time the two aircraft were on a SE course over Peconic Bay, Long Island, N.Y. at 20,000' with tail wind. Time 1747 E, 24 Apr 53.

Immediately upon engaging of the A-P, 641 simultaneously pitched-up and rolled rapidly to the right for approx. 30 degrees of roll. Aft latch opened sometime during this period 641 continued to roll to the right at a decreased rate. Lance broke off in the receiver during this period. (Wing tip with receiver and lance not yet recovered).

The front spar of the B-29 left wing suffered a severe compression failure, 63 inches inboard from tip, during initial pitch-up of 641.

641 struck the wing in an inverted position severely damaging the B-29 outer wing and and knocking the nose section off the F-84.

B-29 started turn to left. 8 seconds later pilot gave command "prepare to bail out". shortly there after the left outer wing disintegrated spreading parts over about 12 square miles. B-29 entered a spin to left. Subsequently the empenage and right outer-wing left the aircraft.

B-29 struck water of Peconic Bay and exploded 53 seconds after impact with F-84. No parachutes were used. Five crew men were aboard.

F-84 performed series of split - S manuevers and stalled several times. Each time recovery was affected. Major Davis apparently had at least partial control (no radio, no boost, aft C.G.) of 641 and from eyewitness accounts probably tried to crash land in unpopulated area. 641 flew level around town of Southampton, for 450 degrees of turn at 100 feet. Finally it stalled and crashed north of the town and burned after severe impact. Pilot killed instantly on impact. Fire destroyed A/C but was shortly brought under control. Non-use, attempted use or failure of ejection system cannot be determined.

Elapsed time between impact with B-29 and impact with ground was 2 minutes 26 seconds. Both other F-84's returned to Farmingdale without incident.

CLASSIFICATION CANCELED ~~OR CHANGED~~
TO ____
BY AUTHORITY OF AFR 205-1 par 39a
DATE 12/2/53

RECOMMENDATIONS for action to prevent similar accidents:

1. That representatives of Wright Air Development Center, Republic Aviation Corp and the Westinghouse Corporation, continue the investigation to determine the exact nature of the malfunction which caused the accident.

2. That aircraft which are engaged in hazardous experimental missions should be modified by installing rapid - escape equipment of the ejection type.

3. That missions of this naturbe be performed over areas allocated for that purpose because of sparse population or other reason.

Section P—AUTHENTICATION (Each investigating board member must sign below)

☐ Personnel Responsible for This Accident Have Been Offered Opportunity of Rebuttal ☒ No Rebuttal Rec'd ☐ Rebuttal Statement(s) Attached

Personnel Responsible Not Available Because of: ☒ Death; ☐ Critical Injury; ☐ Other (Explain)

Base Submitting Report	Member (Name and Grade)	Medical Officer (Name and Grade)
CO 519TH AIR DEFENSE GROUP Suffolk County AFB Westhampton Beach, L.I., N.Y.	WELDON S. DECK, MAJOR	Richard K. Beach RICHARD K. BEACH, 1ST LT.
President (Name and Grade)	**Aircraft Accident Officer (Name and Grade)**	**Member (Name and Grade)**
Henry A. Dietrick HENRY A. DIETRICK, MAJOR	Franklin B. Love FRANKLIN B. LOVE, CAPTAIN	Charles S. Turner CHARLES S. TURNER, MAJOR

5-18

RESTRICTED (WHEN FILLED IN)

T-4-27

REPORT OF AF AIRCRAFT ACCIDENT

Use this form in accordance with AF Reg. 62-14 and AF Manual 62-5, "Aircraft Accident Investigators' Handbook." Fill in all spaces applicable. If additional space is needed, use additional sheet(s) and identify by proper section letter and subsection number.

53-4-24-2

SECURITY INFO

SECRET

Section A—GENERAL INFORMATION

1. Place of Accident: State, county, nearest town—Distance and direction to accident	N.Y. - Suffolk, North Sea, 1½SE, Southampton 1½N
2. Nearest ... to accident ... Distance and direction	Suffolk ... 15W
3. Elevation above S. L. at accident scene	130
4. Date of Accident	24 APR 53
5. Hour and Time Zone	1747/EST
6.	[X] Day [ ] Night [ ] Dawn [ ] Dusk
7. List Numbers involved	EB-29-44...
9.	[X] Incident to Flight [ ] Not Incident to Flight
9. Classification of Accident	[X] Major [ ] Minor
10. Clearance	[ ] IFR [ ] VFR [X] Local [ ] Other
If Other—	From: To:
11. This was a:	[ ] CAP Flight [ ] Air Reserve Flight [ ] ANG Flight [ ] Other
12.	[ ] Fire Occurred Before Accident [X] Fire Occurred After Accident [ ] Fire Did Not Occur
13. Airfield of Last Takeoff	Republic Aviation Corp.
14. Duration of Flight Since Last Takeoff	1:07
15. Mission of Flight (Use Form 5 Symbol)	X-8
16. Activity Aircraft Was Engaged in Just Prior to Accident	Classified Project MX1016

Section B—AIRCRAFT

1. Aircraft No.	48-641
2. Type, Model, Series and Block No.	EF 84D RE
3. Organization Reporting Aircraft on AF-110 Report — Major Command	ARDC (Baltimore RDC)
Subcommand	WADC (WRD)
AF Wing	
Group Number and Type	
Squadron or Unit	Wright-Patterson AFB
4. Technical Orders affecting this aircraft were not complied with at time of accident. (List number and title of these T. O.'s on separate sheet.)	

Section C—OPERATOR (Person at controls at time of accident)

1. Last Name (Jr., II, etc.)	Davis
First Name	John
Middle Name	M.
Grade	Maj
Component	USAF
Serial No.	13704 A
Nationality and Race	U.S. White
Year of Birth	1921
2. Assigned Base	Wright-Patterson AFB
Major Command	ARDC
Subcommand	WADC
AF Wing	Directorate of Flt & all Weather Testing
Group No. and Type	Flt Ops Br.
Squadron or Unit	Fighter Ops Section
3. Attached Base for Flying	Republic Aviation Farmingdale, NY
Major Command	ARDC RDC
Subcommand	WADC WRD
AF Wing	Same
Group No. and Type	
Squadron or Unit	
4. Original Aeronautical Rating and Date Received	Pilot 1 June 1943
5. Present Aeronautical Rating and Date Received	Senior Pilot 14 June 1950
6. Primary Duty Assignment	Pilot

OPERATOR'S FLYING EXPERIENCE (Including Civilian)

7. Type of Instrument Card	Green — Expiration Date 5 DEC 53
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours	3082:50
9. Total 1st Pilot Hours	2456:50
10. 1st Pilot Hours Last 90 Days	60:10
11. 1st Pilot Hours Last 30 Days	20:50
12. 1st Pilot Hours This Model (B-25, F-51, etc.)	325:55
13. Other Pilot Hours (CP, C, SC) This Model	0
14. 1st Pilot Hours Last 90 Days This Model	22:00
15. 1st Pilot Hours Last 30 Days This Model	14:20
16. Total Time Spent in Air During 24 Hrs. Prior to Accident	1:05
17. List by Type and Model 1st Pilot Experience in Similar Aircraft (e.g., B-26, 50 hrs.)	
18. Was Operator on Instruments at Time of Accident or Immediately Before?	[ ] No [ ] Unk [ ] Yes: [ ] Hood [ ] Weather
If above answer is "Yes" or if accident occurred at night or during IFR weather or unknown conditions, fill in items below.	
19. Total 1st Pilot Instrument Weather Hours	N/A
20. Total 1st Pilot Instrument Hood Hours	N/A
21. 1st Pilot Instrument (Weather and Hood) Hours Last 6 Months	N/A
22. 1st Pilot Instrument (Weather and Hood) Hours Last 60 Days	N/A
23. 1st Pilot Night Hours Last 6 Months	N/A
24. 1st Pilot Night Hours THIS MODEL Last 60 Days	N/A

Section D—PERSONNEL INVOLVED (Including operator and all other persons, whether in plane or not)

Duty at time of accident (1)	Name (Last name first) (2)	Type of Aero. Rating (Symbol) (3)	Serial No. (4)	Grade and Branch of Service (5)	Component (See AFM 62-5) (6)	Organizational Assignment—Command, Subcommand, Group Number and Type, Base (7)	Fatal, Major, Minor, None, Missing (8)	Parachute Used Yes (9)	Parachute Used No (10)
P	Davis, John M.	SP	13704 A	Maj USAF	USAF	ARDC, WADC	FTL		X

Remarks: Date of last posting to form 5, 18 April 1953

CLASSIFICATION CANCELED OR CHANGED
TO
BY AUTHORITY OF AFR 205-1 ...
BY E. ... DATE 17 ... 58

SECRET SECURITY INFO

RESTRICTED (WHEN FILLED IN)

AF FORM 14 (1 JUL 49) Previous editions are obsolete. Replaces AF Form 14A, 1 Jul 46, which is obsolete.

RESTRICTED (WHEN FILLED IN)

Section E—RATED PERSONNEL AT OTHER SET OF DUAL CONTROLS (Instructor, Copilot, etc.)

1. Last Name (Jr., II, etc.)	First Name	Middle Name	Grade	Component	Serial No.	Nationality and Race	Year of Birth
N/A			N/A	N/A	N/A	N/A	N/A

2. Assigned Base	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit
N/A	N/A	N/A	N/A	N/A	N/A
3. Attached Base for Flying: N/A	N/A	N/A	N/A	N/A	N/A

4. Original Aeronautical Rating and Date Received	5. Present Aeronautical Rating and Date Received	6. Primary Duty Assignment
N/A	N/A	N/A

FLYING EXPERIENCE (Including Civilian)

Item	
7. Type of Instrument Card N/A Expiration Date	N/A
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours	N/A
9. Total 1st Pilot Hours	N/A
10. Total Hours, ☐ IP ☐ CP ☐ C (Check applicable one)	N/A
11. Pilot Hours Last 90 Days	N/A
12. 1st Pilot Hours Last 90 Days	N/A
13. Hours Last 90 Days, ☐ IP ☐ CP ☐ C	N/A
14. Pilot Hours Last 30 Days	N/A
15. Total Pilot Hours This Model (B-25, F-51, etc.)	N/A
16. 1st Pilot Hours This Model	N/A
17. Hours This Model, ☐ IP ☐ CP ☐ C	N/A
18. Total Pilot Hours This Model Last 90 Days	N/A
19. 1st Pilot Hours This Model Last 90 Days	N/A
20. Hours This Model Last 90 Days, ☐ IP ☐ CP ☐ C	N/A

21. List by Type and Model: ☐ IP ☐ CP ☐ C Experience in Similar Aircraft (e.g., B-26, IP, 30 hrs.)

Fill in items below if Instrument and Night Experience of Operator was listed in Section C

Item	
22. Total 1st Pilot Instrument Weather Hours	N/A
23. Total 1st Pilot Instrument Hood Hours	N/A
24. 1st Pilot Instrument (Weather and Hood) Hrs. Last 6 Months	N/A
25. 1st Pilot Instrument (Weather and Hood) Hrs. Last 60 Days	N/A
26. Total Pilot Night Hours Last 6 Months	N/A
27. 1st Pilot Night Hours Last 6 Months	N/A
28. Night Hours Last 6 Mos., ☐ IP ☐ CP ☐ C	N/A
29. Total Pilot Night Hours This Model Last 60 Days	N/A
30. 1st Pilot Night Hours This Model Last 60 Days	N/A
31. Night Hrs. This Model Last 60 Days, ☐ IP ☐ CP ☐ C	N/A

Section F—DAMAGE

1. Describe Briefly in General Terms the Extent of Damage to the Airplane, Engines, and Propellers.

Aircraft destroyed upon contact with ground
and destroyed by fire.

X Y

2. Check Proper Damage Classification	
None	
Minor	
Substantial	
Destroyed	X

3. ☒ Plane or Wreckage Was Returned to an AF Base
☐ Plane or Wreckage Was Left at Scene of Accident
4. Is Plane Damaged Beyond Economical Repair? ☒ Yes ☐ No
5. If Plane Is To Be Repaired, Give Engineering Officer's Estimate of Number of Man-Hours Required for Repair: N/A Man-Hrs.
6. Was Private Property Damaged? ☐ Yes ☐ No None Rpt.
If "Yes," Describe Damages on Separate Sheet.

7. Give below a considered estimate of cost of this accident to the Air Force:

Cost of Damage to Aircraft	$
Cost of Damage to Other Government Property	$
Cost of Damage to Private Property	$
Cost of Injuries	$
Cost—Other (Explain)	$
Total Estimated Cost of Accident	$

Section G—SPECIAL EQUIPMENT

1. Check items of special equipment which affected the accident

☐ Radios ☐ Armament ☐ De-Icers ☐ Equipment for Clear Vision From Cockpit
☐ Instruments ☐ Fire Extinguishing Equipment in Plane ☐ JATO ☒ Classified Test Equip.

2. Describe Briefly How the Use, Nonuse, Misuse, or Absence of Special Equipment Affected the Accident

Reference files on project MX 1016. Malfunction of this special equipment is indicated.

CLASSIFICATION CANCELED OR CHANGED
TO ~~__________~~
BY AUTHORITY OF ~~__________~~

Section H—WEATHER (At time and place of accident)

Ceiling	Visibility	Wind Direction and Velocity	Temp.	Dew Point	Other Weather Conditions
25,000	15	SW 11 mph	55	44	

If weather other than unfavorable wind conditions for takeoff, landing, or taxiing was a factor in the accident, attach statement of weather officer describing climatic conditions and how they probably contributed to accident.

Section I—CHECK LIST FOR ATTACHMENTS

☐ Form 1 ☒ Clearance ☒ Photographs ☐ Form 14C
x Form 14 Parts II & III ☐ Crew Members' Statements ☒ Form 14A ☐ Form 14D
☐ List of T.O.'s Not C/W ☒ Witnesses' Statements ☒ Form 14B ☐ Form 14E
x See Table Of Contents

SECRET — SECURITY INFO

Section J—ACCIDENT TYPE

Check one accident type as "Primary." Check all others applicable as "Secondary."

Primary	Secondary	
		Ground or Water Loop
		Wingtip Landing
		Wheels-Up Landing
		Hard Landing
		Collapse or Retraction of Landing Gear
		Undershoot
		Overshoot
		Nose Up or Nose Over
X		Collision With Other Aircraft
	X	Collision With Ground or Water
		Other Collisions
		Spin or Stall
	X	Fire on Ground
		Fire and/or Explosion in Air
		Airframe Failure in Flight
		Abandoned Aircraft
		Prop or Jet Blast Accident
		Other (List):
		Undetermined

Section K—PHASE OF OPERATION

(Check only ONE)

	Taxiing Incident to Flight
	Take-Off
X	In Flight
	Landing
	Go Around
	Engine Running—Not Taxiing
	Ground Operations
	Undetermined

Section L—CONDITIONS AFFECTING ACCIDENT

(Check all applicable)

	Immediate Forced Landing
	Precautionary Landing
	Fuel Exhaustion
	Engine Stoppage
	Lost
	Pertinent T.O.'s Not Complied With
X	Other (List): Testing of Experimental Equipment

Section M—VIOLATIONS

(Check all applicable)

	Improper Taxiing Procedures
	Failure To Use Checklist
	Unauthorized Low Flying
	Instrument Flying on VFR Clearance
	Unauthorized Formation
	Other (List):

Section N—CAUSE FACTOR ANALYSIS

Check one specific cause as "Primary." Check all others applicable as "Secondary." (See AFM 62-5 for definitions)

1. ERRORS OF AIR CREW

- Misused Power Plant or Power Plant Controls
- Misused Brakes and/or Flight Controls on Ground
- Improper ...
- Exceeded ...
- Inattention ...
- Failed to ... Retract Landing Gear Properly
- Selected Unsuitable Terrain or Runway for Takeoff or Landing
- Failed To Compensate for Wind Conditions
- Misjudged Distance
- Failed To Level Off Properly
- Failed To Observe Other Aircraft or Objects
- Failed To Maintain Adequate Flying Speed
- Became Lost (Weather at, above or below)
- Continued VFR Flight Into Unfavorable Weather
- Improper Operation on Authorized Instrument Flight
- Operated Aircraft in Reckless Manner
- Made Inadequate Flight Preparations
- Attempted Flight Beyond Ability or Experience
- Failed To Use or Incorrectly Used Miscellaneous Equipment
- Other (List):

2. ERRORS OF OTHER PERSONNEL

- Aircraft Inadequately Maintained
- Aircraft Improperly Cleared for Flight
- Weather Incorrectly Forecast
- Improperly Operated Airport/Airway Facilities
- Improperly Supervised Training (Ground Personnel)
- Improperly Supervised Training (Flight Instructors and Flight Leaders)
- Other (List):

3. MATÉRIEL FAILURE—POWER PLANT

- Cooling System
- Lubricating System
- Fuel System
- Engine Structure (Includes Jet Engine)
- Engine Control System
- Propeller and Propeller Accessories
- Supercharger (Reciprocating Engine only)
- Ignition System
- Engine Accessories
- Other:
- Undetermined

4. MATÉRIEL FAILURE—AIR FRAME

- Flight Control System
- Wings, Rotors, and Flaps
- Cowling and Fairing
- Fuselage
- Other:
- Undetermined

5. MATÉRIEL FAILURE—LANDING GEAR

- Main Landing Gear
- ...
- Landing Gear Position Indicators
- Brakes
- Tires
- Other:
- Undetermined

6. MATÉRIEL FAILURE—EQUIPMENT AND ACCESSORIES

- Automatic Pilot
- Radio Equipment
- Electrical System
- Hydraulic System
- Oxygen or Pressurization System
- Safety Equipment
- Instruments
- Cockpit, Seat, Canopy, Fittings, Doors, Hatches
- Armament
- X Other: Malfunction of Experimental equipment.

7. WEATHER

- Low Ceiling
- Smoke—Haze
- Rain—Fog
- Snow—Hail
- Icing Conditions
- Unfavorable Wind Conditions for Landing, Taxiing, or Takeoff
- Turbulence in Flight
- Winds Aloft
- Thunderstorms
- Downdraft—Updraft
- Other:

8. LANDING AREA

- Wet
- Soft
- Snow
- Ice
- Rough
- Obstacle
- Runway Too Short
- Other Hazard:

9. GROUND EQUIPMENT

- Airport Facilities
- Airway Facilities
- Arresting Devices
- Launching Devices
- Other:

10. MISCELLANEOUS

- Bird in Flight Path
- Shot Off Target in Flight Path
- Other:

11. UNDETERMINED

CLASSIFICATION CANCELLED OR CHANGED TO ... BY AUTHORITY OF AFR 205-1 pm-39a BY ... DATE 19 Dec 51

SECRET — SECURITY INFO (WHEN FILLED IN)

RESTRICTED (WHEN FILLED IN)

Section O—DESCRIPTION OF ACCIDENT

Tell in narrative form, in as much detail as necessary, everything that is known about the accident. Make certain that items checked on reverse side are justified by this narrative. If fire was involved in accident, explain in detail its origin and progress and steps taken to extinguish it.

B-29 and two F-84's were engaged in obtaining performance data on project MX1016. Pilot in third F-84 acted as observer. F-84, 48-661 remained coupled on right wing of B-29 for approx. one half hour without operating auto-pilot (remote flight control system) because of failure to recieve auto-pilot power from B-29, 48-661 un-coupled and F-84 48-641 coupled to left wing of B-29.

After remaining coupled for approx. twenty minutes during which time F-84 power remained reduced and aircraft was trimmed, Major Davis the pilot of 641 readied the auto-pilot, Checked all circuitry and tested the aileron (roll) portion of the A-P. This test was satisfactory although roll control was slightly erratic.

Next, Major Davis engaged the complete A-P, intending to engage only momentarily.

At this time the two aircraft were on a SE course over Peconic Bay, Long Island, N.Y. at 20,000' with tail wind. Time 1747 E, 24 Apr 53.

Immodiately upon engaging of the A-P, 641 simultaineously pitched-up and rolled rapidly to the right for approx. 30 degrees of roll. Aft latch opened sometime during this period 641 continued to roll to the right at a decreased rate. Lance broke off in the receiver during this period. (Wing tip with receiver and lance not yet recovered).

The front spar of the B-29 left wing suffered a severe compression failure, 63 inches inboard from tip, during initial pitch-up of 641.

641 struck the wing in an inverted position severely damaging the B-29 outer wing and and knocking the nose section off the F-84.

B-29 started turn to left. 8 seconds later pilot gave command "prepare to bail out". shortly there after the left outer wing disintegrated spreading parts over about 12 square miles. B-29 entered a spin to left. Subsequently the emperage and right outer-wing left the aircraft.

B-29 struck water of Peconic Bay and exploded 53 seconds after impact with F-84. No parachutes were used. Five crew men were aboard.

F-84 performed series of split - S manuevers and stalled several times. Each time recovery was affected. Major Davis apparently had at least partial control (no radio, no boost, aft C.G.) of 641 and from eyewitness accounts probably tried to crash land in un-populated area. 641 flew level around town of Southampton, for 450 degrees of turn at 1000 feet. Finally it stalled and crashed north of the town and burned after severe impact. Pilot killed instantly on impact. Fire destroyed A/C but was shortly brought under control Non-use, attempted use or failure of ejection system cannot be determined.

Elapsed time between impact with B-29 and impact with ground was 2 minutes 26 seconds. Both other F-84's were returned to Farmingdale without incident.

CLASSIFICATION ~~CANCELED OR CHANGED~~
TO ______
BY AUTHORITY OF AFR 205-1 par 34a
E. Leeba
DATE

RECOMMENDATIONS for action to prevent similar accidents:

1. That representatives of Wright Air Development Center, Republic Aviation Corp and the Westinghouse Corporation, continue the investigation to determine the ~~exact nature~~ of the malfunction which caused the accident.

2. That aircraft which are engaged in hazardous experimental missions should be modified by installing rapid - escape equipment of the ejection type.

3. That missions of this naturbe be performed over areas allocated for that purpose because of sparse population or other reason.

Section P—AUTHENTICATION (Each investigating board member must sign below)

1. ☐ Personnel Responsible for This Accident Have Been Offered Opportunity of Rebuttal ☒ No Rebuttal Rec'd ☐ Rebuttal Statement(s) Attached

2. Personnel Responsible Not Available Because of: ☒ Death; ☐ Critical Injury; ☐ Other (Explain)

Base Submitting Report	Member (Name and Grade)	Medical Officer (Name and Grade)
CO 519TH AIR DEFENSE GROUP Suffolk County AFB Westhampton Beach, L.I., N.Y.	WELDON S. DECK, MAJOR	Richard R. Beach 1st Lt. RICHARD R. BEACH, 1ST LT.
President (Name and Grade)	Aircraft Accident Officer (Name and Grade)	Member (Name and Grade)
Emery A. Dietrich EMERY A. DIETRICK, MAJOR	Franklin B. Love FRANKLIN B. LOVE, CAPTAIN	Charles S. Turner CHARLES S. TURNER, MAJOR

U. S. GOVERNMENT PRINTING OFFICE 16—60047-1

REPORTS CONTROL SYMBOL AF-X2

AIRCRAFT CRASH FIRE AND RESCUE REPORT

1. REPORT NUMBER: 7

2. REPORT DATE: 27 APRIL, 1953

3. REPORTING INSTALLATION: 519th AIR DEFENSE GROUP SUFFOLK CO AFB, WESTHAMPTON BEACH, N.Y.

4. COMMAND: EADF ADC

I. IDENTITY OF ACCIDENT

5. LOCATION: NORTH SEA, TOWN OF SOUTHAMPTON LONG ISLAND, NEW YORK.

6. ☐ ON ☐ OFF BASE

7. DISTANCE FROM APPARATUS: 20.5 MILES

8. DATE OF ACCIDENT: 24 APRIL 1953

9. TIME OF ACCIDENT: 1747

10. TIME ALARM RECEIVED: 1750

11. TIME APPARATUS ARRIVED: 1830

12. TIME UNDER CONTROL: 1838

13. DELAY IN RESPONSE, ☐ YES X NO (If yes, give reason)

II. WEATHER

14. GENERAL: 25,000 V 15+

15. WIND DIRECTION: SOUTHWEST

16. WIND VELOCITY (mph): 17

17. TEMPERATURE (°F): 55

18. HUMIDITY (%): 65

III. NATURE OF ACCIDENT

19. FIRE INVOLVED: A. BEFORE IMPACT; B. ON IMPACT; X C. AFTER IMPACT; D. DAMAGED; E. NO FIRE

20. TYPE EMERGENCY: A. TAKE OFF; B. LANDING; X C. IN FLIGHT; D. ON LINE; E. IN PARK; F. TAXIING

21. DESCRIBE PREACCIDENT STATUS OF AIRCRAFT: CLASSIFIED MISSION INVOLVED A B-29

22. LOCATION OF FIRE: A. INITIAL: UNKNOWN; B. ON ARRIVAL: TOTAL; C. ULTIMATE: TOTAL

IV. ALARM STATUS

23. NOTIFICATION BY (Check in order by number as appropriate box): A. RADIO-AIRWAY; B. RADIO-TOWER; X C. TELE-TALK; X D. CRASH-PHONE; E. OTHER

24. STATUS OF CRASH CREWS AT TIME OF ALARM: X A. IN STATION; B. LINE ALERT; C. RUNWAY STANDBY

REMARKS:

25. DESCRIBE DELAYS OR DEFICIENCIES: NONE

V. AIRCRAFT

26. TYPE: F-94

27. MODEL: B

28. SERIAL NUMBER: 5041

29. NO. OF ENGINES: 1 ☐ JET ☐ CONVENTIONAL

30. UTILIZATION: X-PER

31. FUEL ON BOARD: UNKNOWN

32. FUEL INVOLVED: JP-4

33. OTHER HAZARDOUS CARGO: NONE

VI. TERRAIN

34. TYPE (Check as many multiple boxes as appropriate): A. RUNWAY; B. STATION; C. APRON; D. HARDSTAND; E. REVETMENT; F. AIRFIELD; G. OPEN FIELD; H. WOODS; I. OVERGROWN; J. HOUSING; K. SWAMP; L. MARSH; X M. OPEN WATER; N. MOUNTAIN; O. OTHER

P. DESCRIBE IF PERTINENT

35. CONDITION: A. CONCRETE; B. MACADAM; C. DIRT; D. SAND; E. GRASS; F. HARD; G. SOFT; H. WET; X I. DRY; J. LEVEL; K. SLOPE; L. DITCH; M. OTHER

N. DESCRIBE IF PERTINENT

VII. LOSS DATA

36. CAUSE OF ACCIDENT: COLLISION WITH OTHER AIRCRAFT.

37. CAUSE OF FIRE: IMPACT

38. PHYSICAL EXTENT OF DAMAGE: A. IMPACT; B. FIRE; C. RESCUE EFFORT: AIRCRAFT DESTROYED COMPLETELY

39. MONETARY LOSS: A. LOSS TO CONTENTS: UNKNOWN; B. LOSS TO ADJACENT PROPERTY: NONE REPORTED; C. LOSS TO AIRCRAFT: 267,521.00

VIII. RESCUE

40. TOTAL NUMBER INVOLVED: 1; A. CREW: 1; B. PASSENGERS: NONE

41. TOTAL NUMBER OTHER THAN OCCUPANTS INVOLVED: NONE

A. TYPE OF RESCUE	B. NUMBER OF PERSONS	C. PHYSICAL INJURIES MAJOR	MINOR	NONE	D. BURN INJURIES MAJOR	MINOR	NONE	B. NUMBER OF PERSONS	C. PHYSICAL INJURIES MAJOR	MINOR	NONE	D. BURN INJURIES MAJOR	MINOR	NONE
(1) ESCAPED UNAIDED														
(2) RESCUED ALIVE														
(3) REMOVED DEAD														
(4) RECOVERED DEAD	1													

IX. OPERATIONS

42. TYPE AND REGISTRATION NUMBER OF ALL EQUIPMENT RESPONDING (List in order of arrival): CHIEF CARRYALL R-2039 C3-503C31, 300 BOAT, TRUCK 57144.

43. NUMBER OF PERSONNEL RESPONDING: A. CIVILIAN: 4; B. MILITARY: 6

44. SUPERVISORY CAPACITY IN CHARGE OF OPERATIONS: CHIEF CIVILIAN

45. EQUIPMENT REMAINING IN SERVICE: O-10 R-165 O9-CO7545, 4-5(?), 503-5C3755

46. PERSONNEL REMAINING IN SERVICE: 5 (ON DUTY) 4 (OFF DUTY) TOTAL 9

47. METHOD OF RESCUE (General): AFTER REMOVAL OF BODY, FIRE WAS EXTINGUISHED WITH FOAM. EXTINGUISHED FLAME ON BODY, THEN REMOVED BODY.

48. EXTINGUISHING MATERIALS USED:

A. WATER (gals)	B. CO2 GAS (lbs)	C. FOAM LIQ (gals)	D. FOAM POWD (lbs)	E. DRY CHEM (lbs)	F. C.T.C. (gals)	G. OTHER
150	200	5	NONE	NONE	NONE	250 GAL PREMIXED F

AF FORM 282 REPLACES WD AGO FORM 5-6, WHICH IS OBSOLETE IN THE AF.

1 MAY 50

Copy 4-24-53

I. NARRATIVE REPORT

(Elaborate on pertinent prior data in appropriate spaces; include statement of unusual conditions, obstacles, deficiencies, meritorious actions, etc.; identify condition of personnel removed at the time rescue was effected; enter appropriate comments and recommendations involving organization, equipment, personnel, methods, training, etc., as displayed by the incident and as may relate to improved efficiency.)

50. FIRE ACCIDENT STATUS

AIRCRAFT WAS TOTALLY DESTROYED BY FIRE

51. ALARM RESPONSE

RECEIVED ALARM FROM THE CONTROL TOWER OF CRASHES OF A B-29 AND AN F-94 IN THE VICINITY OF COWS NECK, HAMPTON BAYS AND NORTH SEA AREAS, RESPONDED WITH CHIEFS CARRYALL, 110 CRASH TRUCK AND 300 BRUSH TRUCK, GUIDED TO THE SCENE OF THE CRASH BY A RADIO OF A T-6 ACFT.

52. ACCIDENT

AIRCRAFT WAS ON A CLASSIFIED MISSION AT 20,000 FEET WITH A B-29

53. FIRE CONTROL

USED 250 GALLONS OF PRE-MIXED FOAM TO EXTINGUISH AIRCRAFT FIRE AND 150 GALLONS WATER TO EXTINGUISH AND WET DOWN RESULTING WOODS FIRE.

54. DEFICIENCIES

NONE

55. RESCUE EFFORT

INDICATE LOCATION IN PLANE, DESCRIBE METHODS, EQUIPMENT, AND CLOTHING USED, IDENTIFY CAUSE OF DEATHS AND INJURIES, ETC.

FOUND PILOT IN BURNED OUT SECTION OF COCKPIT. USED 200 LBS. CO_2 TO EXTINGUISH FIRES ON BODY OF PILOT AND COCKPIT SECTION FOR THE IMMEDIATE REMOVAL OF THE BODY.

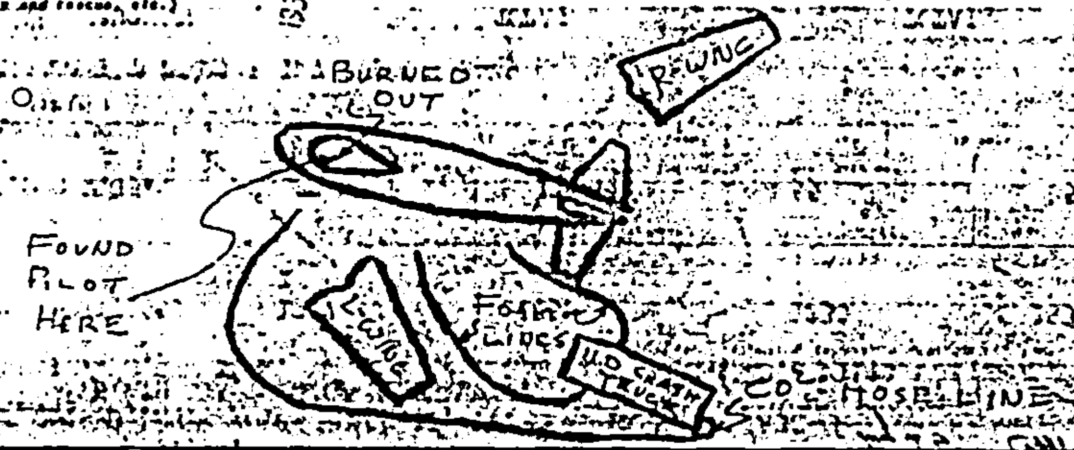
56. COMMENT RECOMMENDATIONS

NONE

MAIL & MESS CENTER

II. DIAGRAM

(Show location of aircraft at rest, placement of apparatus, turrets and hand lines operating, location of personnel in aircraft, points of entry and rescue, etc.)



III. APPROVAL AND REVIEW

57. PREPARED BY	58. APPROVED BY	59.	60. REVIEWED AND ENTERED BY
DATE 29 ... 53	25 ... 53		DATE

U.S. GOVERNMENT PRINTING OFFICE

INTER OFFICE CORRESPONDENCE SECURITY INFORMATION

REPUBLIC AVIATION CORPORATION
FARMINGDALE, NEW YORK

DATE April 25, 1953

TO Mr. G. Hardman
ccs: Messrs. Hass, Major Turner

FROM W. Grady

~~SECRET~~ ~~SECURITY INFO.~~

SUBJECT: ACCIDENT REPORT ON AIRCRAFT EF-84D-2RE - 48-641 - F-418

Aircraft time at take-off 74:30 hours. Engine time at take-off 13:50 hours.

At approximately 1645 hours on 24 April 1953, and after making contact with aircraft ETB-29A - AF S/N 44-62093, aircraft crashed in proximity of Watermill, Long Island - Pilot: Davis, John W. Major.

Aircraft at present in custody of the Air Force at Suffolk County AFB, Westhampton, Long Island. Postflight inspection completed with no open items on 23 April 1953. A complete operational check of Auto-pilot was performed by Westinghouse Representative on 24 April 1953 at 1400 hours. Preflight inspection completed on 24 April 1953 and released for flight at 1600 hours.

The status symbol on AF Form I being a red diagonal for the following open technical orders.

01-65BJB-39 - Modification of cabin refrigerator system. (To be accomplished at next engine removal).

01-65BJB-43 - Rework of radio compass loop cords. (To be accomplished at next engine removal).
NOTE: Radio compass inoperative due to removal of units for installation of Auto-Pilot units.

02B-105C-27 - Inspection of engines encountering excessive oil consumption. (Engine not using excessive oil)

01-65BJ-70 - Modification of cal. .50 machine gun feed chute saddles. (Guns removed due to installation of auto-pilot components).

01-65BJ-107 - Inspection and modification of elevator trim tab system. (Compliance not directed due to Auto-pilot installation).

01-65BJ-132 - Safety wiring check nut on aileron boost. (Auto-pilot follow-up control installed on boost valve)

On previous flights of this aircraft on 11 April 1953 and 22 April 1953, and also making contact with ETB-29A the pilot's remarks on AF Form 1 were #1 OK with pilot's signature.

400
Involving B-29, 44-62093
and F-84, 48-641
24 April 1953

~~SECRET~~

~~SECURITY INFO~~

April 25, 1953

Mr. G. Hardman
ccs: Messrs. Hass, Major Turner

~~SECRET~~ ~~SECURITY INFO.~~

ACCIDENT REPORT ON AIRCRAFT F-418

The 10th Periodic inspection was accomplished on 3 March [illegible] 65:05 hours on aircraft.

The next periodic inspection due on 3 June 1953 or 119:05 hours.

Complete "G" file and all AF 60 series forms, AF Form I, all RAC completed maintenance and inspection records on file in Inspection Office, Hangar #1.

ACCIDENT REPORT ON AIRCRAFT ETB-29A - 44-62093

Aircraft time at take-off 658:45 hours. Engine time at take-off	#1	12:45 hrs.
	# 2	159:40 hrs.
	#3	255:15 hrs.
	#4	255:15 hrs.

At approximately 1630 hours on 24 April 1953, and while making contact with aircraft F-84D-2RE, 48-641, RAC No. F-418, aircraft crashed into Peconic Bay - Pilot: J.J. Papenick, Capt.

Last postflight inspection accomplished 22 April 1953.

Last preflight inspection accomplished 24 April 1953.

Sixth (6th) Major inspection accomplished 10 March 1953 at 646:55 hours. Next Major inspection (7th) due on 10 September 1953 or 746:55 hours.

Aircraft flying on red dash due to compass swing overdue.

All loose equipment, "G" file and AF Maintenance forms stowed aboard aircraft prior to flight.

R.A.C. maintenance forms on file in Inspection Office, Hangar #1.

Aircraft crashed into Peconic Bay, Long Island following collision with F-84D-2RE - F-418 (48-641).

CLASSIFICATION CANCELED ~~OR CHANGED~~
BY AUTHORITY [illegible]
DATE 23 Dec 58
BY [illegible]

W. Grady
W. GRADY
Inspection Superintendent

WG/mm

~~SECRET~~ ~~SECURITY INFO.~~

~~CONFIDENTIAL~~

FLIGHT CRABS

TOWED FLIGHT #4 (4-22-53)

ITEM	REMEDY
1. Right interconnector did not cross over.	1. Replaced pressure relief valve. Found loose wire to switch on interconnector that cuts off hydraulic pressure when interconnector is fully extended. Also cleaned up and checked wiring and valves in both wings. Cylinder pressure to both interconnector cylinders set for min. 300 psi.
2. Left F-84 rolled heavily when A.P. was turned on. Aft latch opened, but emergency system did not go off.	1. Emergency system checked very carefully. Sequence of operation was satisfactory.
3. Scribe plates on right interconnector were bent.	1. Removed plates from both wing tips.
4. Snub out light flickered.	1. Readjusted cylinder center switch.
5. F-84-641 pitch trim could not be balanced out completely.	1. Increased trim range available by removing resistors from trim circuit.
6. F-84-641 rolled sharply when auto flight control was turned on.	1. Cam follow-up pot was open causing large trim signal. Pot replaced.

~~SECRET~~
~~SECURITY INFO.~~

CLASSIFICATION CANCELLED ~~OR CHANGED~~
TO ______
BY AUTHORITY OF AFR 205-1 par 39a
BY E. Luke DATE 23 Dec 58

~~SECRET~~
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MAJOR ACFT ACC
Involving B-29, 44-620..
and F-84, 48-641
24 April 1953

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By: ______
DATE: ______

(Restricted) Report of Special Investigation of Aircraft Accident B-29 46-62093 and F-84D 48-641 on 24 April 1953, Six Miles Northwest of Southampton, Long Island, New York

THE ACCIDENT

1. The B-29 46-62093 and F-84 48-641, with two (2) additional F-84 aircraft, were airborne approximately one hour on a classified experimental test flight on Project MX-1016. The F-84 641, coupled to the left wing of B-29 093 suddenly rolled one hundred eighty degrees (180°) to the right and while inverted struck the top of the B-29 wing. The impact sheared the nose section of the F-84 and severely damaged the left outboard wing section of the B-29. Both aircraft crashed with fatal injuries to all crew members.

CONCLUSIONS

2. It is concluded that:

a. The primary cause of the accident was a malfunction of the experimental automatic flight control equipment installed in the F-84 and B-29 resulting in the collision of the two (2) aircraft (see paragraph 7).

b. The emergency release mechanism of the coupling system did not disengage the aircraft (see paragraphs 7 and 11).

RECOMMENDATIONS

3. IT IS RECOMMENDED THAT WRIGHT AIR DEVELOPMENT CENTER:

a. Install on all aircraft engaged in hazardous experimental missions, such as Project MX-1016, a rapid ejection escape system for all crew members (see paragraph 20).

b. Require complete ground checking, simulating actual release in flight, of release mechanism of coupling system by the use of the aircraft or a mock-up jig of the coupling device. (See paragraph 15)

ACTION TAKEN

4. F-84 empennage removed to Republic Aviation Corporation (RAC) for investigation of malfunction of automatic flight control by WADC, RAC, and Westinghouse Corporation.

HISTORY OF FLIGHT

5. The B-29 crew and the three (3) F-84 pilots were briefed for an estimated two (2) hour experimental test flight of the automatic flight control (AFC) system for coupled flight. The F-84 661 was to couple to right wing of B-29 and check the automatic flight control with F-84 641 coupled to left wing to provide symmetrical drag load. F-84D 321 was to act as observer for the mission. The B-29

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HISTORY OF FLIGHT (continued)

departed Republic at 1615 EST. F-84 661 and 641 departed at 1640 EST. The test aircraft assembled at twenty thousand feet (20,000'). F-84 661 coupled to the right wing of the B-29. Due to a malfunction of coupling mechanism, 661 could not check automatic flight control, so decoupled. F-84 641 then coupled to the left wing of 093, and had been towed for approximately thirty (30) minutes while completing operational check of coupling device and AFC.

6. Since the automatic flight control in 641 had been completely checked prior to flight, it was decided by the pilot in 641 to complete the auto flight control check as the system in 641 appeared to be functioning in satisfactory manner. After trimming the aircraft, the roll channel, with the pitch channel off, was checked several times with a resulting erratic but not violent floating of the aircraft. Due to installation, the pitch channel could not be checked independently of the roll channel. It was decided to turn on both channels, pitch and roll, for a moment to check coupled operation of the system.

7. The aircraft were proceeding on a southeasterly heading at twenty thousand feet (20,000'). As the automatic flight control was engaged, F-84 641 rolled violently to the right twenty-five (25) to thirty degrees (30°). The observer pilot noted that the rear latch and electrical connector were disengaged and that the B-29 wing buckled approximately twenty-five feet (25') from tip. The roll of the F-84 continued at a slower rate. At approximately one hundred degrees (100°) of roll, it was noted that the F-84 was free of the B-29. The F-84 continued to roll and while inverted, struck the top of the B-29 wing. The F-84 fuselage struck the B-29 wing at the inboard end of the aileron. The nose section forward of windshield of the F-84 sheared off and a large hole was torn in the B-29 wing at the area of F-84 fuselage impact.

8. Following the collision, F-84 641 cleared the B-29 in a split S maneuver, recovered and entered a second split S. After recovering, the aircraft appeared to circle the town of Southampton, L. I., straighten out and proceed north of the town in a series of shallow banked turns. The aircraft crashed in a wooded area two (2) miles north of Southampton. The ground impact was followed by a small explosion and fire. The pilot of F-84 661 following the descent of 641, did not observe any indication that the pilot had escaped from the aircraft. The aircraft crashed two (2) minutes twenty-six (26) seconds after the initial collision.

9. F-84 321 followed the B-29 after the collision. The aircraft made a turn to the left of approximately ninety (90) to one hundred eighty degrees (180°) losing altitude. At approximately seventeen thousand (17,000) feet, the damaged portion of the left wing separated. The spiral tightened up and at approximately ten thousand (10,000) feet the right wing outboard of nacelle and the remaining portion

(Restricted) Report of Special Investigation of Aircraft Accident B-29 46-62093 and F-84D 48-641 on 24 April 1953, Six Miles Northwest of Southampton, L. I., New York

HISTORY OF FLIGHT (continued)

of left wing outboard of the engines sheared. The empennage of the B-29 sheared at approximately ten thousand feet (10,000') as pieces were found in water about one mile from point fuselage hit water. The aircraft went into a tight corkscrew spin and exploded upon impact with the water two and one-half ($2\frac{1}{2}$) miles southwest of Robins Island. A large fire was observed on the surface of the water but no wreckage was noted. The B-29 crashed in the water fifty-three (53) seconds after collision with F-84. No parachutes were observed from the B-29.

INVESTIGATION AND ANALYSIS

10. Investigation at the scene of the F-84 crash indicated the aircraft contacted the trees at an angle of approximately forty degrees (40°) from the horizontal on a heading of ninety degrees (90°). Contact with the ground was in a tail low wing level attitude. The wing panels of the F-84 sheared at the root upon ground impact and the aircraft uprooted a large stump at the approximate place where the aircraft stopped. Wreckage was confined to an area of approximately ten (10) yards radius. The aircraft except for nose section forward of windshield was intact at time of impact. The canopy was found directly beside the fuselage and had not been fired as the rollers were still installed. The fuselage section forward of rear row of blades of the engine compressor was destroyed by fire following the ground impact. The pilot had remained in the cockpit.

11. Examination of the right wing tip of the F-84 revealed the coupling lance and forward aluminum mounting casting had been torn from the airplane. The electrical connection in the F-84 wing tip showed only fire damage. As this connector is a light casting, any bending would damage electrical contacts or the casting itself. The rear coupling roller did not show any marks or damage from the rear latch installed in the B-29. The landing gear, wing flaps and dive brakes were retracted. Examination of elevator tab jack screw indicated elevators trimmed to neutral position; normal for coupled flight. Seat and canopy jettison systems were destroyed by fire. It was undetermined if systems had been activated. The top bow of the windshield frame contained a deep dent, however, the matching canopy bow was not marked. The canopy was noted to be intact after collision with the B-29. The gun deck cover was found two (2) miles east of Southampton - eight (8) miles from collision and three (3) miles from wreckage of the F-84.

12. B-29 093 exploded upon impact with water. Observer pilot in 321 reported no wreckage at point of impact. A PBY and two (2) crash boats reported only an oil slick at point B-29 struck water. Search following the accident disclosed a section of the leading edge of B-29 left wing from two and one-half ($2\frac{1}{2}$) to eight and one-half ($8\frac{1}{2}$) feet inboard of tip, top skin between front and rear spar from two and one-half ($2\frac{1}{2}$) feet from wing tip to approximately twenty-five (25) feet inboard of tip where the F-84 nose section had contacted the wing, and smaller pieces of left wing to be scattered on land in an area approximately one and one-half ($1\frac{1}{2}$)

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INVESTIGATION AND ANALYSIS (continued)

miles from impact of B-29 along direction of flight. Tips of each horizontal stabilizer, sections of vertical stabilizer and approximately thirteen (13) feet of fuselage tail cone were recovered from water approximately one mile from impact area. Small pieces of rear fuselage and wing were scattered along direction of flight in water and on land.

13. Examination of recovered sections of left wing of B-29 revealed that the front spar failed sixty-five inches (65") from the wing tip in bending. The high points of this buckling failure on the upper surface of the wing were marked with aluminum paint from the left wing tip of the F-84. Yellow paint marks from yellow nose cowl of F-84 and OD paint from nose gun deck cover of F-84 were found on the inboard end of the B-29 wing skin. Repositioning the gun deck cover at the paint marks and matching the angle the cover was sheared by the rear spar of the B-29, revealed the distance from buckle in wing to center of gun deck cover to be the semi span of the F-84. The F-84 made contact in a yawed position. The F-84 canopy probably missed the trailing edge of the B-29 aileron. The towed aircraft could roll twenty-five degrees (25°) before the lance support on the F-84 would bottom on the receiver installed on B-29 wing tip. The receiver being fixed could not rotate. The rolling of the F-84 beyond twenty-five degrees (25°) loaded the B-29 wing and caused the wing to buckle. The inboard end of the B-29 wing skin was sheared by the nose of the F-84.

14. On the previous flight (22 April 1953), the pilot of 641 had experienced a violent left roll when engaging the automatic flight control (AFC). AFC was shut off and aircraft resumed normal coupled position. However, the emergency release of coupling system did not function thru complete cycle. Pilot reported he had been unable to completely balance out the signal circuit of AFC; this coupled with a malfunction of cam follow-up potentiometer had caused the roll down when AFC was activated. The AFC in 641 had been completely checked and calibrated after maintenance and before the flight on 24 April 1953. Elevator travel during AFC flight was restricted to 4° by limit switches which disengaged the AFC to prevent large loads on aircraft. After disengaging auto pilot, the aircraft would return to towed position. AFC could be disengaged by elevator travel switches, on-off switch on the F-84 instrument panel and the gun trigger switch on grip. The malfunction of the AFC which caused the violent roll of the F-84 is unknown.

15. The emergency release installed in the coupling system could be activated by the pilot of either the B-29 or the coupled F-84 by means of a toggle switch in each cockpit, or by limit switches on B-29 wing set at 10° roll of the F-84, or by switches on the lance of the F-84 set at twelve degrees (12°) down and thirteen degrees (13°) up roll. The release sequence after activation was; air retraction of electrical connector and then air release of aft latch which in the retracted

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(Restricted) Report of Special Investigation of Aircraft Accident B-29 44-62093 and F-84D 48-641 on 24 April 1953, Six Miles Northeast of Southampton, L. I., New York

INVESTIGATION AND ANALYSIS (continued)

position completed the ground of the circuit, to fire the squibs that released forward receiver from B-29. In event the rear latch did not complete the squib circuit, a delay relay activated at the time the system was activated fired the squibs after a two (2) second delay. One second was required to fire squibs if rear latch completed circuit. Therefore, release required a minimum of one second and maximum of two (2) seconds after activation. On flight of 22 April 1953 following the roll down, the release system was activated, however, the system did not effect release of receiver. F-84 641 accomplished release thru normal operation of coupling system. A complete electrical check with lights in place of squibs did not show any malfunction when the release switches were activated by hand. The squibs were removed and checked and then rechecked after installation. All checks showed system to be operational. However, the system was not activated by use of a jig or the F-84 aircraft during this check. The observer pilot noted on 24 April 1953 that at about twenty (20) to thirty degrees (30°) roll of 641 the rear latch and connector were retracted indicating the emergency release system was cycling. The receiver has not been recovered and since the lance was broken from F-84 it is not determined whether the cycle was completed.

16. Earlier in the test program pitch limit switches were installed in the B-29 wings. Prior to the flight of 22 April 1953, the pitch limit switches were removed as a result of an emergency release due to flexing and vibration of B-29 wing and slight pitch of F-84 on a flight on 11 April 1953. All project personnel concerned felt these limits were too sensitive and since pitch of towed aircraft was reflected as roll it was decided these switches should be removed. An emergency release retarded the test program several days due to necessary squib replacement and system checking. The only malfunction of the release system occurred on the two (2) flights following removal of the pitch switches. The nature of failure of the release system is undetermined.

17. The pilot of F-84 641 was considered well qualified for this test program. All couplings during program of the F-84 and B-29 had been accomplished by the pilots flying 641 and 661 on 24 April. Since the start of the program in 1950, one hundred fourteen (114) couplings for a total of 26:10 hours towed flight, have been made with the two (2) pilots about equal in number of couplings and towed flight time. The pilot and co-pilot of the B-29 were considered well qualified for this test program. The B-29 pilot had made six (6) flights on this project and the co-pilot five (5) flights. The project officers from WADC and Republic Aviation Corporation had heard both F-84 pilots comment favorably on the B-29 crew's ability to fly the B-29 as required for the project.

18. A review of the available maintenance records of aircraft involved in this accident did not reveal any aircraft maintenance history that would reflect on this accident. The B-29 Forms were lost in the crash. The test flight write-ups on the

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INVESTIGATION AND ANALYSIS (continued)

program did show a malfunction of the AFC installed in 641 on the previous flight. However, the AFC was repaired and completely calibrated prior to the last flight. On the previous flight the failure of the release system was also noted. However, a complete electrical check of the system had been accomplished prior to the last flight. The operation of the release had not been checked with a jig. A recording of the radio transmissions prior to the accident did not indicate any airframe or engine malfunction.

19. Modification of test aircraft to the present configuration was started in October 1951 and completed in November 1952. The outer wing panels of the B-29 were removed prior to the last eleven (11) couplings for the installation of the modified coupling system which incorporated the power connector terminals for the AFC operation. Inspection at this time did not reveal any defect or damage to the B-29 wing. Due to the classification of this test program, the maintenance on the aircraft involved had been accomplished by the same maintenance crews throughout the program. All work on the AFC and coupling device was accomplished by the Republic engineers and installation crews that made the installation in the aircraft.

20. The B-29 crashed in water fifty-three (53) seconds after initial impact of the F-84 and forty-five (45) seconds after the crew had been alerted for bailout by the pilot. Due to the violent spin of the B-29 following the separation of the left wing and the tight corkscrew spin following the loss of the right wing and the complete empennage, the B-29 crew could not effect escape from the aircraft in the time available. Flight Test Division requires hazardous flights to be conducted with the B-29 unpressurized so as to expedite escape in event of emergency. These instructions had been reaffirmed by the WADC Project Officer prior to the flight on 11 April 1953. However, it was indicated during the investigation that three (3) earlier flights had been conducted with the B-29 pressurized. The aircraft was not equipped with quick release blisters, however, a propelled jettisoning system would be required to enable the crew to escape in the time available and from the maneuvers of the aircraft during descent.

21. Although it was undetermined at what time the pilot of F-84 641 received the fatal head injury, the RAC engineers involved in the investigation of this accident were of the opinion that the aircraft was controlled during the descent due to the flight pattern after the collision. The aircraft was neutrally stable due to the aft C.G. condition after the nose section was sheared, but it was felt it could have been controlled.

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SECURITY INFORMATION

Mr. Nagle/mr, 4717
AFCES-2G

Comment on Special Investigation of Aircraft Accident B-29, 46-62093 and F-84D, 48-641, 24 April 1953.

1. It is assumed that flight control of the B-29 aircraft automatically controls the flight of the towed aircraft without any effort on the part of the pilot of the towed aircraft. The report does not state if this is the case. It is also not known if the autopilot of the B-29 is in use or whether the autopilot of the towed aircraft is automatically fed signals from transmitters associated with flight controls of the B-29, exclusive of the B-29 autopilot installation.

2. It is not known what power is transmitted to the autopilot of the towed airplane over and above signals necessary for autopilot control. Experience has shown that it is highly dangerous if DC circuits of an autopilot are interrupted when there is no interruption of AC power or signal sources.

3. What autopilot system was being used in the F-84?

4. How much experience was gained by an F-84 flying alone with properly simulated signals controlling its autopilot?

5. Why is it necessary to use a coupling system so short as to permit a collision? Since the towed aircraft are manned, overtaking problems should not be difficult and the towed aircraft should be able to assume any roll position without danger of collision.

6. Lack of description on photographs leaves the reader confused.

7. Have no confidence in recommendation No. 1 ever being fulfilled. The ramifications are too involved in considering bomber types of aircraft--cannot envision a mechanical device which will assist the ejection of a crew member pinned against an airplane interior while being in a tight spin. Explosive decompression would help in this instance but the pressurization system was not to be used in the towing aircraft of this project. The desirable effect would be for the whole fuselage to be blown apart.

8. The margin is extremely narrow between disastrous roll and the reliable safe means to separate the two aircraft sufficiently to avoid all further danger of collision. We are depending on electronics to do this, risking lives on a technique that is believed to be somewhat ahead of the state of the art.

9. It is understood that the Navy has mechanically limited elevator travel on air-launched missiles during experimental flights to reduce danger of collision after launching. This technique, although pertaining to missiles, may be found useful in this operation.

10. Recommend curtailment of further airborne contacts, with AFC engaged, until more fail-safe methods are developed.

CLASSIFICATION CHANGED

ROK

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E. Leahy

29 Jul 53

BY:
DATE:

(Restricted) Report of Special Investigation of Aircraft Accident B-29 46-62093 & F-84D 48-641 on 24 April 1953, Six Miles Northwest of Southampton, L. I., New York

THE ACCIDENT

1. ~~The~~ B-29 SN 46-62093 and F-84 SN 48-641, [illegible] ~~with two (2) additional F-84 aircraft~~. were airborne approximately one hour on a classified experimental test flight on Project MX-1016. ~~The F-84~~ 641 coupled to the left wing of B-29 SN 093 suddenly rolled one hundred eighty degrees (180°) to the right and while inverted struck the top of the B-29 wing. The impact sheared the nose section of the F-84 and severely damaged the left outboard wing section of the B-29. Both aircraft crashed with fatal injuries to ~~all crew members~~ the F-84 pilot and the five B-29 crewmembers.

CONCLUSIONS

2. It is concluded that:

a. The primary cause of the accident was a malfunction of the experimental automatic flight control equipment installed in the F-84 and B-29 resulting in the collision of the two (2) aircraft (see paragraph 7).

b. The emergency release mechanism of the coupling system did not disengage the aircraft (see paragraphs 7 and 11).

RECOMMENDATIONS

3. IT IS RECOMMENDED THAT ~~WRIGHT AIR DEVELOPMENT CENTER~~ [illegible] Research and Development Command:

a. ~~Install on all aircraft engaged in hazardous~~ [illegible] ~~such as Project MX-1016, a rapid ejection escape system for all crew members (see paragraph 20)~~. [illegible] experimental equipment under development by ARDC. (See para —)

b. Require complete ground checking, simulating actual release in flight, of release mechanism of coupling system by the use of the aircraft or a mock-up jig of the coupling device. (See paragraph 15)

ACTION TAKEN

4. ~~F-84 empennage removed to Republic Aviation Corporation (RAC) for investigation of malfunction of automatic flight control by WADC, RAC, and [illegible] Corporation.~~ [illegible] contained in para 3 [illegible] Research and Development Command [illegible]

HISTORY OF FLIGHT

5. The B-29 crew and the three (3) F-84 pilots were briefed for an estimated two (2) hour experimental test flight of the automatic flight control (AFC) system for coupled flight. ~~The~~ F-84 SN 661 was to couple to right wing of B-29 and check the automatic flight control with F-84 641 coupled to left wing to provide symmetrical drag load. F-84G SN 321 was to act as observer for the mission. The B-29

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(Restricted) Report of Special Investigation of Aircraft Accident B-29 [illegible] and F-84D [illegible]-641 on 24 April 1953, Six Miles Northwest of Southampton, L. I., New York

HISTORY OF FLIGHT (continued)

departed Republic at 1615 EST. F-84 [illegible] and 641 departed at [illegible] EST. The test aircraft assembled at twenty thousand feet (20,000'). F-84 [illegible] coupled to the right wing of the B-29. Due to a malfunction of coupling mechanism, [illegible] could not check automatic flight control, so decoupled. F-84 641 then coupled to the left wing of ~~B-29~~, and had been towed for approximately thirty (30) minutes while completing operational check of coupling device and ~~[illegible]~~ [illegible]

6. Since the automatic flight control in 641 had been completely checked prior to flight, it was decided by the pilot ~~in 641~~ to complete the auto flight control check as the system ~~in 641~~ appeared to be functioning in satisfactory manner. After trimming the aircraft the roll channel, with the pitch channel off, was checked several times with a resulting erratic but not violent floating of the aircraft. Due to installation, the pitch channel could not be checked independently of the roll channel. It was decided to turn on both channels, pitch and roll, for a moment to check coupled operation of the system.

7. The aircraft were proceeding on a southeasterly heading at twenty thousand feet (20,000'). As the automatic flight control was engaged, F-84 641 rolled violently to the right twenty-five (25) to thirty degrees (30°). The observer pilot noted that the rear latch and electrical connector were disengaged and that the B-29 wing buckled approximately twenty-five feet (25') from tip. The roll of the F-84 continued at a slower rate. At approximately one hundred degrees (100°) of roll, it was noted that the F-84 was free of the B-29. The F-84 continued to roll and while inverted, struck the top of the B-29 wing. ~~The F-84 fuselage struck the B-29 wing~~ at the inboard end of the aileron. The nose section forward of windshield of the F-84 sheared off and a large hole was torn in the B-29 wing ~~at the area of F-84 fuselage impact~~.

8. Following the collision, F-84 641 cleared the B-29 in a split S maneuver, recovered and entered a second split S. After recovering, the aircraft appeared to circle the town of Southampton, L. I., straighten out and proceed north of the town in a series of shallow banked turns. The aircraft crashed in a wooded area two ~~(2)~~ miles north of Southampton. The ground impact was followed by a small explosion and fire. The pilot of F-84 [illegible] following the descent of 641, did not observe any indication that the pilot had escaped from the aircraft. The aircraft crashed two ~~(2)~~ minutes twenty-six ~~(26)~~ seconds after the initial collision.

9. F-84 321 followed the B-29 after the collision. The aircraft made a turn to the left of approximately ninety ~~(90)~~ to one hundred eighty degrees ~~(180°)~~ losing altitude. At approximately seventeen thousand ~~(17,000)~~ feet, the damaged portion of the left wing separated. The spiral tightened up and at approximately ten thousand (10,000) feet the right wing outboard of nacelle and the remaining portion

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(Restricted) Report of Special Investigation of Aircraft Accident B-29 [illegible] and F-84D [illegible] on 24 April 1953, Six Miles Northwest of Southampton, L. I., New York

HISTORY OF FLIGHT (continued)

of left wing outboard of the engines ~~sheared~~. The empennage of the B-29 ~~sheared~~ approximately ten thousand feet (10,000') ~~as pieces were found in water about one mile from point fuselage hit water~~. The aircraft went into a tight corkscrew spin and exploded upon impact with the water two and one-half (2½) miles southwest of Robins Island. A large fire was observed on the surface of the water but no wreck was noted. The B-29 crashed in the water fifty-three (53) seconds after collision with F-84. No parachutes were observed from the B-29.

INVESTIGATION AND ANALYSIS

10. Investigation at the scene of the F-84 crash indicated the aircraft contacted the trees at an angle of approximately forty degrees (40°) from the horizontal on a heading of ninety degrees (90°). Contact with the ground was in a tail low, wing level attitude. The wing panels ~~of the F-84~~ sheared at the root upon ground impact ~~and the aircraft uprooted a large stump at the approximate place where the aircraft stopped~~. Wreckage was confined to an area of approximately ten (10) yards radius. The aircraft (except for nose section forward of windshield) was intact at time of impact. The canopy was found ~~directly~~ beside the fuselage and had not been fired as the rollers were still installed. The fuselage section forward of rear row of blades of the engine compressor was destroyed by fire following the ground impact. The pilot had remained in the cockpit.

11. Examination of the right wing tip of the F-84 revealed the coupling lance and forward aluminum mounting casting had been torn from the airplane. The electric connection in the F-84 wing tip showed only fire damage. As this connector is a light casting, any bending would damage electrical contacts or the casting itself. The rear coupling roller did not show any marks or damage from the rear latch installed in the B-29. The landing gear, wing flaps and dive brakes were retracted. Examination of elevator tab jack screw indicated elevators trimmed to neutral position; normal for coupled flight. Seat and canopy jettison systems were destroyed by fire. It was undetermined if systems had been activated. The top bow of the windshield frame contained a deep dent, however, the matching canopy bow was not marked. The canopy was noted to be intact after collision with the B-29. The gun deck cover was found two (2) miles east of Southampton - eight (8) miles from collision and three (3) miles from wreckage of the F-84.

12. B-29 993 exploded upon impact with water. Observer pilot in [illegible] reported no wreckage at point of impact. A PBY and two (2) crash boats reported only an oil slick at point B-29 struck water. Search following the accident disclosed a section of the leading edge of B-29 left wing from two and one-half (2½) to eight and one-half (8½) feet inboard of tip, top skin between front and rear spar from two and one-half (2½) feet from wing tip to approximately twenty-five (25) feet inboard of tip where the F-84 nose section had contacted the wing, and smaller [illegible] of left wing to be scattered on land in an area approximately one and one-half (1½)

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(Restricted) Report of Special Investigation of Aircraft Accident B-29 46-62093 and F-84D 48-641 on 24 April 1953, Six Miles Northwest of Southampton, L. I., New York

INVESTIGATION AND ANALYSIS (continued)

miles from impact of B-29 along direction of flight. Tips of each horizontal stabilizer, sections of vertical stabilizer and approximately thirteen (13) feet of fuselage tail cone were recovered from water approximately one mile from impact area. Small pieces of rear fuselage and wing were scattered along direction of flight in water and on land.

13. Examination of recovered sections of left wing ~~of B-29~~ revealed that the front spar failed sixty-five inches (65") from the wing tip. ~~in bending.~~ The high points of this buckling failure on the upper surface of the wing were marked with aluminum paint from the left wing tip of the F-84. Yellow paint marks from yellow nose cowl of F-84 and paint from nose gun deck cover of F-84 were found on the inboard end of the B-29 wing skin. Repositioning the gun deck cover at the paint marks and matching the angle the cover was sheared by the rear spar of the B-29, revealed the distance from buckle in wing to center of gun deck cover to be the semi span of the F-84. The F-84 made contact in a yawed position. The F-84 canopy probably missed the trailing edge of the B-29 aileron. The towed aircraft could roll twenty-five degrees (25°) before the lance support on the F-84 would bottom on the receiver installed on B-29 wing tip. The receiver being fixed could not rotate. The rolling of the F-84 beyond twenty-five degrees (25°) loaded the B-29 wing and caused the wing to buckle. The inboard end of the B-29 wing skin was sheared by the nose of the F-84.

14. On the previous flight (22 April 1953), the pilot of 641 had experienced a violent left roll when engaging the automatic flight control (AFC). AFC was shut off and aircraft resumed normal coupled position. However, the emergency release of coupling system did not function thru complete cycle. Pilot reported he had been unable to completely balance out the signal circuit of AFC. This, coupled with a malfunction of cam follow-up potentiometer had caused the roll ~~down~~ when AFC was activated. The AFC in 641 had been completely checked and calibrated after maintenance and before the flight on 24 April 1953. Elevator travel during AFC flight was restricted to ∠4° by limit switches which disengaged the AFC to prevent large loads on aircraft. After disengaging auto pilot, the aircraft would return to towed position. AFC could be disengaged by elevator travel switches, on-off switch on the F-84 instrument panel and the gun trigger switch on grip. The malfunction of the AFC which caused the violent roll of the F-84 is unknown.

15. The emergency release installed in the coupling system could be activated by the pilot of either the B-29 or the coupled F-84 by means of a toggle switch in each cockpit, or by limit switches on B-29 wing set at ∠10° roll of the F-84, or by switches on the lance of the F-84 set at twelve degrees (12°) down and thirteen degrees (13°) up roll. The release sequence after activation was: air retraction of electrical connector and then air release of aft latch which in the retracted

(Restricted) Report of Special Investigation of Aircraft Accident B-29 46-62093 and F-84D 48-641 on 24 April 1953, Six Miles Northwest of Southampton, L. I., New York

INVESTIGATION AND ANALYSIS (continued)

position completed the ground of the circuit to fire the squibs that released forward receiver from B-29. In event the rear latch did not complete the squib circuit, a delay relay activated at the time the system was activated, fired the squibs after a two (2) second delay. One second was required to fire squibs if rear latch completed circuit. Therefore, release required a minimum of one second and maximum of two (2) seconds after activation. On flight of 22 April 1953 following the roll down, the release system was activated, however, the system did not effect release of receiver. F-84 641 accomplished release thru normal operation of coupling system. A complete electrical check with lights in place of squibs did not show any malfunction when the release switches were activated by hand. The squibs were removed and checked and then rechecked after installation. All checks showed system to be operational. However, the system was not activated by use of a jig or the F-84 aircraft during this check. The observer pilot noted on 24 April 1953 that at about twenty (20) to thirty degrees (30°) roll of 641 the rear latch and connector were retracted, indicating the emergency release system was cycling. The receiver has not been recovered and since the lance was broken from F-84 it is not determined whether the cycle was completed.

16. Earlier in the test program pitch limit switches were installed in the B-29 wing. Prior to the flight of 22 April 1953, the pitch limit switches were removed as a result of an emergency release due to flexing and vibration of B-29 wing and slight pitch of F-84 on a flight ~~on~~ 11 April 1953. All project personnel concerned felt these limits were too sensitive and since pitch of towed aircraft was reflected as roll it was decided these switches should be removed. An emergency release retarded the test program several days due to necessary squib replacement and system checking. The only malfunction of the release system occurred on the two (2) flights following removal of the pitch switches. The nature of failure of the release system is undetermined.

17. The pilot of F-84 641 was considered well qualified for this test program. All couplings during program ~~of the F-84 and B-29~~ had been accomplished by the pilots flying 641 and 661 on 24 April. Since the start of the program in 1950, one hundred fourteen (114) couplings for a total of 26:10 hours towed flight, have been made with the two (2) pilots about equal in number of couplings and towed flight time. The pilot and co-pilot of the B-29 were considered well qualified for this test program. The B-29 pilot had made six (6) flights on this project and the co-pilot five (5) flights. The project officers from WADC and Republic Aviation Corporation had heard both F-84 pilots comment favorably on the B-29 crew's ability to fly the B-29 as required for the project.

18. A review of the available maintenance records of aircraft involved in this accident did not reveal any aircraft maintenance history that would reflect on this accident. The B-29 Forms were lost in the crash. The test flight write-ups on the

ASSIFICATION CANCELLED OR CHANGED

AF 205-1 par 39

E. Drake 9 Nov 55

(Restricted) Report of Special Investigation of Aircraft Accident B-29 46-62093 and F-84D 48-641 on 24 April 1953, Six Miles Northwest of Southampton, L. I., New York

INVESTIGATION AND ANALYSIS (continued)

program did show a malfunction of the AFC installed in 641 on the previous flight. However, the AFC was repaired and completely calibrated prior to the last flight. On the previous flight the failure of the release system was also noted. However, a complete electrical check of the system had been accomplished prior to the last flight. The operation of the release had not been checked with a jig. A recording of the radio transmissions prior to the accident did not indicate any airframe or engine malfunction.

19. Modification of test aircraft to the present configuration was started in October 1951 and completed in November 1952. The outer wing panels of the B-29 were removed prior to the last eleven (11) couplings for the installation of the modified coupling system which incorporated the power connector terminals for the AFC operation. Inspection at this time did not reveal any defect or damage to the B-29 wing. Due to the classification of this test program, the maintenance on the aircraft involved had been accomplished by the same maintenance crews throughout the program. All work on the AFC and coupling device was accomplished by the Republic engineers and installation crews that made the installation in the aircraft.

20. The B-29 crashed in water fifty-three (53) seconds after initial impact of the F-84 and forty-five (45) seconds after the crew had been alerted for bailout by the pilot. Due to the violent spin of the B-29 following the separation of the left wing and the tight corkscrew spin following the loss of the right wing and the complete empennage, the B-29 crew could not effect escape from the aircraft in the time available. Flight Test Division requires hazardous flights to be conducted with the B-29 unpressurized so as to expedite escape in event of emergency. These instructions had been reaffirmed by the WADC Project Officer prior to the flight on 11 April 1953. However, it was indicated during the investigation that three (3) earlier flights had been conducted with the B-29 pressurized. The aircraft was not equipped with quick release blisters, however, a propelled jettisoning system would be required to enable the crew to escape in the time available and from the maneuvers of the aircraft during descent.

21. Although it was undetermined at what time the pilot of F-84 641 received the fatal head injury, the RAC engineers involved in the investigation of this accident were of the opinion that the aircraft was controlled during the descent due to the flight pattern after the collision. The aircraft was neutrally stable due to the aft C.G. condition after the nose section was sheared, but it was felt it could have been controlled.

CLASSIFICATION CHANGED TO ~~[illegible]~~
TO
BY AUTHORITY OF AFR 205-1 Jun 39 a
BY [illegible] DATE 23 Dec 58

6

HEADQUARTERS

Wright Air Development Center

Auth: WADC
BY: Stephen P. Ham, Lt
DATE: 6 July 1953

WRIGHT-PATTERSON AIR FORCE BASE
OHIO

WCG

13 July 1953

SUBJECT: Letter of Transmittal - Report of Major Aircraft Accident (Uncl)

TO: Commander
Air Research and Development Command
ATTN: RDOOT
Post Office Box 1395
Baltimore 3, Maryland

1. Transmitted herewith Report of Major Aircraft Accident, AF Forms 14 and attachments, which occurred near Suffolk County Air Force Base, Long Island, New York, 24 April 1953 involving F-84, serial number 48-641 and B-29, serial number 44-62093 and which resulted in the loss of six military personnel of the Wright Air Development Center. The F-84 was being flown by Major John W. Davis, 13704A, who was killed, and the B-29 was being flown by Captain James J. Vapenick, AO-840881 who is missing, presumed dead.

2. The Wright Air Development Center comments follow:

a. Section 12 reads in part "a complete operational check of the autopilot was performed by Westinghouse representatives on 24 April 1953 at 1400." Section 14, pages 6 through 11 contain testimony of Mr. Kosinski, Republic Aviation Corp., to the effect that the autopilot and emergency release system were very carefully checked prior to the flight of the 24th. In order for the autopilot system in the F-84 and the emergency release system to be properly checked it is necessary to connect the B-29, which provides the power source for the F-84 autopilot, directly to the F-84. This procedure of interconnecting the two was not carried out and the jig to check the emergency system was not used prior to the flight of the 24th. It is considered by this Center that these checks were mandatory prior to making the flight. The failure on the part of the Republic and Westinghouse engineers to properly and completely check out the equipment prior to this, the first attempt to use the complete equipment, is considered to be completely unjustifiable.

b. After a test flight made on 22 April 1953 the Wright Air Development Center project engineer decided that the F-84, serial number 48-641 would not be used anymore for the autopilot tests, since the gain control panel was installed only in F-84, serial number 48-661 (which on the day of this accident was being flown by Lt Colonel Anderson). The project engineer had difficulty convincing Mr. Kosinski that the autopilot in 641 should not be used and the project engineer's decision was obviously ignored, reference radio transcript, Page 2, Section 16 of the Report.

... INFORMATION C3-25523

Ltr WADC, 13 July 1953, to Commander, ARDC, Subj: "(U)Ltr of Transmittal- Rpt of Maj Acft Acdt"

c. The emergency release system designed to separate the F-84 from the B-29, had a built in time delay of two seconds. Although WADC requested Republic Aviation to remove this delay several times it had not been done and might well have been the deciding factor in this accident. The Aircraft Accident Investigating Board did not bring out this point in its investigation.

3. With reference to the findings of the Board, Page 30 and 31, Inclosure 14:

a. Finding Number 1 is concurred in principle. Specifically this Center considers that the accident was caused by a malfunction of the automatic flight control system which caused the F-84 to perform an uncontrollable maneuver probably resulting in a stall.

b. Finding Number 2 is concurred in.

c. Finding Number 3a is concurred in.

d. This Center does not concur in Finding Number 3b. There is little evidence to substantiate this opinion. The WADC believes that Major Davis was unconscious due to impact shock, which was severe enough to shear off the nose section forward of the windshield of the F-84.

e. This Center does not concur in Finding Number 4. Although the project has been in effect for about four years it has involved different types of aircraft and different systems. As previously stated this was the first time that this complete automatic control equipment was being used. Projects of this nature can never become routine as new factors are constantly introduced until such time as the project is completed (or entirely abandoned) and the results placed into operational practice. Air Force Regulation 62-14, paragraph 6e describes the classification of an incident. The Board agrees that this flight was conducted under an approved flight research program. This Center holds the view that damage is always possible on hazardous projects despite all possible precautions being taken. The intent of paragraph 6e is to relieve the Commands concerned from being statistically charged with an accident caused solely by research and development work. It permits an investigation to be made commensurate with the seriousness of the occurrence and does not, in any way, minimize its seriousness. WADC does not believe that Air Force prestige would suffer if this occurrence is classified as an aircraft incident. There is, furthermore, no evidence or indication that the B-29 was not structurally sound until the impact of the F-84 with it. Even had it been unsound it could not have caused the maneuver performed by the F-84. It is therefore requested that this occurrence be reclassified as an incident under the provisions of paragraph 6e, Air Force Regulation 62-14.

CLASSIFICATION CANCELLED OR CHANGED TO ___ BY AUTH AFR 205-1 par 39a BY [illegible] 23 Dec 58

IF INCLOSURES ARE WITHDRAWN (OR NOT ATTACHED) THE CLASSIFICATION OF THIS CORRESPONDENCE WILL BE CANCELLED IN ACCORDANCE WITH AFR 205-1.

C3-25523

Ltr WADC, 13 July 1953, to Commander, ARDC, Subj: "(U)Ltr of Transmittal - Rpt of Maj Acft Acdt"

4. With reference to the Recommendations of the Board, Page 31, Inclosure 14:

a. Recommendation Number 1. Investigation into the cause of the malfunction is continuing. A series of discussions have been held and presentations made to all levels of command to determine the future of this sort of approach to the requirement for which Project MX-1016 was initiated. In any event, the application of this particular approach to the problem will be changed to conform to future weapons systems. This will inevitably lead to new and different components.

b. This Center concurs in Recommendation Number 2. In this particular instance it is believed that all possible precautions were taken and that no other modifications could have been made to improve the escape provisions.

c. Recommendation Number 3 is concurred in. However, there are always considerations which must be made when testing is to be performed. It is some times impractical to remove the aircraft involved from the contractor's facility for obvious reasons. Every effort is made to stay away from densely populated areas on all tests of a hazardous nature.

5. The delay in forwarding this report (approval was obtained from Headquarters, Air Research and Development Command) was necessitated by the requirement to carry out a thorough investigation of this incident, which involved several different laboratories and outside agencies.

1 Incl
Rpt of Acft Acdt
(1 cy)

ALBERT BOYD
Major General, USAF
Commander

OPR 205-1 par 30a
By E. Leahe 23 Dec 58

IF INCLOSURES ARE WITHDRAWN OR NOT ATTACHED THE CLASSIFICATION OF THIS CORRESPONDENCE WILL BE CANCELLED IN ACCORDANCE WITH PAR, 25E, AFR-205-1.

Unclassified
~~SECURITY INFORMATION~~
~~SECRET~~
C3-25523

05/12/1953
&
7/ ?/ 1952/53

X-2

X-2

05/12/53

Aviation History: Were the pressure suits used in the X-2 different from the "torture chamber" suits used in the X-1?

Everest: No, they were the same ones. That's all we had in those days.

Aviation History: One of the unique features of the Bell X-2 was the pilot ejection system. You could literally blow off the front nose portion of the cockpit to escape, right?

Everest: Yes, you could. It was Captain Milburn Apt who was the only pilot to ever use it. Apt was killed in the last flight of the X-2 program. He ended up in an inverted spin during descent, and we knew that when you blew the front cockpit section off, you'd get a 14-G pressure. The tiny X-2 cockpit was so small that your helmet was touching the canopy on both sides, while your legs and feet were straight out in front of you on the rudder bars; your shoulders touched the canopy rails on both sides. So when Captain Apt was in the inverted spin and blew the nose section off, the 14 or even 15 negative Gs knocked him out. The parachute on the cockpit section worked, but it was just used to slow your descent to a lower altitude so you could pop the canopy off and climb out to use your regular parachute. Unfortunately, Apt recovered consciousness when it was too late to bail out. He managed to get the canopy off but he was then too low to use his regular parachute.

Aviation History: The X-2 was launched or dropped from a Boeing B-50 Superfortress as opposed to the B-29 that would normally launch the Bell X-1. Why was that?

Everest: We started using the B-50s to drop the X-1 later on in the program, as well as the X-1A, X-1B and X-ID, because it could go higher and faster than the B-29. So we then continued to use it to launch the X-2.

Aviation History: In 1953, during a captive test flight over Lake Ontario, Bell Aerospace chief test pilot Skip Ziegler and Bell scanner Frank Walko were killed in an explosion and fire while the X-2 was still mated to the B-50. What went wrong?

Everest: Because everything fell into Lake Ontario, no one knows for sure what happened. Investigators surmised that it might have been an overpressurization of some of the propellant tanks in the X-2. Some early X-1s had a similar problem.

Aviation History: On your third powered flight of the Bell X-2, you broke a previous speed record you had set earlier in the Bell X-1B, reaching a speed of Mach 2.5 as opposed to 2.3. What was the maximum speed the engineers felt the X-2 was capable of?

Everest: About Mach 3.

Aviation History: Will you give a description of what it's like to make an altitude flight profile in the Bell X-2?

Everest: Well, a lot was expected of you. The flights themselves cost about one

When the XS-1 was being developed for history's first supersonic aircraft flights, plans were already underway for the XS-2 (later redesignated the X-2), which would fly at speeds and altitudes vastly greater than its predecessor. It was to be a Mach 3 rocket plane, capable of flights over 100,000 feet.

The X-2's structure had to be able to withstand aerodynamic heating never-before encountered, and the life support systems for the pilot needed to address the dangers of extremely high-altitude, high-airspeed flight. The challenges of developing a unique stainless steel/nickel alloy structure, a new throttleable rocket engine ranging in thrust from 2,500 to 15,000 lbs. of thrust, a jettisonable cockpit capsule, and control system difficulties delayed the program for years. The contract was signed in 1945, the first glide flight was in 1952, and the first powered flight occurred in 1955. Ironically, by that time the X-3, the X-4, and the X-5 had all flown.

X-2 Movie Clips

DFRC Movie #	Date	Movie Description
EM-0029-01	1950s	X-2 launch from B-29 mothership

Information about the X-2 research project

If the development of the X-2 was unusually time consuming, the flight test program was tragically brief. Two of the X-2s were built; both were destroyed in accidents.

Ship number two only made only three test glides, and exploded in 1953 during a captive test flight with its B-50 carrier aircraft. It was attached to the mothership when a leather gasket on the X-2's liquid oxygen tank exploded as they were flying at about 30,000 feet. The X-2 was a total loss. Bell test pilot Jean Ziegler and B-50 crewman Frank Walco were killed as the explosion ripped the X-2 out of the bomb bay. The B-50 was landed safely, then scrapped.

Ship number one's first flight at Edwards Air Force Base was on August 5 of the following year. Its first powered flight was made on November 18, 1955. During the next ten months the X-2 was finally showing its potential. On July 23, 1956 Air Force Capt. Frank Everest set a new unofficial world's speed record of Mach 2.87 (1,900 mph). On September 7 USAF Capt. Iven Kincheloe set a new altitude record of 125,906 feet. Then on the aircraft's 13th powered flight, USAF Capt. Milburn Apt (making his first flight in the X-2) was killed after the plane went out of control after successfully breaking Mach 3 (Mach 3.196).

Apt's plane became uncontrollable shortly after a routine engine shut down at 65,500 feet. He jettisonned the cockpit capsule at about 40,000 feet, but was inexplicably unable to leave the capsule and parachute to safety before it impacted the ground. The rest of the airplane crashed about five miles away.

The X-2 program advanced the technologies of heat resistant alloys and rocket engines, but the grim lessons learned about the dangers of inertial coupling, which caused the aircraft to go out of control, and the requirements of flight safety became its legacy. The National Advisory Committee for Aeronautics' High-Speed Flight Station (predecessor of today's NASA Dryden Flight Research Center), which expected to receive the airplane for flight research, never received it because of the accident, but it had supported the Air Force with advice and data analysis during its flight testing.

Back to the Dryden Movie Gallery home page

Responsible NASA Official: Dill Hunley Dill.Hunley@dfrc.nasa.gov

Page Curator: Robert Binkley Robert.Binkley@dfrc.nasa.gov

Modified: February 2, 1997

'Go get it'

One of only two Bell supersonic X-2 airplanes ever built has rested at the bottom of Lake Ontario since during a 1953 test flight from the Niagara Falls Air Force Base. Now, after years of research, a local ent gets final approval for his plan to try to raise the stainless steel craft from its watery grave.

By BILL MICHELMORE / News Niagara County Bureau

Photo Courtesy of NASA

Above, Louis Ricciuti holds a model of the supersonic Bell X-2, which he will attempt to recover from the bottom of Lake Ontario, where it has rested since 1953. In the photo at right, taken in late 1952 or early 1953, the X-2 that now rests on the bottom of Lake Ontario is seen at Edwards Air Force Base after a glide test in which the X-2 was dropped from the belly of a B-50 and glided back to earth. But upon landing, the X-2's nose wheel collapsed, creating the long gouge in the desert floor visible behind the plane. The plane was then returned to Niagara Falls for repair.

NIAGARA FALLS — The late afternoon sky was overcast as Captain William Leyshon pulled back on the control yoke and lifted the B-50 from the runway at the Niagara Falls Air Force Base.

Attached to the belly of the big aircraft was an X-2 supersonic rocket plane, one of only two built at the former Bell Aircraft plant in Wheatfield in the late 1940s and early 1950s.

The four-engine B-50, a modified B-29, took off into the prevailing westerly wind, circled to the right and headed east over Lake Ontario.

Sitting next to the 46-year-old Leyshon was co-pilot David Howe, 34, of Grand Island. Among the other seven crew members were Bell test pilot Jean L. "Skip" Ziegler, 32, of Snyder, and flight engineer Frank Walco, 33, of Buffalo.

A P-47 chase plane piloted by Capt. William F. Mable followed the B-50 to observe the flight and to radio back to base in the case of an emergency.

None of them knew that this test flight on May 12, 1953, would end in tragedy.

The X-2 was the successor to the X-1 series of rocket planes built at the Bell plant in the 1940s. Legendary test pilot Chuck Yeager broke the sound barrier in an X-1 on Oct. 14, 1947. On that day, Yeager's X-1 dropped from the belly of a B-29 bomber 42,000 feet above the California desert and Yeager pushed the bright orange airplane past Mach 1 — about 700 miles an hour.

That X-1 now hangs in the National Air and Space Museum. Yeager went on to become the embodiment of "The Right Stuff," after Tom Wolfe published a book describing Yeager's role in the high-flying derring-do that preceded the space program.

But the "Right Stuff" didn't start in California, notes Niagara Falls entrepreneur and local expert on the X-series aircraft, Louis Ricciuti.

"The 'Right Stuff' started right here in Niagara County and Western New York," Ricciuti said.

And on that fateful day, a sad chapter would be written in the ...

... larger plane had not yet been launched as designed.

But this X-2 had already flown independent of the B-50 mother ship, with just one glitch. Some ...

... Ontario in restricted military airspace.

First, the crew checked communications arrangements between the two planes. The fuel ...

... board, it had to be jettisoned.

Capt. Mable, in the chase plane, reported seeing "a ball of fire" as his aircraft was flipped over by the impact of the explosion.

Another cre
Robert Walze
ds, was injur
knocked out
four engines.
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never flown ag
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mained in 33
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Base.
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sensitive data
when it fell in
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magnetometers
under water.
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X-5

13/10/53

1/53

Even the vicious spinning characteristics of the X-5 yielded a wealth of data for determining poor aircraft spin design.

Bell built two X-5s. Following the completion of the contractor test program with aircraft number one (serial number 50-1838) in October 1951, the Air Force flew a brief evaluation program totaling six flights and turned the aircraft over to the NACA for the remainder of the 133 research flights by a variety of NACA pilots including Joseph Walker, Walter P. Jones, Scott Crossfield, and Stan Butchart. Future astronaut Neil Armstrong flew the final flight on 25 October 1955 at the NACA's High-Speed Flight Station (later the Dryden Flight Research Center).

Only Bell and the Air Force operated the second X-5 (50-1839), which was lost in a spin accident in 1953.

In this 8-second movie clip we see the Bell aircraft X-5 coming in, wings swept, for a low-level pass by the camera.

Keywords: Bell; X-5; variable wing sweep; Air Force; NACA; National Advisory Committee for Aeronautics; High-Speed Flight Station; Dryden Flight Research Center; Joseph Walker; Walter P. Jones; Scott Crossfield; Stan Butchart; Neil Armstrong; spin

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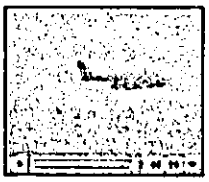
Back to X-5 Research Aircraft Movie Gallery home page



X-5 in flight

Movie Number: EM-0032-01
Movie Date: 1950s

Formats: 160x120 QuickTime Cinepak Movie (435 KBytes)
320x240 QuickTime Cinepak Movie (2,160 KBytes)
320x240 QuickTime Sorenson Movie (523 KBytes) (Requires Quicktime 4)
320x240 MPEG Movie (1,129 KBytes)

Description: The Bell X-5 completed all of the research goals originally set for the first aircraft capable of variably sweeping its wings in flight. Demonstrating wing sweep from 20 to 60 degrees, the aircraft verified NACA wind-tunnel predictions of reduced drag and improved performance resulting from increased wing sweep as it approached Mach 1.

11-21 TT-70-18

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REPORT OF AF AIRCRAFT ACCIDENT

Use this form in accordance with AF Reg. 62-14 and AF Manual 62-5, "Aircraft Accident Investigators' Handbook." Fill in all spaces applicable. If additional space is needed, use additional sheet(s) and identify by proper section letter and subsection number.

91029 — Section A—GENERAL INFORMATION — 9153-M

1. Place of Accident: State, county, nearest town—Distance and direction to accident	Calif, Kern, Edwards, 15 Miles South East
2. Nearest Airport Suitable for landing this plane—Distance and direction to accident	Edwards AFB, Calif. 15 Miles East
3. Elevation Above Sea Level at accident scene	2500 feet
4. Date of Accident	13 Oct 53
5. Hour and Time Zone	1509 PST / [X] Day [ ] Night [ ] Dawn [ ] Dusk
7. List Numbers of All Other Aircraft Involved	None
8.	[X] Damage to Plane [ ] No Damage to Plane
9. Classification of Accident	[X] Major [ ] Minor
10. Clearance	[ ] IFR [X] Local [X] VFR [ ] Other
If Other— From / To	N/A
11. This was an	[ ] CAP Flight [ ] Air Reserve Flight [ ] ANG Flight [X] Other
12.	[ ] Fire Occurring Before Accident [X] Fire Occurring After Accident [ ] Fire Due to Accident
13. Airdrome of Last Takeoff	Edwards AFB
14. Duration of Flight Since Last Takeoff	0:40
15. Mission of Flight (Use Form 1 Symbol)	X-1
16. Activity Aircraft Was Engaged in Just Prior to Accident	Unintentional spin

Section B—AIRCRAFT

1. Aircraft No.	50-1839A
2. Type, Model, Series and Block No.	X-5
3. Organization Reporting Aircraft on AF-110 Report — Major Command	ARDC RDC
Subcommand	AFFTC AFT
AF Wing	—
Group Number and Type	—
Squadron or Unit	—
Base	Edwards AFB 9153
4. Technical Orders affecting this aircraft were not complied with at time of accident. (List number and title of these T. O.'s on separate sheet.)	—

Section C—OPERATOR (Person at controls at time of accident)

1. Last Name (Jr., II, etc.)	POPSON
First Name	RAYMOND
Middle Name	ANDREW
Grade	Major
Component	USAF
Serial No.	12634A
Nationality and Race	U.S. W
2. Assigned Base	Edwards AFB
Major Command	ARDC
Subcommand	AFFTC
AF Wing	—
Group No. and Type	—
Squadron or Unit	—
3. Attached Base for Flying	9153
Major Command	RDC
Subcommand	AFT
AF Wing	—
Group No. and Type	—
4. Original Aeronautical Rating and Date Received	Pilot 13 Dec 42
5. Present Aeronautical Rating and Date Received	Sr. Pilot 4 Jan 50
6. Primary Duty Assignment	8744, Exp. Test Officer

OPERATOR'S FLYING EXPERIENCE (Including Civilian)

7. Type of Instrument Card	White — Expiration Date 10/7/54
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours	3788:05
9. Total 1st Pilot Hours	2624:20
10. 1st Pilot Hours Last 90 Days	40:10
11. 1st Pilot Hours Last 30 Days	19:10
12. 1st Pilot Hours This Model (B-29, F-51, etc.)	1:40
13. Other Pilot Hours (CP, O, BC) This Model	—
14. 1st Pilot Hours Last 90 Days This Model	1:40
15. 1st Pilot Hours Last 30 Days This Model	1:40
16. Total Time Spent in Air During 24 Hrs. Prior to Accident	1:40
17. List by Type and Model 1st Pilot Experience in Similar Aircraft (e.g., B-29, 30 hrs.)	N/A
18. Was Operator on Instruments at Time of Accident or Immediately Before	[X] No [ ] Unk [ ] Yes [ ] Hood [ ] Weather
If above answer is "Yes" or if accident occurred at night or during IFR weather or unknown conditions, fill in items below.	
19. Total 1st Pilot Instrument Weather Hours	
20. Total 1st Pilot Instrument Hood Hours	
21. 1st Pilot Instrument (Weather and Hood) Hours Last 6 Months	
22. 1st Pilot Instrument (Weather and Hood) Hours Last 90 Days	
23. 1st Pilot Night Hours Last 6 Months	
24. 1st Pilot Night Hours THIS MODEL Last 90 Days	

Section D—PERSONNEL INVOLVED (Including operator and all other persons, whether in plane or not)

Duty at time of accident (1)	Name (Last name first) (2)	Type of Aero. Rating (Symbol) (3)	Serial No. (4)	Grade and Branch of Service (5)	Component (See AFM 62-5) (6)	Organizational Assignment—Command, Subcommand, Group Number and Type, Base (7) RDC 9153	Fatal, Major, Minor, None, Missing (8)	Parachute Used Yes (9)	No (10)
P	Popson, Raymond A.	Sr.Plt	12634A	MAJOR, AF	USAF	ARDC, AFFTC, Edwards	Fatal		X

AF FORM 14 APR 49 Previous editions are obsolete. Replaces AF Form 14A, 1 Jan 48, which is obsolete.

RESTRICTED (WHEN FILLED IN)

[redacted]

RESTRICTED (WHEN FILLED IN)

Section E—RATED PERSONNEL AT OTHER SET OF DUAL CONTROLS (Instructor, Copilot, etc.)

1. Last Name (Jr., II, etc.)	First Name	Middle Name	Grade	Component	Serial No.	Nationality and Race	Year of Birth

2. Assigned Base	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit
3. Attached Base for Flying	**Major Command**	**Subcommand**	**AF Wing**	**Group No. and Type**	**Squadron or Unit**

4. Original Aeronautical Rating and Date Received	5. Present Aeronautical Rating and Date Received	6. Primary Duty Assignment

FLYING EXPERIENCE (Excluding Civilian)		21. List by Type and Model: ☐ IP ☐ CP ☐ C Experience in Similar Aircraft (e. g., B-36, IP, 60 hrs.)	
7. Type of Instrument Card	Expiration Date		
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours			
9. Total 1st Pilot Hours		Fill in items below if Instrument and Night Experience of Operator was listed in Section C	
10. Total Hours, ☐ IP ☐ CP ☐ C (Check applicable one)			
11. Pilot Hours Last 90 Days		22. Total 1st Pilot Instrument Weather Hours	
12. 1st Pilot Hours Last 90 Days		23. Total 1st Pilot Instrument Hood Hours	
13. Hours Last 90 Days, ☐ IP ☐ CP ☐ C		24. 1st Pilot Instrument (Weather and Hood) Hrs. Last 6 Months	
14. Pilot Hours Last 30 Days		25. 1st Pilot Instrument (Weather and Hood) Hrs. Last 90 Days	
15. Total Pilot Hours This Model (B-36, F-84, etc.)		26. Total Pilot Night Hours Last 6 Months	
16. 1st Pilot Hours This Model		27. 1st Pilot Night Hours Last 6 Months	
17. Hours This Model, ☐ IP ☐ CP ☐ C		28. Night Hours Last 6 Mos., ☐ IP ☐ CP ☐ C	
18. Total Pilot Hours This Model Last 90 Days		29. Total Pilot Night Hours This Model Last 90 Days	
19. 1st Pilot Hours This Model Last 90 Days		30. 1st Pilot Night Hours This Model Last 90 Days	
20. Hours This Model Last 90 Days, ☐ IP ☐ CP ☐ C		31. Night Hrs. This Model Last 90 Days, ☐ IP ☐ CP ☐ C	

Section F—DAMAGE

1. Describe Briefly in General Terms the Extent of Damage to the Aircraft, Engines, and Propellers.

Destroyed by Explosion and Fire

D 2,154,074

2. Check Proper Damage Classification	
None	
Minor	
Substantial	
Destroyed	X

3. ☒ Plane or Wreckage Was Returned to an AF Base ☐ Plane or Wreckage Was Left at Scene of Accident	7. Give below a considered estimate of cost of this accident to the Air Force
	Cost of Damage to Aircraft $713,536.00
4. Is Plane Damaged Beyond Economical Repair? ☒ Yes ☐ No	Cost of Damage to Other Government Property $
5. If Plane Is To Be Repaired, Give Engineering Officer's Estimate of	Cost of Damage to Private Property $
Number of Man-Hours Required for Repair: N/A Man-Hrs.	Cost of Injuries $ 50,000.00
6. Was Private Property Damaged? ☐ Yes ☒ No	Cost—Other (Explain) $793,536.00
If "Yes," Describe Damages on Separate Sheet.	Total Estimated Cost of Accident $

Section G—SPECIAL EQUIPMENT

1. Check items of special equipment which affected the accident.

☐ Radios ☒ Armament ☐ De-Icers ☐ Equipment for Clear Vision From Cockpit
☐ Instruments ☐ Fire Extinguishing Equipment in Plane N/A ☐ JATO ☐ ____________

2. Describe Briefly How the Use, Misuse, Misuse, or Absence of Special Equipment Affected the Accident

Wing sweeping during spin could have affected this accident.

Section H—WEATHER (At time and place of accident)

Ceiling	Visibility	Wind Direction and Velocity	Temp.	Dew Point	Other Weather Conditions
Clear	30	NNW 7	76°	35°	___

2. If weather other than unfavorable wind conditions for takeoff, landing, or taxiing was a factor in the accident, attach statement of weather officer describing weather conditions and how they probably contributed to accident.

Section I—CHECK LIST FOR ATTACHMENTS

☒ Form 1 ☒ Clearance ☒ Photographs ☐ Form 14C
☒ Form 1A ☐ Crew Members' Statements ☒ Form 14A ☐ Form 14D
☒ List of T.O.'s Not C/W ☒ Witnesses' Statements ☒ Form 14B ☐ Form 14E
☒ Tear Sheet

Section J—ACCIDENT TYPE

Check one accident type as "Primary." Check all others applicable as "Secondary."

Primary	Secondary	
		Ground or Water Loop
		Wheels Up Landing
		Wheels-Up Landing
		Hard Landing
		Collapse or Retraction of Landing Gear
		Undershoot
		Overshoot
		Nose Up or Nose Over
		Collision With Other Aircraft
X		Collision With Ground [illegible]
		Other Collisions
	X	Spin or Stall
		Fire on Ground
		Fire and/or Explosion in Air
		Airframe Failure in Flight
		Abandoned Aircraft
		Prop or Jet Blast Accident
		Other (List):
		Undetermined

Section K—PHASE OF OPERATION

(Check only ONE)

	Taxiing Incident to Flight
	Take-Off
X	In Flight
	Landing
	Go Around
	Engine Running—Not Taxiing
	Ground Operations
	Undetermined

Section L—CONDITIONS AFFECTING ACCIDENT

(Check all applicable)

	Immediate Forced Landing
	Precautionary Landing
	Fuel Exhaustion
	Engine Stoppage
	Lost
	Pertinent T.O.'s Not Complied With
	Other (List):

Section M—VIOLATIONS

(Check all applicable)

	Improper Taxiing Procedure
	Failure To Use Checklist
	Unauthorized Low Flying
	Instrument Flying on VFR Clearance
	Unauthorized Formation
	Other (List):

Section N—CAUSE FACTOR ANALYSIS

Check one specific cause as "Primary." Check all others applicable as "Secondary." (See AFM [illegible] for definitions)

Primary	Secondary	1. ERRORS OF AIR CREW
		Misused Power Plant and/or Power Plant Controls
		Misused Brakes and/or Flight Controls on Ground
		Improper Use of Flight Controls in Air
		Exceeded Design Limits of Aircraft
		Inattentive To Fuel Supply or Fuel Selector Valves
		Failed to Extend or Retract Landing Gear Properly
		Selected Unsuitable Terrain or Runway for Takeoff or Landing
		Failed To Compensate for Wind Conditions
		Misjudged Distance
		Failed To Level Off Properly
		Failed To Observe Other Aircraft or Objects
		Failed To Maintain Adequate Flying Speed
		Became Lost (Weather not a factor)
		Continued VFR Flight Into Unfavorable Weather
		Improper Operation on Authorized Instrument Flight
		Operated Aircraft in Reckless Manner
		Made Inadequate Flight Preparations
		Attempted Flight Beyond Ability or Experience
		Failed To Use or Incorrectly Used Miscellaneous Equipment
		Other (List):
X		Loss of control resulting in an unintentional spin

Primary	Secondary	2. ERRORS OF OTHER PERSONNEL
		Aircraft Inadequately Maintained
		Aircraft Improperly Cleared for Flight
		Weather Incorrectly Forecast
		Improperly Operated Airport/Airway Facilities
		Improperly Supervised Training (Ground Personnel)
		Improperly Supervised Training (Flight Instructors and Flight Leaders)
		Other (List):

Primary	Secondary	3. MATÉRIEL FAILURE—POWER PLANT
		Cooling System
		Lubricating System
		Fuel System
		Engine Structure (Includes Jet Engines)
		Engine Control System
		Propeller and Propeller Accessories
		Superchargers (Reciprocating Engine only)
		Ignition System
		Engine Accessories
		Other:
		Undetermined

Primary	Secondary	4. MATÉRIEL FAILURE—AIR FRAME
		Flight Control System
		Wings, Ribbons, and Flaps
		Cowling and Fairing
		Fuselage
		Other:
		Undetermined

Primary	Secondary	5. MATÉRIEL FAILURE—LANDING GEAR
		Main Landing Gear
		Nose Wheel or Tail Wheel
		Landing Gear Position Indicators
		Brakes
		Tires
		Other:
		Undetermined

Primary	Secondary	6. MATÉRIEL FAILURE—EQUIPMENT AND ACCESSORIES
		Automatic Pilot
		Radio Equipment
		Electrical System
		Hydraulic System
	X	Oxygen or Pressurization System
		Safety Equipment
		Instruments
		Cockpit, Seat, Canopy, Fittings, Doors, Hatches
		Armament
		Other:

Primary	Secondary	7. WEATHER
		Low Ceiling
		Smoke—Haze
		Rain—Fog
		Snow—Hail
		Icing Conditions
		Unfavorable Wind Conditions for Landing, Taxiing, or Takeoff
		Turbulence in Flight
		Winds Aloft
		Thunderstorms
		Downdraft—Updraft
		Other:

Primary	Secondary	8. LANDING AREA
		Wet
		Soft
		Snow
		Ice
		Rough
		Glassy
		Runway Too Short
		Other Hazards

Primary	Secondary	9. GROUND EQUIPMENT
		Airport Facilities
		Airway Facilities
		Arresting Devices
		Launching Devices
		Other:

Primary	Secondary	10. MISCELLANEOUS
		Bird in Flight Path
		Shot-Off Target in Flight Path
		Other:

Primary	Secondary	
X	X	11. UNDETERMINED

SECTION O - DESCRIPTION OF ACCIDENT

X-5, Serial Number 50-1839A, piloted by Major Raymond A. Popson, 12631A departed Edwards Air Force Base at 1429 PST for a local familiarization check out flight, escorted by F-86, Serial Number 2848, piloted by Major Arthur Murray, 18622A. Take-off and climb to 40,000 feet were normal. At 40,000 feet Major Popson performed stalls at 20°, 40° and 60° wing sweep and level flight accelerations. After this he made a dive (20° wing sweep) and pull up, sweeping to 60° wing sweep during pull up. Then a dive to .96 Mach indicated was made and level off accomplished at 35,000 feet. Major Popson then called Major Murray and informed him that he had lost his oxygen pressure. Major Murray instructed him to begin an immediate descent. During descent, dive brakes extended, Major Popson stated that he had between 25 - 50 pounds of oxygen pressure. Both aircraft leveled off at 10,000 feet where Major Popson informed Major Murray that he had 120 gallons of fuel remaining and would like to "feel the aircraft out some more" before landing. They climbed to 12,000 feet MSL (approximately 10,000 feet above terrain) and stalls were made, using 20 and 40° wing sweep. A third series of stalls were begun using 60° wing sweep, but during this stall the aircraft rolled slowly on its back and began a spin to the right. The aircraft crashed after completing 4 - 6 turns in the spin. Major Murray called Major Popson during the entry of the third turn and told him to "get out" but received no reply. The aircraft exploded and burned upon impact. The pilot received fatal injuries. The crash occurred at 1509 PST approximately fifteen miles east of Edwards Air Force Base.

Total disintegration of the aircraft resulted from the explosion on impact, but examination of the crater revealed that the aircraft struck the ground in a slight turn, approximately 60° dive. Both wing sweep ball bearing jack screws were recovered and by comparison with like items of the NACA X-5, it was estimated that the wings were at 45° to 47° sweep at time of crash. Enough of the canopy and fuselage were also recovered to determine that the canopy was not ejected from the aircraft prior to crash. All safety pins pertaining to seat and canopy ejection mechanism had been removed prior to flight.

The Aircraft Accident Investigation Board is of the opinion that this accident was the result of loss of control of the aircraft resulting in an unintentional spin at insufficient altitude for recovery but it is felt that seve al factors or conditions could have contributed to this loss of control. These are as follows;

1. Wing Sweep Control - It is reasonably certain that the wings were not at 60° sweep at the time of crash. From Major Murray's statement, and from the plan of flight, it is assumed that the wings were in the 60° sweep position at entry to the final stall. It is the opinion of the Board the pilot was attempting to sweep the wings back to 20° during the unintentional spin. Reaction of the aircraft during a spin while the degree of sweep is being changed is unknown, since this condition had not been previously encountered. A noticeable trim change is known to be present during wing sweep changes at straight and level flight conditions.

2. Oxygen System and Pressurization - Examination of the Form 1, Part II disclosed that the cabin pressurization of the X-5 was inoperative. The cabin

pressure indicator of this aircraft usually indicated a thousand feet higher than the actual altitude. It is probable that Major Popson was using 100% oxygen from take-off until he reported the loss of oxygen pressure.

Testimony of competent witnesses reveals that by using 100% oxygen from take-off throughout the duration of a flight, the supply of oxygen would not normally be exhausted before approximately 35 minutes of flight. Total time elapsed between take-off and the time that the pilot notified the escort that he was out of oxygen was 26 minutes. Within a period of two minutes from time of initial notification of the loss of oxygen, the pilot further stated that he had between 25 and 50 pounds of oxygen pressure. The Crew Chief of the X-5 is certain that a full supply of oxygen was on board the airplane prior to this flight. This would indicate excessive leakage or partial malfunction within the oxygen system.

The medical member of the Aircraft Accident Investigation Board is of the opinion that these conditions were favorable to induce some degree of hypoxia, but to what extent is unknown. Although the pilot's radio conversation and reactions to the stalls at 20° and 40° wing sweep appeared normal, it is felt that hypoxia could have been a contributing factor to this accident.

3. The intentions of Major Popson upon entering the stall at the 60° sweep configuration is unknown. Full exploration of the stall characteristics at that altitude would have been unwise; however, a pilot of his known ability should have been able to effect recovery. It is possible that there was a misuse of controls during the attempted recovery from the unintentional spin; i.e., aileron against the spin rather than with, excessive elevator trim (which is highly effective) against the high elevator forces required in the 60° configuration. This is considered less likely, however, than the assumption of partial hypoxia which would reduce the pilots "keenness" or "edge" of reaction.

4. The block "Undetermined", Section N, AF Form 14, was checked because if any one of the factors discussed had occurred first, the loss of control of the aircraft would have been a secondary cause of this accident.

S T A T E M E N T

13 October 1953

The following statement is made by Major Arthur Murray, 14622A, with reference to the fatal accident on X-5 aircraft, Serial Number 1839, piloted by Major Raymond A. Popson, 12634A.

As X-5 instructor pilot I took off in F-86 #846 at 1400 Pacific time, to escort Major Popson on his qualification flight. I picked up the X-5 on take-off. On switching to "C" channel, assigned frequency for this flight, I proceeded on normal climb to 40,000 feet at which point (nine (9) minutes after take-off) Major Popson felt out the airplane at 20, 40 and 60 degrees of wing sweep; did a dive at 20 degrees pulled up, swept the wings to 60 degrees and dove to approximately .96 indicated Mach number; pulled up and headed southeast at approximately 35,000 feet.

After seventeen (17) minutes at altitude, most of which was at 40,000, the X-5 pilot called to say he had lost all his oxygen pressure. I advised an immediate descent which was set up as a gentle dive. In order to steepen the dive, I asked that the dive brakes be opened. While descending Major Popson stated that he had caught the loss in pressure at about 50 pounds and was reading between 25 and 50 pounds. The descent consumed approximately four (4) minutes.

The airplane was levelled off at 10,000 feet and dive brakes were closed. Pilot reported 120 gallons of fuel and asked if stalls could be done at this altitude. I advised him to climb to 12,000 feet. Stall approaches and stalls were accomplished at 20 degrees of wing sweep, slats and flaps in and out, 40 degrees of wing sweep, slats and flaps in and out. Major Popson completed the work at 40 degrees then re-climbed to approximately 12,000 feet where full forward translation and 60 degrees of wing sweep were checked externally. At this point ten (10) minutes had been spent between 10 and 12 thousand feet.

As the X-5 slowed with a high drag of 60 degrees, I over-ran to the left at approximately 160 knots and slightly above the X-5. In this position I could not be certain of the position of the slats and flaps. The stall entry appeared normal with the airplane rolling over rather slowly to the right at the stall as though the slats and flaps were up or rudder was being used to counter wing drop. Airplane continued rolling in an approximately level attitude, followed by a dropping of the nose. At the end of the first turn the nose dropped to about 40 degrees below the horizon and by the second turn had dropped to about 60 degrees below the horizon.

On entering the third turn I called for the pilot to get out. No radio transmissions had been received since entry in the stall. The airplane continued to spin about 1½ to 2 seconds per turn and, after an estimated total of five turns, struck the ground approximately wings level and exploded.

Arthur Murray
ARTHUR MURRAY
Major, USAF, 14622A

The Aircraft Accident Investigation Board, appointed by Letter Order No. 372, Headquarters, Air Force Flight Test Center (ARDC), Edwards Air Force Base, California, dated 19 October 1953, convened at 0810 hours on 20 October 1953 in the Directorate Conference Room, Edwards Air Force Base, to discuss the accident of aircraft X-5, Serial Number 50-1839A that occurred at 1509 hours, 13 October 1953 at Edwards Air Force Base, California.

Presiding Officer:

Colonel Horace A. Hanes

Members Present:

Colonel Howard C. Knapp	Medical Representative
Lt. Colonel Jackie L. Ridley	Member
Major Harold G. Russell	Member
Major Graydon D. Spurgeon	Engineering Representative
Captain James A. Bryant	Aircraft Accident Investigating Officer, Recorder

The meeting was called to order by the Presiding Officer. Lt. Colonel Frank K. Everest, Jr., Member, was excused. A brief resume of the accident and subsequent investigation was presented by the Aircraft Accident Investigating Officer. The Medical Representative made a brief report. Following that a discussion was held concerning the accident and related factors.

Captain Bryant: Investigation at the scene of the crash was very limited due to almost total disintegration of aircraft and parts due to explosion. But it was determined that the canopy was with the aircraft at the time of impact, both Wing Sweep Jack Screws were recovered and by comparison with like items on the National Advisory Committee for Aeronautics (NACA) X-5 it was determined that wing sweep was between 45° to 47° at time of crash. Further investigation revealed that wing flaps, slats and dive brakes were up (retracted) at time of crash. Weather was not a contributing factor to this accident. Investigators were unable to find any part of the oxygen system.

Colonel Knapp: Several weeks previous to the date of the accident, Major Popson had reported to the Base Hospital with a mild upper respiratory infection. Routine examination revealed microscopic hematuria, further investigation revealed no cause for this hematuria. Consultation was secured at the March Air Force Base Hospital where no cause was found and no suggestions for treatment were made. Major Popson was under observation. Having considered the problem with the attending physcian and with March Hospital consultation it was my opinion that there was no reason why he could not perform full duty, including flying.

1ST WITNESS: Arthur Murray, Major, USAF, 1462A, Experimental Test Pilot. Escort pilot of X-5 on flight of 13 October 1953

Q. Please state your name, rank, serial number and duty assignment at the Air Force Flight Test Center?

A. Major Arthur Murray, 14622A, Experimental Test Pilot, X-5 Instructor Pilot and escort pilot on qualification flight of X-5. Project Officer on X-5.

Q. Approximately how many hours do you have in the X-5?

A. I would estimate that I have 40 hours, I have not checked it.

Q. How long have you been associated with the X-5 aircraft?

A. Two years.

Q. Are there any additions that you would like to make on your statement. Going back over check out procedures?

A. Yes sir. During the time I have been flying the X-5, I have talked to our fighter people about the general characteristics of the airplane and things that we had encountered. NACA had been talked to about the things that they had encountered. During the two year period I had escorted both the NACA and Air Force X-5's on their flights. Approximately a week prior to the qualification program I reviewed the specific handling characteristics and cautionary items on the X-5, with the pilots asking questions. I covered the complete operation from taxi out, during the flight, and landing. Each of the pilots had accomplished at least 30 minutes of cockpit review prior to qualification, during which time I again reviewed the general items that would cause trouble, such as the reason for locking the manual wing sweep control, stabilizer setting required for take-off, loss of lateral control with slats closed on take-off, peculiarities of fuel control, flap setting for take-off and landing, blanking out the elevator with dive brakes open, high speed characteristics of the airplane, stall and approach and landing characteristics. Pilots were briefed that should difficulty be encountered with aircraft reaching a neutral point at stall of 40° it should be possible to get the nose to pitch down by momentarily opening the dive brakes. Items listed as cautionary were 4° of stabilizer trim required for take-off, slats open, flaps 20°, dive brakes closed. Cautionary items during flight, high aileron forces at high speed, approached nose down pitch on opening dive brakes, very high stick forces per "G" at 60° wing sweep and elevator ineffectiveness during dive. Not to enter dives with more than 5° nose up elevator trim if necessary on high speed pull outs. Regarding stalls, general characteristics in 20°, 40° and 60° of wing sweep were completed stressing the variation characteristics and loss of lateral control at 40°, airplane approaching neutral point and stall at 40°, vicious wing roll at the stall at 60°. After explaining these items each of the pilots took off and were given close escort by the Instructor Pilot.

Q. One other time you described the wing translation with sweep. Would you double back on that, could you restate that?

A. Yes sir, that was one of the items covered in the cockpit check and during the pilots briefing.

Q. The fact that it was always recommended to reset the indicator knob to 20° in case you had trouble at 60°?

A. That was covered with the pilots. The reason being that the handling characteristics of the airplane were so much better at 20°. Pilots were cautioned to set the sweep control knob to the angle of sweep desired. Operate the sweep mechanism and double check, sweep vs translation on the sweep selector dial, that was intended to assure that the aircraft "CG" would not get out of limits by operating translation independently of sweep. It had been indicated that difficulty had been encountered in the NACA airplane possibly from malposition of the translation. As a further check wing sweep and translation were checked visually by the Instructor Pilot in the air. I believe that covers the items that were stressed to the pilots during the explanation of the mission to be performed.

Q. Actually the independent translation was locked out of the airplane?

A. Yes sir, the circuit breaker was locked out.

Q. Do you have anything to add that is not contained in your statement?

A. It proceeded the same as other flights with the exception of lossoof oxygen.

Q. Approximately what was the altitude you called and told him to bail out?

A. I would judge on entering the third turn, I would judge 6000 feet.

Q. There was no cabin pressure, did you suggest the use of oxygen, such as full use of oxygen at altitude, or did you get any indication of what he was using?

A. No sir. I noticed on the ferry flight to Dayton, Ohio that using 100% from taxi and climb, exhausted the oxygen in approximately 35 minutes.

Q. In your statement you said after 17 minutes at altitude most of which was at 40,000, said he had lost all his pressure, later said he had caught it, was this before descent?

A. That was during descent.

Q. No indication if on full oxygen or not?

A. No sir.

Q. During that radio contact did Major Popsons voice sound normal, or did you get any indication that he could have hypoxia?

A. At the time I did not, he was perfectly normal it seemed, and his actions in the cockpit.

Q. At the time you noticed the first dropping of the nose while the airplane was at approximately a level attitude, do you feel that a pilot with full control of his faculties could have recovered from this situation?

A. By the time that this attitude had been attained no.

Q. The situation had developed from which you could not recover?

A. Not at that point, the airplane had always had a tendency to roll strongly, until the second turn, it was hard to guess what kind of difficulty he was in.

Q. Would you explain the use of the ejection seat in the X-5, is it possible to get out without the ejection seat?

A. I don't think so, if the canopy was off. At that airspeed under those conditions the ejection seat would be vital. The manual release is between pilots legs right at full center, after pulling manual release then release both seat handles. Release comes into view on the right. This varies from other aircraft as they have only two, this aircraft has three. Had been told that unless the canopy had been pulled it would not eject.

Q. Had all procedure before flight been accomplished?

A. On return, I did notice that Mr. Rice had the flags in his hand, but I did not check these items. It was also covered completely in the check list that I had asked all the pilots to use.

Q. You had indicated the pilots comments when he was at 40° sweep just prior to 60° sweep?

A. Yes sir, at 40° sweep the general stall characteristics were for the pilot to encounter loss of lateral control and from there the airplane approaches the neutral point, however, at all degrees of sweep the rudder was very effective, so that Major Popson was quite happy to see that at 40° he could walk the airplane down through the stall with the rudder.

Q. Did Major Popson indicate this by radio transmission?

A. Yes, he did.

Q. Again he seemed normal, his words were used properly, no slurring of speech?

A. When talking through a mask a voice sounds garbled, at the time I was under the impression that he was in a normal condition, gave no hesitation in answering.

Q. Approximately how long were you at this altitude, 10,000 feet.

A. About 10 minutes.

Q. Upon entry of stall prior to crash, did you have a chance to visually see the X-5?

A. Did see the wings, it seemed to be at 60°, also checked the translation, it was full forward on the track at the normal point, gear appeared to be up, dive brakes closed. Wasn't certain of the slats and flaps as I was over running slightly abreast.

Q. Have you ever been in a spin with this aircraft?

A. No. The information that we got from NACA and our pilots was that the spin appeared to be the type of thing where the airplane rotated or rolled as it spun. Rotating around the longitudinal axis. Captain Givens was escorting when NACA had a spin inadvertently.

Q. Did you have any conversation with Major Popson prior to take-off?

A. Yes, we went through the cockpit and general items to be covered in flight and things to look out for, I would say it took us about 30 minutes.

Q. Do you remember whether the point of resetting the rheostat back to 20° wing sweep was discussed?

A. Yes it was. I recall I had to explain the setting on the knob. To over shoot the knob to get 60° before resetting to 20°.

Q. Did you go through the actual procedure of wing sweep?

A. Yes. Setting for 60° the knob is turned full clockwise beyond the 60° position, bomb release button on the stick is held causing an electric motor and worm gear to sweep the wings, the bomb release button is released and at this time the sweep selector knob is reset to 20° position so that at any time the pilot holds the bomb release button the wing sweep will return to the 20° position. Unless the sweep selector knob is returned to 20° position, moved from 60°, holding the bomb release button is ineffective.

Q. Have you ever thought there was any indication that the flight characteristics of this aircraft differed from the NACA aircraft?

A. They differ quite a bit in the high speeds in that our airplane tends to become uncontrollable .93 to .96 and we have noticed a great difference in the stall characteristics. In accelerated stalls and unaccelerated stalls the airplane will recover as soon as the elevator was put forward and after speed was regained lateral control comes back.

Q. The NACA airplane will go through Mach 1 with no difficulty?

A. Yes sir.

Q. Would their stalls be less abrupt?

A. I believe they are encountering the same thing we are.

Q. In going through the cockpit check do you recall if you actually checked the oxygen pressurization?

A. I normally do check the oxygen pressure and nitrogen source pressure. I didn't make a specific check on his pressure other than pointing it out to him. It had been noted that there was no cabin pressurization, the cockpit altimeter usually indicated one or two thousand above actual altitude.

Q. Was Major Popson aware that he could obtain no cabin pressurization?

A. I am sure all the pilots were.

Q. Normally at what altitude do you conduct your stalls?

A. Originally did at 10,000 feet, moved on to 25,000 feet at time NACA entered rolling type of spin. Had no apprehension with stalls at 10,000 feet.

Q. How long does it take to get 60° sweep back to 20° sweep?

A. Approximately 20 seconds, it is about 3° per second.

Q. Do you recall the static "CG" position that is on the ground loading condition?

A. No, I do not. It has not been changed since the airplane was weighed during the testing.

Q. What are the stall characteristics of the airplane with the wing sweep at 60°?

A. That appeared not to be the worst configuration of the airplane, the elevator was still effective.

Q. With drop of elevator does condition improve?

A. The longitudional condition improves.

Q. When you return from 60° do conditions improve?

A. In going through the 45° sweep the longitudional and aileron control are getting worse before hitting 20°.

Q. Investigation revealed that the aircraft crashed with the wings in an approximate 45° to 47° of sweep, do you have any explanation to this?

A. Yes, I would assume this, if they have trouble they should get the airplane to 20° sweep during this they would have to go through the 45° position.

Q. Are you sure he was swept at 60°?

A. It appeared to be.

Q. Would you say he was more than 45° to 47°?

A. Yes, it looked to me like they were at 60°. There were no external indexes on the airplane.

Q. You state that the stalls were accomplished at 20° and 40° of sweep, did he verify that on the radio?

A. He called it out and I checked externally. The procedure was that he was to proceed with the airplane first clean (slats in), and then dirty (slats out flaps down).

Q. Then it is only natural to assume that he conducted his stall at 40° and then would go to 60°?

A. That would be the assumption, there was no apprehension to go on to 60°, although the stall is more rapid.

Q. Did you have any conversation via radio with Major Popson after recovering from 40° wing sweep stall?

A. No, I don't recall. He was going to 60° and we knew approximately what he was going to do.

Q. Was there a lot of radio static?

A. Yes, it was not satisfactory. At 40,000 feet we had sporadic interruptions from Castle H_omer. This was fairly blocked out at 10,000 feet.

Q. At the 40° sweep he was getting everything out of the stall that he possibly could, is that your opinion when he talked about walking it down?

A. I couldn't tell. He was pretty close to full stall in order to get to the point where he could walk it down.

Q. Was it apparent that he used the same procedure at 20° of sweep?

A. Yes, I would say so, it was hard to tell. He was going to stall the same as I had earlier conducted in the program.

Q. Approximately how much altitude would you say he lost on the 40° stall?

A. I would judge from climb back he lost about 3000 feet, that is a little more than I recall losing on stalls I had accomplished.

Q. At the same altitude?

A. Yes sir.

2ND WITNESS: Joseph A. Walker, Aeronautical Research Pilot

Q. Would you state your name and job assignment here at Edwards Air Force Base?

A. Joseph A. Walker, Aeronautical Research Pilot for National Advisory Committee for Aeronautics.

Q. Approximately how much flying time do you have in the X-5?

A. In the neighborhood of fifty to sixty hours, closer to sixty.

Q. How long have you been acquainted with the airplane?

A. Since November 1951, when it was assigned to NACA.

Q. In this particular accident concerning Major Popson, he stalled the aircraft with 60° sweep, clean configuration and entered a spin from which he did not recover, have you experienced any similar conditions during your flights of the X-5?

A. In a 1G stall, clean configuration, 60° sweep I have experienced several different conditions. The airplane exhibited increasing loss of lateral control and abrupt yaw to the left. The most vicious stall approach was with slats extended and occurred with no warning. This took the form of a half snap roll to the left. If excess right rudder were used it would probably have been to the right. It seemed like I had perfect control of the airplane before the snap roll. Application of trim by actuation of the stabilizer with the electric motor results in excess control which pitches the airplane into a spin condition near the stall.

Q. Have you ever been in a spin?

A. I have had three occasions where I had one half turn, 180° of roll, which I stopped by a rapid forward motion on stick with the sweep at 60°. I had one from a pitch up at about .69 Mach starting at 43,000 feet. Stall was a result of entering region of reduced longitudional stability. Was accompanied by directional divergence to the right. Airplane entered a spin to the right which appeared to be a snap roll combined with spinning motion. I pushed the stick forward and full opposite rudder with no apparent recovery being effected. As I found out later I had done wrong. I had little aileron with the spin. Spin tests showed best recovery was with aileron full with the spin. Since this did not appear to give any response as a last resort I gave full nose down trim, after having done this I noticed it was slowing down. As it slowed down I regained control and brought the roll to a stop. This was the worst one I had. Apparently it followed the same general pattern as the others at the start.

Q. How much altitude lost?

A. I started at 43,000 feet, recovered and stopped losing altitude at 37,000 feet, 6000 feet lost. The airplane started generally on a horizontal or little above and gradually went on up and over the hump to straight down.

Q. This was a clean configuration?

A. Yes.

Q. No translation?

A. No translation.

Q. Aileron against the spin, these are the worst conditions for spin recovery?

A. No one has been able to prove it in actual flight. It was determined in a wind tunnel test held at Wright-Patterson Air Force Base, and later at Langley Field.

Q. Have you accomplished any intentional spins?

A. All of the spins were unintentional.

Q. Do you have anything further that you might add?

A. I would like to say at a 1G stall approach at 60°, is accompanied by large loss of altitude. You get an increase of drag with an increase of angle of attack. Below 170 MPH use of full throttle still required about 5000 feet altitude to gain sufficient speed to be able to pull out of the dive.

Q. Are you familiar with the spin encountered by Mr. Crossfield, would you give the board the benefit of your information?

A. Yes. His were encountered at 30,000 feet, were generally the same as mine at a 1G stall condition except that he went about one and one-half turns before complete recovery.

Q. Do you know how much altitude he lost before he was straight and level, approximate?

A. I believe it was in the neighborhood of 5000 feet.

Q. Do you know the type recovery he used?

A. His recovery consisted in forward stick and full opposite rudder abruptly applied.

Q. Did he express any difficulty in recovering from the spin?

A. His remarks then indicated that he had difficulty. That the airplane exhibited uncontrol during the spin.

Q. During your X-5 flights, have you experienced any difficulty with the oxygen system?

A. If you use 100% oxygen below 15,000 feet there is insufficient oxygen to last for one hour of flight.

Q. Your longest flight, approximate time?

A. One hour and ten minutes time.

Q. Normal procedure?

A. Normal. I selected 100% oxygen at 10,000. Our normal test altitude has been 30,000 to 40,000 feet at any time that I intend to come down to below 30,000 feet I turn back to normal mixture.

Q. In the recovery from the spin how much physical force did you exert?

A. The ones that I had 180° of roll, I don't know, I think that I just slammed the stick full forward, during the fully developed spin I had difficulty, I believe I measured 120 pounds forward force on the stick.

3RD WITNESS: Thomas C. Rice, Mechanic, Crew Chief of X-5.

Q. Would you state your name and job assignment at Edwards Air Force Base?

A. Thomas C. Rise, Fighter Maintenance Aircraft as a mechanic, Crew Chief of X-5.

Q. Were you at the X-5 during the pre-flight inspection by Major Popson?

A. Yes sir, I was at the X-5.

Q. Did you assist him in his pre-flight preparations?

A. In the normal pre-flight preparation of the aircraft, yes sir.

Q. Prior to the flight did you assist in the servicing of the aircraft?

A. Yes sir, I did service it.

Q. That was including oxygen?

A. That is a touchy one to answer, I serviced it after the last flight and sometimes reservice prior to flight. I may add another 10 pounds or so.

Q. Can you remember the pressure, what it was?

A. Yes sir, I would not check it off for pre-flight.

Q. Prior to his take-off for taxi out, did you remove any pins?

A. I removed three on the cockpit and three on the landing gear.

Q. What three pins on the cockpit?

A. One pin from canopy cartridge, one from the canopy release handle, one from seat release mechanism.

Q. Normally what is the load of oxygen pressure prior to flight?

A. Four hundred twenty five pounds minimum, 440 maximum, red line at 440.

Q. In your mind, the day of this flight did the aircraft have that much oxygen?

A. It had a minimum of 425 pounds, that fluctuates with temperature as much as 10 pounds.

Q. You were put on the investigation team to determine the angle of sweep of the wing, at the time of crash, do you feel that the wings were approximately 45° to 47° of sweep at time of crash?

A. That is a touchy one. I know how that figure was reached, I feel that the sweep was more, not less than 40°. It was between 47° and 60° is my feeling. To get within 15° is very hard.

Q. Loading was normal on the aircraft?

A. Fuel loading, yes sir.

Q. If you had to fill the oxygen, how much pressure would you have to bring up?

A. Never over 15 pounds, sometimes if it is filled to fast it will bleed down.

Q. No leaks in this system?

A. Not in this system, a while back we had trouble, about five months ago.

Q. With 425 pounds pressure indicated, in the gauge, with pilot going on 100% oxygen, how long should it last?

A. In the past with tests of 40,000 feet we have not used below 200 pounds maximum.

Q. We have accounted for 26 minutes of flight at which time the pilot reported by radio that his oxygen was gone, or below 50 pounds?

A. ~~The A14 oxygen regulator has given trouble. Major Murray had trouble about~~ five months ago, it would go out suddenly

Q. You feel reasonably sure that the indicator was not a fault?

A. No sir, we check the indicator and double check with the oxygen cart.

Q. In regard to canopy, is there anything required to make operational checks to see they work?

A. Trip mechanism is inspected on Major Inspection, trip mechanism is checked and greased. This was complied with on last Major Inspection.

Q. Is there anything tricky about putting the canopy back on?

A. Not on that canopy, it is very simple.

The witness was excused. A discussion was held and recommendations with suggested action to be taken were made. The Board was adjourned at 1205.

Telephone Conversation between Colonel Cornett and Major Kline, Edwards AFB, Calif on 14 Oct 53 regarding X-5 aircraft accident, SN 50-1839 which occurred on 13 Oct 1953

Maj K: The pilot of the chase plane, Major Murray, has made a statement. He was mentioning the stalls - going through the stalls at 60 degrees sweep, at approximately 10,000 feet and got into an untentional spin, something stalled, and never did recover from it. General Holtoner was talking this morning, we were talking it over, and he says that it looks a little fishy to him because lots of other people have stalled that airplane and had no trouble, in fact, just the other day he himself had stalled it at a 60 degree sweep and had not had any trouble in getting recovery. We're not sure if it's the configuration of the airplane or there may be some presumption that pressurisation was out, before that he had been at high altitude, I don't remember, I think it was around 30,000 feet, and NACA has one airplane just exactly like it here and we are going to go over the accident with them. I don't think they have done much - this airplane has never been spun before. Although NACA is planning some spin tests and they have---. The General would like to have some assistance from you people if it is possible.

Col C: I have a couple of questions. What type of oxygen system did this aircraft have in it?

Maj K: It had a regular oxygen system, not liquid, it was a pressurized system.

Col C: Did you say it was not liquid?

Maj K: No, sir.

Col C: What type oxygen regulator, do you know?

Maj K: No, sir, I don't right off hand.

Col C: What type of air work was he doing prior to this?

Maj K: I think, I'm not positive, but they were at a higher altitude prior to that, it was the last flight of that airplane before we were going to turn it over to NACA, he was investigating stalls, Now I don't know if he was investigating stalls at a higher altitude before that or not. Just a minute. Let me get Colonel Brady on the wire, he was in on that investigation last night.

Col B: Colonel, this is Colonel Brady up at Edwards. I Guess. Major Kline gave you some of the details as far as the accident and made a request for some of your people.

Rg 8 for file in
Form 14A 53-10-13-8

Col C: Yes, what I'm curious about is the type of oxygen system which it had aboard, whether it was a high pressure, low pressure or liquid. I understand it wasn't liquid.

Col B: It was not liquid. Whether it was high pressure or low pressure, I'm afraid I don't know. I'm not familiar with that airplane.

Col C: You don't know what regulator it had in it.

Col B: Off-hand, without checking, I'd be afraid to say.

Col C: Had this pilot been associated with this aircraft all the time or was he new on it?

Col B: No, this particular pilot was new on it.

Col C: How much had he flown it previously, do you know?

Col B: Very little, I'd say.

Col C: We've been pretty well slugged with accident investigations recently. Are you particularly interested in an aerodynamicist, structural or general investigator?

Col B: We'd like-at this point the only thing we can even begin to suspicion is, I think Major Kline mentioned, the possibility and it is only a possibility, of oxygen. He probably gave you the details on that. And somebody on a control system. We know the characteristics of the airplane, but we did wonder if maybe something happened that we didn't know about, that we didn't know as far as the characteristics, something like that. So we are at this point sort of grasping for cause. So we're requesting any help and all help we can get.

Col C: We discuss these things each morning at 9:00 and I'll elaborate, of course, the only information we had was from your preliminary TWX which we received and I can give them this information. Now if we're not able to assist directly xx we have gone to AMC for special assistance and the factory concerned, but if we have personnel available, we're only too glad to help you out. We may be able to stir up somebody.

Col B: Well, anything you could do, we certainly would appreciate it. We are naturally proceeding with our investigation, dig up all the details we can and of course we do have pretty good engineers down here, but we'd still like to have someone to assist and who knows the procedures, the method of investigation.

Col C: Have you disturbed the wreckage as yet?

Col B: Not as yet.

Col C: I wonder if you would hold that until you hear from us. Can you put a guard on that and keep--

Col B: We have a guard on it now. We had a guard on it last night. When we went out this morning to start taking care of things, I'm sure it hasn't been disturbed.

Col C: Well, of course, you'll have to get the pilot out, if it's not already out, but don't disturb it anymore than you have to to do that. How far from Edwards is it?

Col B: It's just about 15 miles east of this base, it's actually over within our reservation, so there's no problem there.

Col C: Well, hold the wreckage and don't let anyone fool with it until we call you back.

Col B: Okay, fine. Did you get the details of what we think-exactly what happened?

Col C: Yes, I understood he had been at approximately 30,000 feet and had let down to 10,000 feet and was practicing stalls at 60 degree sweepback condition and at that time the chase plane said he apparently inadvertently went into a spin and didn't recover. Now what type of ejection seat did this machine have?

Col B: I might add that they got down and were going through a series of 20, 40 and 60 degree sweeps. They had successfully completed the 20 and 40. Colonel, that was a low pressure oxygen system with an A-14 regulator.

Col C: Should I call you when we get out of the meeting?

Col B: Yes, sir.

Col C: And what's that extension?

Col B: 386.

Col C: Okay, it will be about an hour.

Col B: Okay, Colonel, thanks very much.

Col C: Okay, bye.

AIRCRAFT CRASH FIRE AND RESCUE REPORT

Reporting installation: [illegible] 6604th AB Wing [illegible]

Location: 15 miles West of [illegible]

Date of accident: 23 Oct 53 | Time of accident: 1909 | Time alarm received: 1926 | Time apparatus arrived: [illegible]

Delay in response: Yes. Waited for Helicopter for guide.

Ceiling: 30 miles clear | Wind direction: [illegible] | Wind velocity (knots): 10 knots | Temperature: [illegible]

Pre-accident status of aircraft: Routine operational flight.

Location of fire: a. Initial: Black [illegible] fuel | c. Ultimate: [illegible]

Reported delays or deficiencies: Waited for Helicopter for guide.

Type: F-? | Serial number: 50-[illegible] | No. of engines: (1) | Utilization: Flight [illegible]

Fuel on board: 80 gals | Fuel involved: 60 gals | Other hazardous cargo: None

Cause of accident: Loss of control | Cause of fire: Impact

Physical extent of damage: Completely demolished | Loss to property: Unknown | Loss to aircraft: None | [illegible]

Total number involved: 1 | Crew: 1 | Passengers: 0 | Total number other than occupants involved: None

Type of rescue	Number of persons	Physical injuries Major	Minor	None	Burn injuries Major	Minor	None	Number of persons	Physical injuries Major	Minor	None	Burn injuries Major	Minor	None
Not rescued/escaped	0			0			0	0			0			0
[illegible] alive	0													
[illegible] dead	0													
[illegible] dead	1													

Type and registration number of all equipment responding (list in order of arrival): 02- ME #500832 & 02- ME #503815

Number of personnel responding: a. Civilian: 5 | b. Military: 0

Supervisory capacity in charge of operations: Deputy Chief Fireman [illegible]

Equipment remaining in service: 2-02, 2-01, 2-05, 1-04, 2-500 gallon, 2-750 gallon, 1-1000 gallon tanker 30.

Method of fire control (general): None necessary.

Method of rescue (general): None necessary.

Extinguishing materials used:

a. Water (gals)	b. [illegible] (lbs)	c. Foam [illegible] (gals)	d. Foam powder (lbs)	e. Dry powder (lbs)	f. C.B. (gals)	g. Other
DNA	DNA	DNA	DNA	DNA	DNA	DNA

AF FORM 302 REPLACES WD AGO FORM [illegible] WHICH IS OBSOLETE IN THE AF.

NARRATIVE REPORT

(Elaborate on pertinent prior data in appropriate spaces; include statement of unusual conditions, obstacles, deficiencies, meritorious actions, etc.; identify condition of personnel removed at the time rescue was effected; enter appropriate comments and recommendations involving organization, equipment, personnel, methods, training, etc., as disclosed by the incident and as may relate to ground efficiency.)

FIRE ACCIDENT STATUS

Flash fire on impact. Out on arrival of fire equipment.

ALARM RESPONSE

Received alarm at 1525. Crew and equipment responded at 1545 when helicopter was available for guide to scene of accident.

ACCIDENT

Pilot lost control.

2ND IG UNIT MAIL & MESSAGE CENTER 9 AM 11:14

FIRE CONTROL

None necessary.

DEFICIENCIES

None

RESCUE EFFORT

INDICATE LOCATION IN PLANE, DESCRIBE METHODS, EQUIPMENT AND CLOTHING USED, IDENTIFY CAUSE OF DEATHS AND INJURIES, ETC.

None necessary.

RECOMMENDATION

No comment.

DIAGRAM

(Show location of aircraft, placement of apparatus, hose and hand lines operating, location of personnel in aircraft, points of ... and ...)

APPROVED AND REVIEWED

Captain

NOV

FINAL EVALUATION
REVIEW AND ANALYSIS

DATE [illegible]

AIRCRAFT TYPE L-5

AIRCRAFT SERIAL NO. [illegible]A

ACCIDENT NO. 53-10-13-[illegible]

FINAL CODING

CHANGE: YES NO X

UNSAFE ACTS								UNSAFE CONDITIONS										
Pers. Duty		Major		Spec.		Viol.		Major		Spec.		Minor		Cross Ref.		SEQ.	C. A.	Basic Cause	
								0	8	9	9					7	6	9	9
								9	8	1	1					7	9	9	8
0	1	1	2	1	8											7	1	4	1
								0	2	6	1	9	8			7	9	9	9

EVALUATION

The nature and type of aircraft involved precludes any comments by the undersigned.

F. C. KENYON, CAPTAIN, USAF
SIGNATURE

ACCIDENT REFERENCE SHEET [illegible]

RESTRICTED (When Filled In)

Operator's Name & Rank	[illegible] A. Maj.
Dollar Loss	
Type, Model and Series — Serial No.	50-[illegible]
Type	[illegible]
Command	[illegible]
Accident Number	53-10-13-8
Place of Accident	Edwards AFB, Calif - 15 Mi. E.
Station	Edwards AFB, California

Phase of Operation — In Flight: Normal (X)

Type of Accident — 12: Spin or Stall (X)

Activity or Maneuver Prior to Accident — F: Normal Flight (X)

Conditions Affecting Accident — C: Fuel Exhaustion (X)

Aircraft Damaged — Destroyed (X)

Persons Injured — Fatal (X)

Flight Reference — 1: Contact (X)

Day (X)

Not in Formation (X)

Date 11-6-53

Undetermined. Cause of loss of control unknown.

Loss of control of acft, resulting in an unintentional spin at insufficient altitude for recovery.

Pilot reported loss of oxygen pressure after 26 mins of flight. This indicates excessive leakage or partial malfunction of oxygen system.

Conditions were favorable to induce some degree of hypoxia, but to what extent is unknown. Hypoxia could have been a contributing factor.

It is possible that there was a misuse of controls during the attempted recovery from the unintentional spin.

[illegible]. Reaction of acft during a spin while the degree of sweep is being changed is unknown.

ACCIDENT REFERENCE SHEET B/FOR

RESTRICTED (When Filled In)

Operator's Name & Rank: [illegible] A. [illegible]

Type, Model and Series: Serial No. 50-1679 — Type: F-86

Command: EDC

Accident Number: 53-10-13-8

Dollar Loss: ____

Place of Accident: Edwards AFB, Calif – 15 Mi. E. — Home Station: Edwards AFB, California

Phase of Operation: 41 X Normal (In Flight)

Type of Accident: 12 X Spin or Stall

Activity or Maneuver Prior to Accident: F X Normal Flight

Conditions Affecting Accident: C X Fuel Exhaustion

Aircraft Damaged: Destroyed X

Persons Injured: Fatal X

Flight Reference: 1 X Contact

Light: 1 X Day

Formation: 2 X Not in Formation

a.c. 1

R. & A. Date: 11-6-53

CAUSE FACTORS

Personnel Duty	Unsafe Acts: Major	Unsafe Acts: Specific	Unsafe Acts: Minor	Unsafe Conditions: Major	Unsafe Conditions: Specific	Unsafe Conditions: Minor	Cross Ref.	Phase Age	Basic Cause	
?								0		Undetermined. Cause of loss of control unknown.
				0 8	9 9			7	6 0 9	Loss of control of acft, resulting in an unintentional spin at insufficient altitude for recovery.
				9 8	1 1			7	9 9 8	Pilot reported loss of oxygen pressure after 26 mins of flight. This indicates excessive leakage or partial malfunction of oxygen system.
8 1	1 8	1 8						7	1 4 1	Conditions were favorable to induce some degree of hypoxia, but to what extent is unknown. Hypoxia could have been a contributing factor.
				0 8	5 1	9 8		7	9 9 9	It is possible that there was a misuse of controls during the attempted recovery from the unintentional spin.
										[illegible] control. [illegible] of acft during a spin while the degree of [illegible] is being changed is unknown.

ACCIDENT BOARD ACTION FINDINGS

The Board is of the opinion that this accident was the result of loss of control of the acft resulting in an unintentional spin at insufficient altitude for recovery. It is felt that several factors or conditions could have contributed to this loss of control. These are as follows:

1. Wing Sweep Control.
2. Oxygen System and Pressurization

RECOMMENDATIONS

Stalls be performed above 20,000 feet in Research Acft having unknown qualities.

REMARKS REVIEW & ANALYSIS DIVISION

Awaiting command action.

REMARKS MEDICAL SAFETY DIVISION

One fact apparently overlooked is that even after descending to 12,000 MSL where stalls were practiced for about 10 minutes, the cabin pressure would have been near 13,000 feet to 14,000 feet and hypoxia possibly induced at a higher altitude would not be completely recovered from since mild hypoxia is actually induced at these altitudes. Concur generally with findings. JPD

REMARKS I & S E DIVISION

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REMARKS I & S E DIVISION

AIRWAYS AND AIR COMMUNICATIONS SERVICE
DETACHMENT 1907-1
1907th AACS Squadron
Edwards Air Force Base, Edwards, Calif.

Station EDWARDS AFB, CALIFORNIA

Date 13 OCTOBER 53

SUBJECT: Aircraft Accident Report

TO: Base Operations Officer EDWARDS AF Base

Date of Accident 13 OCT 53 Time of Accident 1520

Place of Accident 15 MILES EAST OF EDW No Aircraft Involved 1

Aircraft Identification(s) AF 1839 Type Aircraft X-5

Pilot's Name(s) _____ Pilot's Rating _____

Reported Weather at time of Accident 0 30 76/35 WSW 7 2995

Additional Weather Information observed by operator at time of Accident

NONE

Location and path of aircraft at time of accident 15 MILES EAST OF EDWARDS, PATH OF FLIGHT UNKNOWN..

Clearance given to aircraft NONE

BRIEF account of accident and all emergency action taken by operator and by aircraft concerned SMOKE WAS OBSERVED BY TOWER, AT THE SAME TIME 2448, F-86, CALLED WITH EMERGENCY CALL. HE ADVISED THERE HAD BEEN A CRASH 15 MILES EAST OF EDWARDS. XRY ADVISED US OF THE SMOKE (OVER)

I certify that the above statements are true and correct to the best of my knowledge.

Larry D. Smith
LARRY D SMITH A/2C 14461260
Senior Controller on Duty

EDWARDS TOWER
Facility

Form 1900-131
Attachment to Hq Reg 55-8
Local Reproduction Authorized

2348 ADVISED US IT WAS THE X-5 AND THAT THE PILOT WENT DOWN WITH THE A/C. BASE OPERATIONS, CRASH STATION, AND DETACHMENT ORDERLY ROOM WERE ADVISED..

~~RESTRICTED~~ uaf

SECURITY INFORMATION

HEADQUARTERS
AIR FORCE FLIGHT TEST CENTER
EDWARDS AIR FORCE BASE
Edwards, California

FTOO

OCT 2 1953

SUBJECT: Report of Major Aircraft Accident - X-5, 50-1839A

TO: Commander
Air Force Flight Test Center
Edwards Air Force Base
Edwards, California

In accordance with paragraphs 41a and 41g, AF Regulation 62-14, transmitted herewith is Report of Major Aircraft Accident concerning aircraft X-5, Serial No. 50-1839A, that occurred on 13 October 1953.

1 Incl
Rpt of Acft Acdt

H. A. Hanes
H. A. HANES
Colonel, USAF
President, Aircraft Accident
Investigation Board

FTG (27 Oct 53) 1st Ind OCT 1953

HQ, AF FLIGHT TEST CENTER, Edwards AFB, Edwards, California

TO: Commander, Air Research and Development Command, P. O. Box 1395, Baltimore 3, Maryland

1. The undersigned has personally reviewed this Report and concurs in the findings and recommendations of the Aircraft Accident Investigating Board.

2. No further action is contemplated by this Headquarters.

J. S. Holtoner
J. S. HOLTONER
Brigadier General, USAF
Commander

1 Incl
n/c

~~RESTRICTED~~ uaf

AFFTC FORM 12

B/L: Hq AFFTC, Edwards, Calif. (FTOO) Subj: Rept of Maj Acft Acdt X-5, 50-1839A

RDOS (27 Oct 53) 2nd Ind

HQ AIR RESEARCH AND DEVELOPMENT COMMAND, P. O. Box 1395, Baltimore 3, Maryland 12 JAN 1954

TO: Director of Flight Safety Research, Office of The Inspector General, Norton Air Force Base, California

1. This Command has reviewed the subject report and concurs with the recommendations and findings of the Aircraft Accident Investigation Board.

2. No further action is contemplated as this is the only aircraft of this type under Air Force control.

FOR THE COMMANDER

1 Incl: w/d

Kurt M. Landon

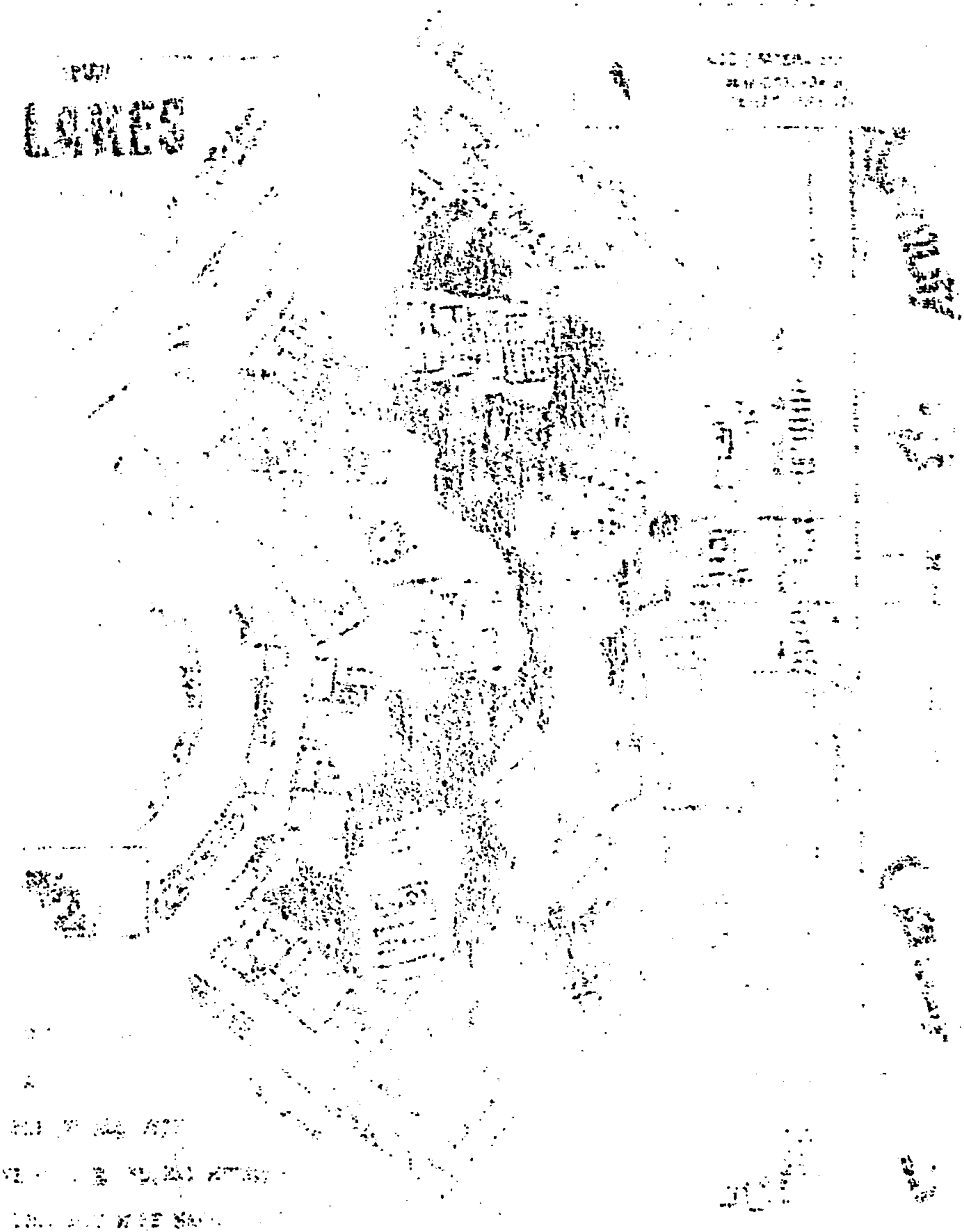
KURT M. LANDON
Brigadier General, USAF
Chief of Staff

702

NTB076
XDB079
JUPER 337
PP JEPHQ JUPNT JEPYD 333
DE JUPER 072G
P 140428Z ZNJ
FM COMDR AF FLT TEST CEN EDWARDS AFB CALIF
TO JEPHQ/THE INSPECTOR GENERAL USAF HQ USAF WASH D C
JUPNT/OFFICE OF THE INSPCTOR GENERAL USAF NORTON AFB CALIF
JEPYB/COMDR ARDC BALTO MD
/R E S T R I C T E D/FTA-10-10-E PD RCS AF-F3 PD PAREN PRELIMINARY
REPORT OF MAJOR ACCIDENT PAREN
A. 13 OCTOBER 1953 CMA 1509 PST CMA EDWARDS BOMBING RANGE CMA EDWARDS
CMA CALIFORNIA
B. BELL X-5 CMA SERIAL NO. 50-1839A CMA AFFTC CMA ARDC CMA EAFT
EDWARDS CMA CALIF COMPLETE DESTRUCTION
C. AFSC 8744 PAREN EXPERIMENTAL FLIGHT TEST OFFICER PAREN CMA RAYMOND
A POPSON CMA 12634A CMA MAJOR CMA FIGHTER OPERATIONS BRANCH CMA
H FLIGHT TEST OPERATIONS LABORATORY CMA AFFTC CMA EAFT CMA EDWARDS
CMA CALIF CMA PARACHUTE NOT USED CMA FATAL PD

PAGE TWO JUPER 072G

D. NOT APPLICABLE
E. NO OTHER PERSONS INVOLVED PD
F. AIRCRAFT ENTERED UNINTENTIONAL SPIN WHILE INVESTIGATIONS HANDLING
AND STALL CHARACTERISTICS AT 12,000 FEET MSL. PILOT WAS UNABLE TO
RECOVER PD AIRCRAFT DISINTEGRATED AND EXPLODED UPON IMPACT WITH GROUND
G. NOT APPLICABLE
H. LOCAL
I. FAMILIARIZATION
J. CLEAR WITH 30 MILES VSBY PD
K. NONE
L. NONE
M. NOT APPLICABLE PD
14/0428Z OCT JUPER



11/02/1953

F-102 11/02/53

in the fuselage. The armament was to consist of six Hughes GAR-1 Falcon air-to-air missiles carried internally in a ventral bay. In addition, twenty-four 2-inch FFAR rockets weere to be carried in channels contained inside the missile-bay doors. A maximum speed of 870 mph at 35,000 feet was promised.

A severe problem cropped up early in 1953, one which was potentially fatal for the entire program. At that time, wind tunnel testing discovered that the initial drag estimates of the YF-102 had been way off, and that the F-102 would be unable to exceed Mach 1. In addition, the maximum altitude would be only 52,400 feet, versus the predicted 57,600 feet, while the ccombat radius would be reduce from 350 to 200 nautical miles.

Even though early wind tunnel tests had indicated that there would be a problem with excessive drag, it took a long time to convince the Convair engineering staff that there was a problem with their basic design. It was not until August of 1953, that Convair engineers reluctantly agreed to redesign their aircraft. By that time, it was too late to incorporate the required changes in the first ten aircraft.

In the meantime, work on the first YF-102s was proceeding at a rapid pace. The first YF-102 was finally completed in the autumn of 1953. It was powered by a J57-P-11, rated at 10,900 lb.s.t. dry and 14,500 lb.s.t. with afterburning. It was trucked from San Diego out to Edwards AFB. It took off at Edwards on its maiden flight on October 24, 1953, with Richard L. Johnson at the controls. In initial tests, severe buffeting was encountered at Mach 0.9. Even more serious, the aircraft proved to be incapable of exceeding the speed of sound in level flight, fully confirming the results of the wind tunnel testing. Additional problems were encounterd with the main landing gear, andthe fuel system operated erratically. To make matters even worse, the J57-P-11 engine did not develop its full rated power. The first YF-102 was written off on November 2 in a forced landing following an engine failure. Test pilot Johnson was seriously injured. The cause of the accident was traced to a failure in the Bendix fuel control system. The second YF-102 flew on January 11, 1954. This aircraft was limited to Mach 0.99 in level flight. Dives at higher speeds resulted in severe yaw oscillations. Even in a 30-degree dive, the YF-102 was only able to reach Mach 1.24. Even though an altitude of 47,000 feet could be reached, handling difficulties limited the practical ceiling to only 40,000 feet.

The F-102 program was in BIG trouble. In fact, the performance of the YF-102 was not all that much better than the F-86D Sabre, which was already in production. If no cure could be found, the whole program would undoubtedly be cancelled.

YF-102 serial numbers:

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52-7994/7995    Convair YF-102 Delta Dagger
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02/04/1954

Bristol 175
"Britannia 101"

02/04/54

AviationSafetyNetwork

Accident Description

Home
sign guestbook
view guestbook
editorial
what's new?
Accident reports
Accident specials
CVR / FDR
Database
Mailing list
News
Other sites
Pictures
Publications
Safety issues
Statistics

Forum
E-mail
About ASN...

Accident description

Date:	**04.02.1954**
Type:	Bristol 175 Britannia 101
Operator:	Ministry of Supply
Registration:	G-ALRX
C/n:	12874
Year built:	1953
Crew:	0 fatalities / 7 on board
Passengers:	0 fatalities / 6 on board
Total:	0 fatalities / 13 on board
Location:	Severn Estuary (UK)
Phase:	
Nature:	Test
Flight:	- (Flightnumber)

Remarks:
Some 7 minutes after takeoff the no.3 engine oil temperature rose. The engine was shut down and relit when oil temperature had fallen. Following demonstration of a stall manoeuvre, the temperature again rose followed by a fire in the no.3 engine nacelle. The fire could not be contained, so the no.4 engine was stopped as a precautionary measure. On approach to Filton the no.1 and 2 engines both quit. The were quickly restarted, but an emergency belly landing was made on the mud flats of the Severn Estuary. PROBABLE CAUSE: "Mechanical failure of the propeller reduction gear."

Source:

[disclaimer]

03/04/1954
12/17/1954
04/14/1955
F104
07/11/1957
05/01/1957

1/2
CMRO

C

REPORT OF AF AIRCRAFT ACCIDENT

Use this form in accordance with AF Reg. 62-14 and AF Manual 62-5, "Aircraft Accident Prevention Manual." Fill in all spaces applicable. If additional space is needed, use additional sheet(s) and identify by proper section letter and subsection number.

91371

Section A—GENERAL INFORMATION

1. PLACE OF ACCIDENT: State, County, nearest town, distance and direction from nearest town. If accident occurred on airport, identify.
Calif., San Bernardino, Hawes, - 1 mi. North - 117° 52' Long., 34° 58' Lat.

2. DATE OF ACCIDENT	3. HOUR AND TIME ZONE (Local)	4. DAY DAWN NIGHT DUSK	5. AIRFIELD OF LAST TAKEOFF
1 May 1957	16:24 PST	X	AF Plant 42, Palmdale, Calif.

6. CLEARANCE: (Check all applicable) IFR__ VFR X Local X Form 175 __ Other__ Cleared Direct Cleared Via Airways
Cleared from____ Cleared to____

7. BASE SUBMITTING REPORT	8. DURATION OF FLIGHT	9. MISSION OF FLIGHT (Use DD Form 181-1)	10. ALTITUDE of aircraft above terrain in collision, fire, airframe failure, bailout, spin, stall, spiral, occurred
McClelland AFB	21 minutes	X-1	21,681

11. AIRFIELD DATA. FILL IN (a) OR (b) AS APPLICABLE. (For seaplanes landing on seadrome, fill in length of landing lanes and other data as applicable. Discuss in Section M.)

(a) If accident occurred on airport:
Length of runway in use N/A ft.
Heading of runway in use___ degrees
Field elevation___ ft. MSL
Type of runway surface: (Check)
Concrete__ Asphalt__
Other__ (Specify)__
Wet__ Dry__

(b) If accident occurred off airport: elevation at scene of acdt 2,319' ft. MSL
Was aircraft taking off, approaching or maneuvering to land? Yes _ No X
If yes, state airport involved ___
If no, state nearest airport suitable for landing this aircraft Edwards AFB
For either airport mentioned in 11b above:
State airport type (i. e., AF, A, N, CG, PC, P) AF
Distance, airport to accident 25 Miles. Heading of runway in use 040° degrees.
Magnetic bearing, airport to accident 070° degrees. Airport elevation 2,302 ft. MSL

12. LIST NUMBERS OF ALL OTHER AIRCRAFT INVOLVED: (File separate Form 14 for each aircraft) NONE

[redacted]

AFR 205-1
by [illegible] date 3-26-6[illegible]

Section B—AIRCRAFT

1. AIRCRAFT NUMBER	2. TYPE, MODEL, SERIES AND BLOCK NUMBER	3. ASSIGNMENT AND STATUS CODE at time of accident: (As specified in AFR 65-110)
55-2962 #8	JF-104A-1-LO	SMAMA; BT (Lockheed A/C Corp.)

4. ORGANIZATION POSSESSING AND REPORTING AIRCRAFT ON AF-110 REPORTS AT TIME OF ACCIDENT

Major Command	Subcommand or AF	Air Division	Wing	Group	Squadron or Unit	Base
AMC B/L	SMAMA SAR	AIRCRAFT BAILED TO		LOCKHEED A/C	CORP., PALMDALE, CALIF.	

5. IF AIRCRAFT WAS BEING FERRIED OR DELIVERED INDICATE: (Gaining and losing organizations, date of transfer, ultimate destination)
N/A

Section C—PILOT(S) INVOLVED (Flight Crew)

1. OPERATOR (Person at controls at time of accident)

a. LAST NAME (Jr., II, etc.) FIRST NAME MIDDLE NAME	GRADE	COMPONENT	SERVICE NUMBER	NATIONALITY	YR. OF BIRTH
Simpson, Jr., John Joseph	Civ.	Test Pilot	L.A.C.	USA	[redacted]

b. POSITION IN AIRCRAFT AT TIME OF ACCIDENT: Front ~~seat~~ X Rear or Right Seat___
c. ASSIGNED DUTY ON FLIGHT ORDER: AC _ IP__ P X CP_ Other (Specify)

d. ASSIGNED ORGANIZATION

Major Command	Subcommand or AF	Air Division	Wing	Group	Squadron or Unit	Base
Civilian	Engineering Test Pilot		Lockheed Aircraft Corp.			

e. ATTACHED ORGANIZATION FOR FLYING

Major Command	Subcommand or AF	Air Division	Wing	Group	Squadron or Unit	Base
N/A CIV						N/A

f. ORIGINAL AERONAUTICAL RATING AND DATE RECEIVED	g. PRESENT AERONAUTICAL RATING AND DATE RECEIVED	h. INSTRUMENT CARD	i. AFSC
Pilot Sept '52	#1317778 CAA Commercial Sep. 55	Type NONE Date of expiration __	Primary N/A Duty _

2. OTHER PILOT

a. LAST NAME (Jr., II, etc.) FIRST NAME MIDDLE NAME	GRADE	COMPONENT	SERVICE NUMBER	NATIONALITY	YR. OF BIRTH
N/A					

b. POSITION IN AIRCRAFT AT TIME OF ACCIDENT: Front or Left Seat__ Rear or Right Seat__ Other__
c. ASSIGNED DUTY ON FLIGHT ORDER: AC _ IP__ P__ CP_ Other (Specify)

d. ASSIGNED ORGANIZATION

Major Command	Subcommand or AF	Air Division	Wing	Group	Squadron or Unit	Base

e. ATTACHED ORGANIZATION FOR FLYING

Major Command	Subcommand or AF	Air Division	Wing	Group	Squadron or Unit	Base

f. ORIGINAL AERONAUTICAL RATING AND DATE RECEIVED	g. PRESENT AERONAUTICAL RATING AND DATE RECEIVED	h. INSTRUMENT CARD	i. AFSC
		Type__ Date of expiration__	Primary__ Duty__

NOTE: IF MORE THAN TWO PILOTS ARE INVOLVED (FLIGHT CREW) REPORT SAME INFORMATION REQUIRED IN SECTION C ON ADDITIONAL SHEET FOR EACH

Section D—FLYING EXPERIENCE OF PILOT(S) INVOLVED

1. WAS OPERATOR ON INSTRUMENTS AT TIME OF ACCIDENT OR IMMEDIATELY BEFORE: Yes ___ No X Unknown ___ If "Yes," check one: Weather ___ Hood ___

ASSIGNED DUTY ON FLIGHT ORDER NOTE: List all time to the nearest hour	PILOT (Last Name) Simpson	CO-PILOT (Last Name)	INSTR. PILOT (Last Name)	AIRCRAFT C'DR. (Last Name)	STUDENT PILOT (Last Name)
2. Total flying hours (including AF time, student time, and other accredited time)	2156				
3. Total rated 1st pilot and instructor pilot hours, all aircraft	1532				
4. Total weather instrument hours	58				
5. Total 1st pilot and instructor pilot hours this model (F-84, B-50, C-119, etc.)	78				
6. Total other (Command, a/c cmdr, co-pilot, radar control pilot) hours this model	-0-				
7. Total 1st pilot and instructor pilot hours this model and series (F-84F, F-86D, etc.)	75				
8. Total other (Command, a/c cmdr, co-pilot, radar control plt) hrs this model and series	-0-				
9. Total pilot hours last 90 days	62				
10. Total 1st pilot and instructor pilot hours last 90 days	62				
11. Total pilot hours (night), last 90 days	2				
12. Total pilot hours, weather and hood, last 90 days	-0-				
13. Date and duration of last previous flight this model	1 May '57 0:50				
14. Date and duration of last previous flight this model and series	1 May '57 0:20				

15. INSTRUCTIONS: Attach a copy of AF Form 5 for pilot(s) involved for the previous calendar month, and for month in which the accident occurred, to include the flight on which the accident took place.

Section E—PERSONNEL INVOLVED

(Including operator and all other persons, whether in plane or not)

Duty at time of accident (1)	Name (Last name first, Grade, Serial Number and Component or Service) (2)	Type Aero Rating (3)	ORGANIZATIONAL ASSIGNMENT Command, Subcommand, Group Number and Type, Base (4)	Injury Class. (or missing) (5)	Parachute Used Yes (6)	Parachute Used No (7)	Ejection Seat Used Yes (8)	Ejection Seat Used No (9)
P 01	Simpson, John Civ.	CAA Comm.	1 14 AF 15 Engineering Test Pilot Lockheed Aircraft Corp., Palmdale, Calif.	None 1	X A		X A	

NOTE: If additional space is required to list all personnel involved, attach additional sheet.

Section F—WEATHER

(At time and place of accident)

Ceiling	Visibility	Wind Direction and Velocity	Temperature	Dew Point	Alt. Setting	Other Weather Conditions
Hi Ø	7	SW 15 G 25	70°	30°	30.02	Haze all quadrants

If weather, including wind conditions, was a factor in the accident, attach statement of weather officer.

Section G—ENGINEERING DATA

1. Damage: (Check one) Destroyed X Substantial ___ Minor ___ None ___ 2. Was aircraft damaged beyond economical repair? Yes X No ___
3. Estimated number of direct manhours for repair, if applicable N/A Cost of damage to aircraft $1,394,308
4. Fire before accident ___ Fire after accident X Fire did not occur ___ 5. Did explosion occur? Yes X No ___ (After impact)
6. How many T.O.s not complied with at time of accident? 9 (List T.O. numbers and titles on separate sheet)
7. Has your Base previously submitted a UR on any factor involved in this accident? Yes ___ No X
8. Is a UR being submitted as a result of this accident? Yes X No ___ (If "Yes" attach copy) UR number 57-59 ?
9. Is TDR requested? Yes ___ No X Attach copy of request

CRASH INVESTIGATION OF JF-104A, S/N 55-2962 AIRCRAFT.

HISTORY OF FLIGHT

JF-104A, No. 55-2962, departed from Palmdale, California, Air Force Plant No. 42 on 1 May 1957, at 1603 PST, on a local engineering test flight. Configuration was empty tip tanks installed, gross weight 18,517 lbs. at 7.49% MAC and 760 gal. internal fuel. This was the second flight by the same aircraft and pilot on 1 May 1957 in this configuration.

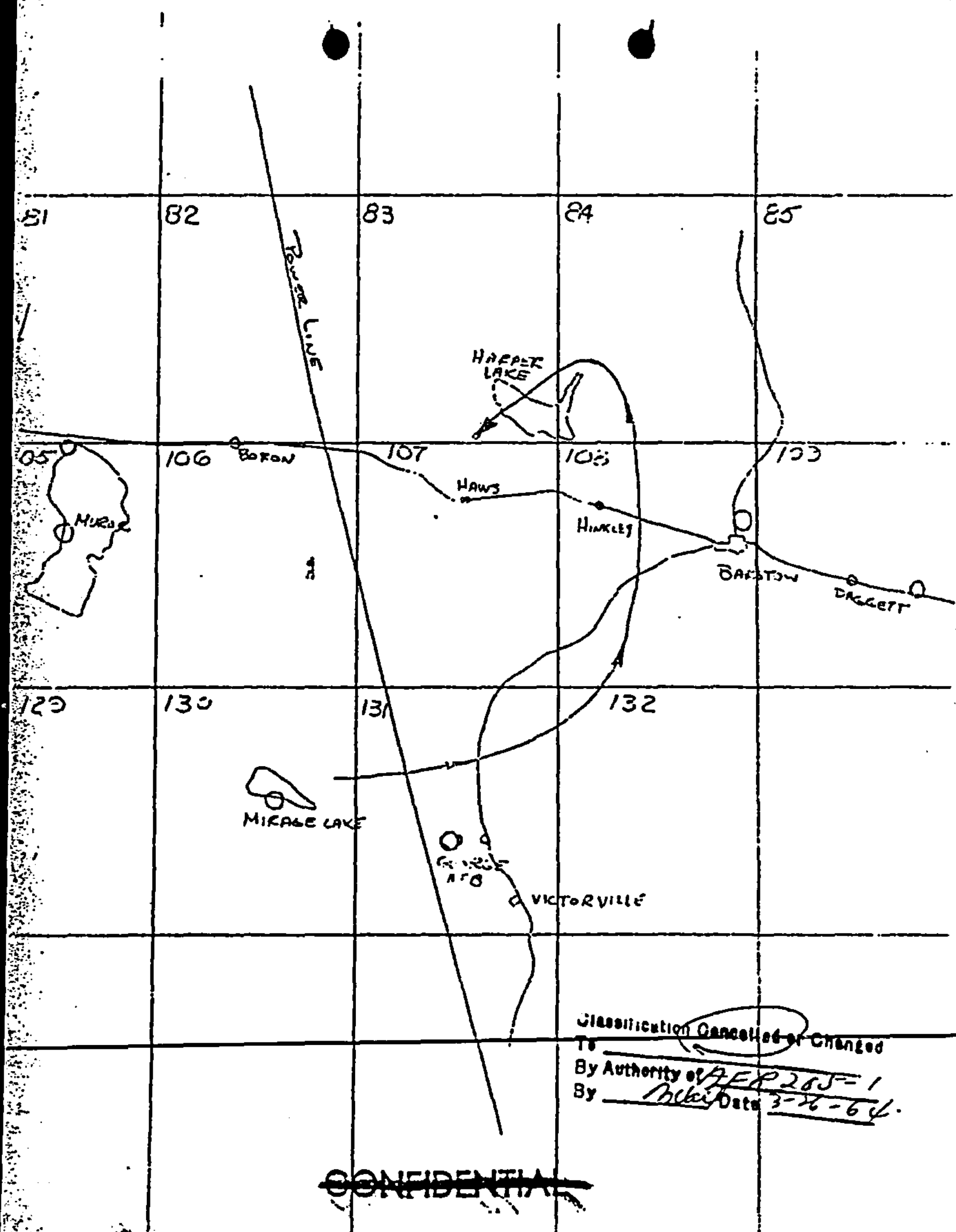
Take off was normal and climb was continued to 27,000 ft. at which point the pilot began tests consisting of 1 g stall approaches and steady sideslips. The tests were not wholly completed when it was decided to discontinue due to doubt as to whether the oscillograph was working.

Over Victorville, California, with the aircraft trimmed for 1 g flight, the pilot observed and reported that the right aileron was deflected upward. East of Harper's Lake, airspeed 340 knots, altitude 24,000 ft., 2200 lbs. of fuel, a turn and descent was started toward Palmdale. The speed brakes were first extended and then retracted. Shortly after starting the descent, a violent pitch down was experienced. After applying full aft stick with no effect, the pilot ejected at approximately 17,000 ft., airspeed 380-400 knots. A violent roll began as the aircraft was abandoned. The ejection was accomplished without incident and the pilot was picked up within a few minutes after landing.

[redacted]

Classification ...
T...
E... AFR 205-1
By DDVail ... 3-16-64

CONFIDENTIAL

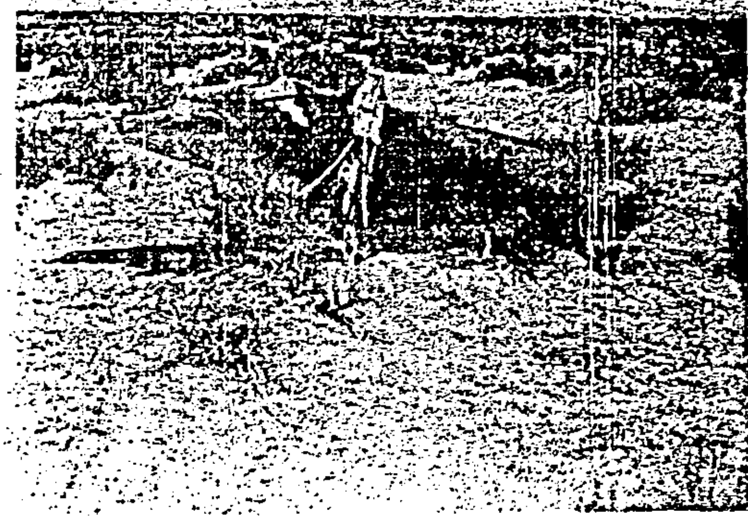


Classification Cancelled or Changed
To
By Authority of AFR 205-1
By ______ Date 3-26-64

~~CONFIDENTIAL~~

To
By Authority
By Date 3-26-66

CONFIDENTIAL

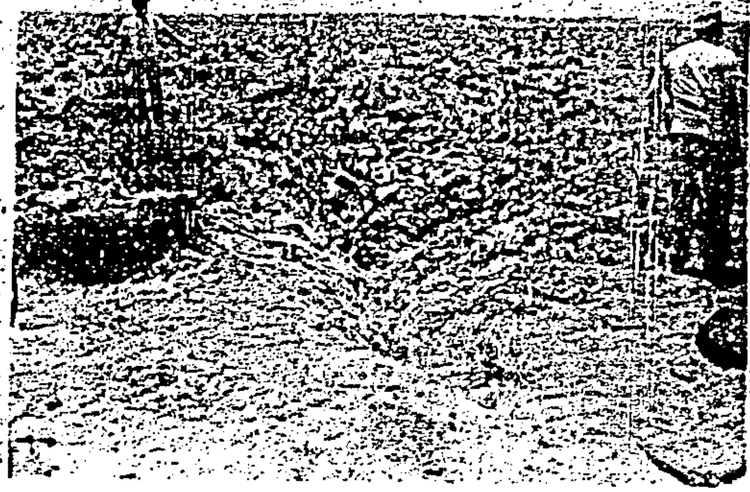


#3 SAME AS ABOVE

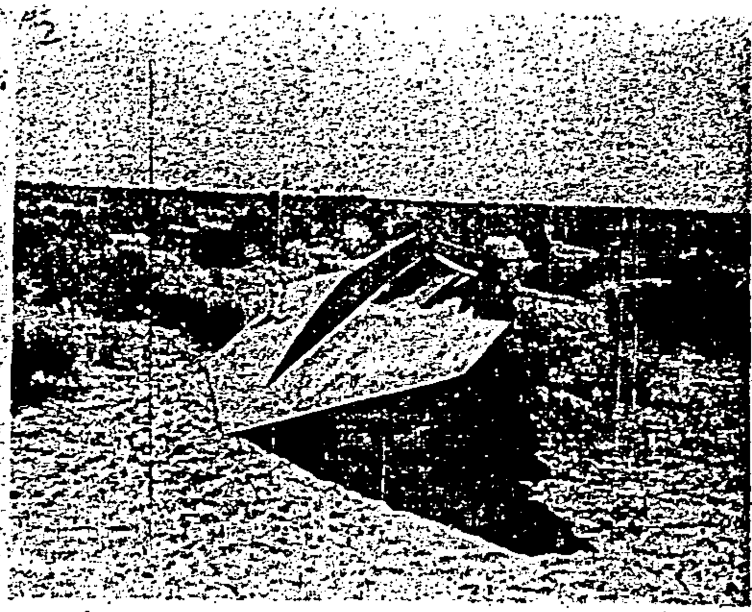
#4 LAYOUT OF PARTS OF RIGHT WING TANK

Classification Cancelled or Changed
To
By Authority AFR 205-1
By Date 3-26-66

CONFIDENTIAL



#1 IMPACT CRATER



#2 HORIZONTAL SURFACES AND PART OF VERTICAL SURFACES

Classification Cancelled or Changed
To
By Authority AFR 205-1
By [illegible] Date 3-26-64

~~CONFIDENTIAL~~

YF-104A
05/01/57

The *Ejection* Site

Starfighter Down:

Ejection from a YF-104 Starfighter

By Jack L. "Suitcase" Simpson

As published in the February 1998 issue of Flight Journal (with minor editing).
Used with the permission of the author.

I radioed the flight-test engineer in the control room at the Lockheed Flight Test Center and said, with more that a little trepidation, "Larry, I'm sure I followed the flight-test procedures you detailed me on the mission profile card, but as I reached the first test point on airspeed, angle-of- attack and yaw input, the plane went crazy; it snapped into an inverted nose-down roll. It really surprised me; it took me over 9,000 feet to recover. Remember yesterday; it didn't act like this at all."

I was a Lockheed experimental test pilot on the development of the F-104 Starfighter, the world's first jet fighter designed to fly more than twice the speed of sound. Lockheed Aircraft Company hired me because of my experience as an Air Force test pilot at North American Aviation, flying out of Los Angeles International Airport, on the development of the F-100 Super Sabre. The F-100 was the first supersonic fighter to move into mass production.

As a Lockheed experimental pilot, I felt I was part of the legacy of famous aircraft and intrepid men. Lockheed designed and built the P-38 Lightning for WW II. It became famous in the Pacific theater of operations. Lockheed also designed, in its renowned "Skunk Works," the F-80- the first operational jet fighter. I flew the Shooting Star, as it was named, both in gunnery training at Nellis AFB and in Korea in preparation for my first combat mission.

The F-104 was born in Kelly Johnson's famous "Skunk Works" the design aim was to produce a supersonic fighter that would have a performance capability in excess of Mach 2 and combat altitude of over 60,000 feet. So, although I was a lone in the cockpit, that day trying to figure out what went wrong at 30,000 feet, I was in the company of esteemed designers, builders and widely known experimental flight test pilots.

"Not like yesterday at all," as I stated earlier to Larry, meant that I had flown this specific stability and control test the day before and everything had gone according to the flight test plan. But the electronic mechanism designed to send signals from the test aircraft to the control room had malfunctioned; none of the data collected was usable for studying past performance before planning the next experimental flight. When you hear about aircraft accidents today, the familiar word is the importance of recovering the "flight data recorder." Well, 40 years ago, it wasn't as sophisticated; therefore, I was asked to do the experimental test over again. I agreed to do so.

I took off, climbed to 30,000 feet and started my experimental flight. I controlled the aircraft as precisely as called for on the flight test card. I was less than 40 seconds into the test, when wham, the plane snapped into a pitch-up and inverted roll. It was then that I radioed Larry, after I got control of the plane and myself!

"OK," I said to Larry, "maybe I did something wrong. I'm going to try the test once again, but if it reacts the same, I'm coming home. I'll climb back to designated altitude, and I'll talk my way through. That way, we'll both be able to try to determine the unusual behavior of this lady with, it seems to me, an agitated composure."

"That's a good idea," said Larry, "but everything seemed to go so well yesterday. Hope nothing is wrong."

How soon we were to find out!

"Roger," I remarked, as I leveled off at the proper altitude. "I'm ready! I'll talk through each step! OK! Here goes! I'm at altitude, attaining-there I am-at the indicated airspeed as called for, angle of attack coming- coming-there it is-holding angle-of-attack-airspeed OK, here comes the rudder-more-more-WOW! Why so much rudder? Damn it Larry! Here I go again!" I yelled. "I have a vicious pitch-up! I have a huge roll input! Going crazy-I'm upside-down-the plane's going crazy!"

The nose had yawed right with horrific violence. Everything became a blur as the plane tumbled out of control toward the ground. I said to myself, "This is crazy; this isn't me, this is terrifying!" For a nanosecond, my first combat mission flashed before my eyes, with the terror I experienced in seeing flak and tracers, and realizing for the first time that the enemy was trying to shoot me down with the intention of killing me!

Now this @#%*_?? plane was trying to do the same thing!

I couldn't talk anymore. I had to get control; the airplane had stalled out. I was about 60 degrees upside-down and yawing. I didn't even know which way, I was so disoriented, but I knew I was heading down-fast I didn't move the stick or push either rudder pedal. I didn't advance the throttle; I quickly checked the exhaust gas temperature and the rpm gauge; the engine had not flamed out.

"Take it easy," I said to myself. "Take it easy-don't fight the controls. You have altitude-let it go-let it go. OK now, roll it upright-little roll input-easy-easy-little rudder-whoops! The other way-easy on the stick-check the tuck-little more roll-little bit at a time-just a touch of rudder-just a touch damn it! Don't know what's wrong-little bit-little bit . " Slowly, ever so slowly, I started to lead and the lady was following me; we started our majestic waltz-gliding on thin air. I had talked her out of her determination to fatally test the law of gravity. I finally had number 55-2962, the eighth YF-104A manufactured, flying level. She had an "eight ball" tattooed to her right side. I had lost 16,000 feet. Yes, I had literally been "behind the eight ball."

I called Larry, gave him the particulars, and told him something was definitely wrong. I didn't know what it was, but I knew something was amiss; so much so that I instinctively started to climb and head for the dry lake at Edwards AFB. The dry lake had saved me many times during past test flights when things were not functioning properly, particularly with the new YJ79-GE-3 (General Electric) engine; a beautifully designed, but, what turned out to be, an extremely vexatious-and deadly-engine.

In experimental flight tests, we were stretching the state of the art for an innovative fighter. Everything was new: new design of aircraft, new engine, new variable guide inlet guide vanes, new main fuel regulator, new type of afterburner, new altitudes never explored, and speeds never researched. It was the first time in any aircraft that the engine was combined with a fully variable duct system that could adapt itself to all contrasting conditions from takeoff to Mach 2.2; at least it was supposed to. The F-104's wings were also unique, tailored purely to the supersonic regime-extraordinarily small span and area-without sweep. The next time you take a look at the new generation of fighters-the F-14, the F-15, the F-16-look at the leading edges of the wings. They look like Mt. Rushmore to the F-104's 15/100 inch thick leading edges.

The Starfighter had a new radar and a new gun. A new pilot's handbook had to be written, meaning new operational and emergency procedures had to be written and tested.

Front line, air-to-air combat pilots convinced Kelly Johnson to go for performance at all costs. The result was one of the most startling airplanes ever built; the "missile with a man in it," as it was called. A far as moving at high speed in a straight line, it had few rivals.

But nothing worked as designed. More than a dozen times, I would be in the throes of an experimental test flight and the engine would flame out- just flat quit-for no apparent reason. I would get the engine started and gingerly head for home. Sometimes, no, many times, I couldn't get the engine started again, so I hurriedly took the option of the dry lake bed at Edwards (the same dry lake bed where the space shuttle first landed 25 years later) and landed the aircraft "dead stick." That five miles of lake bed gave us both lots of room.

Was the lake bed going to save me one more time? I headed toward Edwards for a couple of reasons. I was too far away from Palmdale in case of an emergency; experimental pilots aren't paid to eject out of every test vehicle that presents a sudden, unknown problem. Also, Edwards (named after an experimental test pilot who died in the crash of a flying wing) is a wide-open lake bed that would give me options for direction of landing and a high indicated airspeed on final approach. I planned to avoid any pitch-up, yaw and roll situations. One Lockheed test pilot had recently been killed in a 104 during a flare-out at landing-the "eating an ice cream cone" maneuver used to decrease sink rate just prior to touchdown. It had pitched-up and catapulted while rolling to the right, spewing pieces of airplane and fire that tumbled and reacted explosively along the edge of the runway and into the adjacent field. I was there and saw the results to both pilot and plane. We still hadn't been able to confirm why it happened. We think the plane stalled and pitched up, yawed and then rolled uncontrollably to the right. If I could help it, I wasn't going to let that happen to me.

I reached what I thought was a safe altitude, called Larry and told him my plans. He told me to switch frequencies so Lockheed could monitor my approach to Edwards. I gave him a "Roger" on that and radioed Edwards.

"Edwards tower, this is Lockheed test 2962-over."

"Roger 2962; go ahead," came the instant reply.

"Edwards, 2962 is declaring an emergency although it is not a mayday. Request landing on the lake bed at speeds above normal; not sure of my direction as yet; don't want to make too many turns; not sure when I'll drop my gear; would appreciate, however, fire truck following, over."

"Roger 2962. Wind is light, varying north to northwest at 5 knots, altimeter 30.01."

"OK Edwards. I'll have to make a 90 toward the north-will call about three miles out on final-straight in toward north." "Wind's not that bad and I don't want to move this thing around too much," I said to myself. "I feel like I'm encased in an eggshell."

"Edwards," I radioed, "I'm presently at three one thousand feet west of Barstow; parallel to 58 [highway 58]; have Harper Dry Lake at one o'clock. I'm on the letdown."

"Roger 2962," came the reply from Edwards. "Keep us informed. I understand Lockheed is monitoring this frequency. The fire trucks are rolling." Fire trucks! That sent a chill though my spine.

I gingerly started to lose altitude, pulled the throttle back to about half quadrant and cracked open the speed brakes. I had descended about 2000 feet when I ran into a rumble of clear air turbulence. I inched back on the throttle and instinctively closed the speed brakes to reduce buffet. I told the tower I was in CAT; I knew Larry was listening. I then said to myself, "OK eight ball, take it easy; we've been through a lot of things together. We'll get through this. Take it easy."

But just as I looked down to check the airspeed indicator, the nose violently pitched almost straight down and continued to move through 90 degrees. I was starting to tumble. I called "Larry!," as I was pulling hard, real hard, back on the stick, "I've lost control! I have zero pitch input! I've got to get the hell out! Now!"

At that instant, I reached for the ejection ring between my legs with both hands and pulled as the aircraft continued to tumble. Boom! I was out, ejected upward, upside-down at 27,000 feet.

I might explain. The F-104 was at first designed with a "downward" ejection seat because it flew extremely fast at low altitude where, of course, the air is dense. Any ejection, up or down, at high speed would be like hitting a brick wall-a thick brick wall-at 700mph. No question: that's Excedrin headache number 1! The seat ejection systems at that time were not powerful enough to eject the pilot "upward" for fear of jamming him, due to high pressure, into the horizontal and vertical tails, each having a leading edge with a .01-inch radius. I wasn't ready for sliced "Suitcase"! Thus we ejected "downward."

It's a funny thing about life; or fate. Three of my test-pilot friends were killed in the F-104 when they were forced to eject close to the ground. The ejection system didn't function for them at low altitude or they were too close to the ground when they made their decision to eject.

I can still remember the powerful, full force of rushing air-pinning me to my seat-like going downhill in the front seat of a mile high roller coaster. Only this blast was instantaneous; it hit me at about 450mph. One second after I ejected, the lap belt separation system worked; it blew the belt in half and freed me from the seat. For a few seconds, the seat and I were inches apart floating to a stop as we reached the apex of our arc. A lanyard, one end attached to half of my seat belt and the other end attached to a pin in my chute, seemed to be hanging around, slithering like an eel in water. Then the seat drifted, or fell, away. The eel became a frozen rope and pulled the pin that armed my parachute to open at 15,000 feet.

I started to roll and tumble and corkscrew for about 10,000 feet, like an oak leaf being blown from a tall oak tree in a vicious windstorm-sway and tumble, no control, no power over anything, no stability, just another body simply subjected, nakedly to the divine agency to which the order of things is prescribed. Would I be a favorite son, or a fatality? Would I be vicariously and rudely shoved back in time to Greek mythology and become Icarus and fall to my death by flying too close to the sun; or would I become the winged horse Pegasus carrying the thunderbolt of Zeus and be allowed to live and, like he, be captured by my Bellerophon (Lockheed) and continue to ride through many adventures?

Speaking of thunderbolts: what the hell happened? This isn't me, falling through space hoping my chute will open. Where's the ring for manual opening? Where are my hands? What happened to my airplane? Was "eight ball" angry with me? Did I step on the lady's toes too often?

My thinking was interrupted with an abrupt, cruel and intense punch to my crotch and chest. My chute opened with a vicious snap, a whoosh, a big shaking, followed by a smaller one: it was extremely violent. I was a rag doll in the mouth of a giant killer lion, and then he dropped me-plop! And there I was! Hanging by two leg straps and a chest belts-15,000 feet in the air. I was stunned-this wasn't me-I'm having a nightmare!

I'm dreaming-Clark Gable and Spencer Tracy and a snazzy blond in "Test Pilot." But then, a sudden reality; the wind came, wheezing through the shrouds rocking me back and forth, back and forth. I was in a backyard swing, only I couldn't put my feet down to stop it. I was afraid to look down, but when I did, it was most frightening-oh my God!! Would those straps hold me? Will I fall out? I still had about 12,000 feet to go: My first experience in a parachute. I will never forget it!

I looked around. I could see San Bernardino, Barstow, Edwards, Lancaster, Palmdale, and the Valley-all those places and hundreds of thousands of people; yet I was all alone. I looked at my legs and arms and hands. I moved them. My hands were holding on to the rigging with a tighter grip than snap-on pliers. I wasn't about to let go. Somewhere along the line I had lost my left glove and my watch; my flight suit looked like the remains of a flag flown at full mast during a hurricane. It was in shreds. But my helmet and oxygen mask stayed with me; I was sucking, rather readily I might add, emergency oxygen. My laced up boots were still on my feet. I looked down and moved my head around. I didn't dare make a body turn; didn't want to disturb anything. The wind still had that eerie sound as it continued to pick its way through the shroud lines. It reminded me of "intersanctum," but that was a squeaky door. I really felt depressed. How could this happen to me? And I started to think, "You're in the big leagues now, Suitcase. This is serious stuff, ejecting out of an experimental aircraft. You're not a 'flyboy' anymore. You are dealing with a very profound, abstruse, difficult subject matter-this test-flying stuff. It's beyond the ordinary knowledge or understanding of almost everyone. Most people think of you in a leather jacket and a white scarf in the company of glamorous women. No glamour here. You better pray it wasn't your fault because of a dumb mistake."

I was looking for smoke from my crash-nothing!! I remember thinking that I hoped a United Airlines DC-6 wouldn't run into me. Why United? Why a DC-6? I have no idea.

I looked down. "Wow!" I said to myself, "I'm coming down pretty darn fast, I better get ready for a sudden stop."

I don't know at what rate of descent I hit the ground; I went from so many feet per second to stop! Just like that! I do remember, as I neared the ground, seeing a small ranch house, or cabin, with clothes hanging on a washline. A blessing! The clothes gave me an indication of which way the wind was blowing so, when I hit the ground, I would be prepared to get up and run in the direction of my chute and grab the lower shroud lines and collapse it. Sounds good! That's what they do in movies. But everyday life is serious play, and your never given any time to practice. This was my first ejection and parachute ride, and I was never given any in-depth lectures or practices in landing-in a harness, say, by jumping from a tower as you see in the training movies.

The clothesline was strung from the roofline of the cabin to a pole about 30 yards away. It was high enough to help me in my depth perception. When my eyes were even with the clothesline I closed them, tucked in my legs a bit, went limp and waited. Whomp! I hit the ground-hard. The chute did not collapse; the wind was stronger than I anticipated. And let me tell you, there was none of this get-up-and-run stuff; I was being dragged. I managed to roll over onto my stomach, used my elbows for speed brakes-I still have the scar tissue-and slowly crawled forward to shorten the distance to the bottom of the chute. I finally managed to get it to collapse-then I did too!

In a few long minutes, I sat up and looked around. Nobody came from the cabin, but I was more concerned about what had happened to the aircraft. I kept thinking! My God! What if I was responsible?! This really isn't happening! I'm going to lose my job! Is my experimental career over already?

I also was looking for smoke from the wreckage, but there was nothing except a lot of dust and haze on the 360-degree horizon. The wind was getting stronger-blowing from the west. I pulled in more of the chute. I was alone in the middle of nowhere, sitting in a dusty, dried-up, brown, grasslike field and my back was killing me. I decided not to move, Lockheed would be looking for me by now anyhow. I unhitched one side of the parachute risers and let the chute flare out.

I heard a motor. It wasn't the sound of an airplane. I struggled to stand up and saw a truck driving toward me. It continued until it came right up beside me and stopped. It was driven by a farmer with eyes the size of an "on-deck" batter's circle. I had taken off my helmet, so at least he knew I wasn't from another planet--I think!

"I seen ya come down from way off," he said. "took me a time to git here. What happened? Is you busted up? You one of them paratroopers from out yonder at Bicycle Lake? Wher'd yawl come from?"

I said, "I don't know what happened. I just got here myself." My try at dry humor went directly over his head. "I'm OK, but I would appreciate a ride to the nearest town. I'd like to make a phone call."

"Boy, ain't no towns `round here. Yawl in the middle of nowhere. This yous'd to be Alfalfa-ain't nothin' now. No water. As I says ain't no towns, but I kin take you to a country-like store. They got a phone outside. C'mon git in."

"He," his name was "Gus," helped me gather my chute and helmet and off we went. I made the mistake of telling Gus my back hurt a little. From that time on, until Lockheed picked me up at the edge of a dry lake bed, Gus told me about his back troubles, his wife's lumbago troubles, his kids troubles and money troubles. On the way to the "country-like" he asked, "How much do you trouble shooters make?"

"Not enough," I answered.

"You married?"

"No thanks."

"Hey, hey, hey! Yeah marriage is like jumping int'a a hole in the ice in the midd'l winter; you do it once and you remember it the rest of your days! Yer Smart! Got girl friends?"

"Not enough! Although I am dating a blond right now."

"What's `er name? She pretty?"

"Her name is Jane and, yes, she is very pretty; she could make a bishop kick a hole in a stained glass window just to see her pass by."

"Heh, heh, heh! Probably wanted to see mor'n that. Heh, heh! That's a good'n."

"How long have you been married Gus?"

"Heck man, I've been in love with the same woman for thirty-eight years. If my wife ever finds out, she'll kill me. Heh, heh, heh! Naw! Just kiddin'," Gus said, "I'm married to mah third one. Nice lady. Took on two of her kids, and I guess she liked that. We ain't got much money, but we git along. You seem I drive a tractor for a big rancher near'n Ridgecrest and, when I work, pay's pretty good. Long hours though."

We were now bouncing along a dirt trail in Gus's pickup truck headed toward the edge of Harper Dry Lake. I had called Lockheed, collect. Ellie Hawks, the chief of all flight tests accepted the call. The conversation was surreal.

"Hi, Suitcase. Where are you calling from?"

"I'm out here at a crossroads gas station."

"Oh? Where?"

"I dunno, somewhere south of Harper Dry Lake, so I'm told." I was beginning to realize that, for some reason or other, Ellie didn't know I had lost an airplane. I found out later that the guys upstairs in engineering were in a panic and Ellie had just returned from the bank or something; no one had had the chance to call him.

"Did you have a breakdown or something?"

"Yeah, Ellie, Your number eight airplane is broken way down-into a thousand pieces, is my guess. For God's sake Ellie, I just ejected from number eight."

Dead silence for a long, long second!

"Wha! What! Ya, ya, ya, mean ya, bailed out? Wha-wha-where?? What happened? Are you OK? Where are you calling from?? Are you OK? Can we come get you? Ca-ca-can you walk?"

"Yeah, yeah, Ellie; I'm OK. I don't know what happened. I lost all pitch control. The airplane just pitched down and started to tumble on me, so I had to get the hell out. I had a nice guy pick me up; took me to this `Grapes of Wrath' junction."

"Gosh, I can't believe it. Wait a second! Larry just walked into my office. Just a minute." Mumble, mumble. " OK! Can you get to Harper Dry Lake?"

"Yes, I'm sure this man will take me. But I want to give him a tip: I didn't bring any cash with me."

"Heck, don't worry about that. We'll pick you up in the Bonanza-within the hour."

"OK! Great! Have Larry review the voice tapes with you. That's all we have left anyhow. See you in about an hour. And Ellie, I'm OK. Relax."

"Hey! Wait! Wait! What's the number there? I'll call you right back."

So in a few minutes the phone rang and, after discussing what happened in more detail and Ellie reaching his zenith of excitement and then calming down-plus knowing I was OK-Ellie told me my boss, famous test pilot Tony LaVier, was on his way by plane to pick me up. I suggested to Ellie to have Larry accompany Tony so he could brief him on the way.

My conversations with Gus were vapid, passing the time as we drove, but he turned out to be a very nice man. And it helped me through my anxiety of being in the middle of nowhere, having lost an experimental airplane worth tens of millions of dollars and not knowing the reason why; that's what was haunting me.

Tony landed the twin Beech on Harper Dry Lake and taxied to a stop, bringing a cloud of thick red dust with him. Larry, my flight test engineer, was in the copilot seat. I introduced the two men to Gus, and while Larry was helping with the chute and helmet, Tony took me aside and said, "Don't worry, Suitcase, we think we know what went wrong. Larry and I could see the wreckage from the air. We saw the hole the airplane made, then the ripped off tail section and a finally the mangled tip tank. It looks like the tip tank was torn loose due to the clear air turbulence you reported. It probably wasn't installed correctly. It then, somehow, jammed into the tail and cut through it like butter. It reminds me of the fatal accident we had at Big Spring in a T-33; the tip tank came off and tore into the tail. Only the instructor was at low altitude. Do you remember that?"

"How could I forget? The pilot was one of my instructors."

"Anyhow, we think that's what caused your tumble; thank God the ejection seat worked perfectly. We have some experts on the way to the sites now; I radioed the coordinates."

I was relieved, but depressed. How could something like this have happened? I asked Tony if he had a few bucks. He went over to Gus and thanked him, and then we said our goodbyes. When Tony shook Gus's hand, his palm had a 100-dollar bill in it. Tony LeVier was that kind of man. When it was my turn I didn't say much, just shook Gus's hand, gave him a hug, turned and climbed into the airplane.

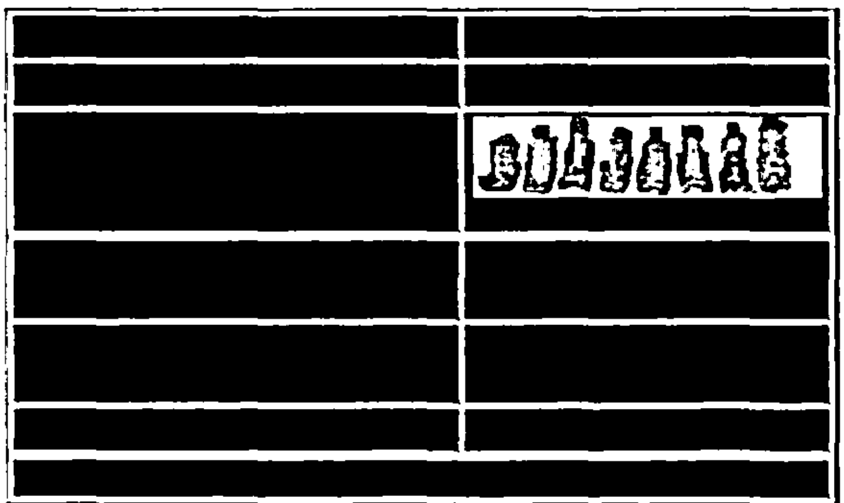
When we arrived at Palmdale, I was given a big welcome, reported to the flight surgeon (my back was just a bruise and I was given a prescription for pain if it got worse), filed a tape recorded detailed report, and visited with Ellie, Tony, and Larry. Things were getting serious, we were loosing too many aircraft. I didn't know it then, but my time would come again.

Tony flew be to Burbank. On the way, Tony told me my aircraft, the number 1 YF-104A Simpson's Appleknocker (my crew chief had painted a flying suitcase on the right side), which I had been test flying was still down for maintenance and would not be ready for another week. The Appleknocker was the first YF-104A off the assembly line as a test aircraft. He said "I don't want to even hear from you until a week from tomorrow."

I went to my apartment a few miles from Burbank. I did go to the plant a few days later though. It took me a few days to recover any semblance of walking correctly because I had never hurt so much in my life: my neck, shoulders, chest, elbows, inner thighs, and even my rear end. I played tennis or worked out religiously every other day, and I thought I was in good shape. Tarzan probably could not have taken the abrupt tugs, pulls and shakes on his body without hurting in the same way, and he had a Jane who worried about him, too!

Anyway, I had our flight-test secretary type a letter for me thanking Gus. I wanted it on Lockheed stationary. I also packed a model of the F-104 and sent it to him-with the tail on!

Tony talked to me while I was there. His first premise turned out to be true. The tip tank had been installed improperly. The rest is history. He didn't offer to show me the pieces.



083-92-01. F-104 3/4/54 12/17/54 4/14/55 7/11/57

Under the guidance of Clarence R. "Kelly" Johnson and project engineer Bill Ralston, the project rapidly moved ahead. The mockup was inspected on April 30, 1953, and at that time it was decided to substitute a single General Electric Vulcan Gatling-type cannon (then under development and known as the T-171) in place of the two 30-mm cannon originally proposed. The T-171 (later to be designated M61) cannon was to be mounted on the left side of the fuselage and was projected to be capable of firing up to 6000 rounds per minute. The cannon was 72 inches long and weighed about 300 pounds. It was to be fed by a 725-round drum of ammunition. The cannon was to be integrated with a Type K-19 fire-control system and incorporated an AN/APG-34 radar and a computing gunsight.

The first prototypes were to be powered by a non-afterburning Wright J65 turbojet (license-built Armstrong Siddeley Sapphire), but production aircraft were to be powered by a single afterburning Wright J65. The J65 would serve as the interim powerplant until the more advanced J79 could be ready.

Construction of the first prototype XF-104 (53-7786) began in the summer of 1953 at Lockheed's Burbank, California factory. This aircraft initially was powered by a non-afterburning Buick-built Wright J65-B-3 turbojet. Construction of the second prototype (53-7787)--the armament test bed--began in the autumn of 1953, but work on this aircraft proceeded at a slower pace in case revisions were needed. The air intakes of the two XF-104s were of fixed geometry without presence of half-cones, since the J65-powered aircraft was incapable of Mach-2 performance. The air intakes were similar to those of the F-94C, being mounted slightly proud of the fuselage, with an inner splitter plate for the boundary layer bleed.

The first XF-104 (53-7786) was ready in early 1954, and was trucked out to Edwards AFB in high secrecy during the night of February 24-25. Veteran Lockheed test pilot A. W. "Tony" LeVier was to do the initial testing. Taxiing runs began on February 27, 1954. On February 28, 1954, the XF-104 made an scheduled short hop of about five feet off the ground during a high speed taxiing run. Its first official flight took place on March 4, 1954. During that flight, the landing gear would not retract. After a low-speed flight of about 20 minutes, Tony LeVier landed. Some adjustments were made, and LeVier took off again, but the landing gear still would not retract. The problem turned out to be low pressure in the hydraulic system, which was fairly easy to correct. However, inclement weather kept the XF-104 on the ground until March 26, when flights three and four were carried out with the landing gear retracting adequately.

The XF-104's original yaw damper was ineffective, allowing the nose to wander left and right. This problem was corrected by revising the rudder-centering device.

The XF-104 could not exceed the speed of sound in level flight when powered by the nonafterburning J65-B-3 turbojet. However, Mach 1 could be easily exceeded during a slight descent, and the transition to supersonic speed was quite smooth.

In July of 1954, the J65-B-3 non-afterburning engine was replaced by the long-awaited afterburning J65-W-7 turbojet rated at 7800 lb.s.t. dry and 10,200 lb.s.t. with afterburner. In that same month, 17 more service test aircraft were ordered. They were also to be powered by the J65-W-7.

With the afterburning engine installed, the performance of the XF-104 was markedly improved. Maximum level speed was Mach 1.49 at 41,000 feet, and an altitude of 55,000 feet could be attained in a zoom climb. Mach 1.6 could be attained in a dive.

The second prototype (53-7787) flew on October 5, 1954. It was fitted with the afterburning J65 from the start. Since it was to be the armament test bed, it was fitted with the 20-mm Vulcan cannon and was equipped with an AN/ASG-14T-1 fire control system. Initial aerial firing tests with the Vulcan cannon were successful, but on December 17, there was an explosion during a firing burst, and the J65 engine started to run rough. Test pilot Tony LeVier immediately shut down his engine and glided back to make a successful dead-stick landing at Rogers Dry Lake. An investigation later showed that one of the 20-mm cannon rounds had exploded in the breech, blowing the bolt out the rear of the gun and into the forward fuselage fuel cell. Jet fuel gushed into the gun bay, and leaked out of the gun bay door joints and into the left engine air intake. The engine immediately flooded with fuel, choking it to death. Tony LeVier was lucky to be alive.

XF-104 number one achieved a top speed of Mach 1.79 at 60,000 feet on March 15, 1955. Lockheed test pilot J. Ray Goudey was at the controls. This was the highest speed achieved by either of the XF-104 prototypes.

The second prototype (53-7787) was lost on April 14, 1955 when test pilot Herman R. "Fish" Salmon was forced to eject during gun-firing trials at 50,000 feet. The gun malfunctioned during a test firing, and severe vibrations began to build up which knocked loose the ejection hatch on the belly of the plane. Cabin pressure was immediately lost, and Salmon's pressure suit pumped up and covered his face so that he could not see. Recalling Tony LeVier's harrowing experience with the exploding cannon shell the previous December, Salmon believed that the same thing had happened to him and that he had no option but to eject. This he did. He later found out that he could have saved 53-7787 by simply bringing it down to a lower altitude and waiting for his pressure suit to deflate.

With the loss of the armament testbed, Lockheed engineers were forced to find an alternative. Armament trials were continued on a modified Lockheed F-94C Starfire.

The first XF-104 was accepted by the USAF in November of 1955. XF-104 number 1 was lost in a crash on July 11, 1957, when it developed an uncontrollable tail flutter while flying chase for F-104A flight tests. The entire tail group was ripped from the airframe, and Lockheed test pilot Bill Park was forced to eject.

Consequently, no XF-104 prototype survives today.

Serials of Lockheed XF-104 Starfighter

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53-7786/7787     Lockheed XF-104 Starfighter
                         c/n 083-1001/1002
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7/1/56-57

provision for four underwing and one fuselage stores pylon, the maximum takeoff weight was 24,584 pounds.

The first YF-104A (55-2955) was completed in February of 1956, and was trucked out in high secrecy to Edwards AFB. It made its first flight there on February 17, 1956, with Lockheed test pilot Herman "Fish" Salmon at the controls.

On February 16, 1956, the second YF-104A (55-2956) was used for a media-covered official rollout ceremony at Lockheed's Burbank factory. This was the first display of the Starfighter to the public. Before that, there had been only rumors in the aviation press about the existence of a truly revolutionary new fighter aircraft, plus a few speculative drawings. The engine air intakes were covered with temporary fairings, since the Air Force didn't want people to see the half-cones in the air intakes.

The first Starfighter photographs were released in the spring of 1956. These were limited to air-to-air shots of the prototype and ground photos of YF-104A 55-2956 with the intake fairings still fitted. It was not until mid-1956 that the J79-engined F-104 lateral intakes were finally revealed to the public.

The J79 engine provided a spectacular improvement in performance. 55-2955 reached Mach 2 on February 28, 1956, becoming the first fighter aircraft capable of double-sonic speed in level flight.

An initial order for production F-104As was issued on October 14, 1956.

Together with the first 35 production F-104As, all seventeen YF-104As were used for flight-test and to evaluate early versions of the J79 (the -3, -3A, and -3B) engine, the Vulcan cannon, the AIM-9 (formerly GAR-8) Sidewinder air-to-air missile and the wingtip-mounted fuel tanks. Airframe strengthening and local redesign were progressively introduced. Various forms of flap blowing were tested, and a ventral fin was introduced to improve directional stability at supersonic speed. Some YF-104As were also used to test wingtip racks for either 170 US-gallon drop tanks or Sidewinder infrared-homing air-to-air missiles.

On May 7, 1958, Major Howard C. Johnson reached an altitude of 91,249 feet in a zoom climb at Edwards AFB in California, setting a new altitude record. On May 16, 1958, Captain Walter W. Irwin flying a YF-104A set a new world's air speed record of 1404.19 mph flying over a 15/25 kilometer course at Edwards AFB. For the first time in history, the same aircraft type held both the world speed and altitude records at the same time.

A large percentage of the seventeen YF-104As were lost in crashes during the test program. At the end of this program, the surviving YF-104As were brought up to F-104A production status and were turned over to USAF squadrons for duty. Following the withdrawal of the F-104A from active service in 1960, at least four of the ex-YF-104As (55-2956, 2957, 2969, 2971) were converted into unmanned QF-104A target drones. They were all most likely shot down during tests.

Of the seventeen YF-104As built, only two are known to survive today. The first survivor is the seventh YF-104A (55-2961). This aircraft was transferred to the National Advisory Committee for Aeronautics (NACA) in August of 1956. It was initially numbered 018, which was later changed to a civilian registration of N818NA. In 1958, NACA was reorganized as NASA, and the YF-104A remained with NASA until November of 1975. This aircraft is now hanging in the National Air and Space Museum in Washington. I saw it there in October of 1993. The other survivor is the thirteenth YF-104A (55-2967). It is now on display at the Air Force Academy in Colorado Springs, Colorado. I remember seeing it sitting outside the Chapel when I visited the Air Force Academy in 1971.

Serials of Lockheed YF-104A Starfighter

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55-2955/2971     Lockheed YF-104A Starfighter
                           c/n 183-1001/1017
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10/20/1954

F9F
Cougar

10/20/54

There was a single triangular-shaped vertical tail. The all-flying horizontal tailplane was mounted low on the rear fuselage.

The Navy Bureau of Aeronautics was sufficiently impressed with the G-98 proposal that on April 27, 1953 they ordered two flying prototypes (BuNo 138604 and 138605) plus a static-test airframe (BuNo 138603). Even though the G-98 now bore no relationship whatsoever to the F9F-6/F9F-7 Cougar, the Navy assigned the designation XF9F-8 to the project. Four months later, the Navy changed its mind and reassigned the XF9F-8 designation to the G-99 project, which WAS a straightforward derivative of the basic F9F-6/F9F-7 Cougar, and redesignated the new G-98 as XF9F-9, which confused just about everyone.

Tests were carried out with a rocket-launched scale model and with a small model mounted on the nose boom of a F9F-6 Cougar. The Navy now felt sufficiently confident to order 42 service test and initial production aircraft (Bu Nos 138606/138647).

Work on the XF9F-9 proceeded rapidly and the first flying prototype was available in July of 1954. However, the afterburning J65 engine was still not available, and a non-afterburning Wright J65-W-7 turbojet rated at 7500 lb.s.t. was fitted for the initial trials. XF9F-9 BuNo 138604 took to the air for the first time on July 30, 1954, test pilot Corwin "Corky" Meyer being at the controls. In spite of the use of the non-afterburning engine, the aircraft almost achieved Mach 1 on its first flight, which further increased the Navy's confidence in the design. The second prototype (BuNo 138605) took to the air for the first time on October 2, 1954.

On October 20, 1954, XF9F-9 BuNo 138604 crashed at the edge of a wooded area near the Grumman Calverton facility on Long Island following an engine flameout. The pilot, LtCdr W. H. Livingston, survived the crash, but the aircraft was too heavily damaged to be repaired. The second XF9F-9 prototype (BuNo 138605) was moved to Edwards AFB in California in search of better flying weather. Once at Edwards, 138605 was fitted with an afterburner and was finally able to achieve supersonic performance in level flight. However, the XF9F-9 (in contradiction to some sources) was not the FIRST Navy fighter to achieve this feat, that honor belonging to the Douglas F4D-1 Skyray which first went supersonic in level flight in June of 1954.

Flight testing at Edwards AFB did turn up some control and stability problems which needed fixing before the aircraft could be declared ready for service. These modifications were incorporated in BuNo 138606, which flew for the first time on December 15, 1954. It had redesigned vertical tail surfaces with a narrower chord rudder, a boundary layer splitter plate for the air intakes, a clear sliding canopy to improve rearward visibility, and a slightly longer nose. By then, an additional 388 production fighter aircraft had been ordered (BuNos 141728/141980, 143232/143366) and 85 reconnaissance versions

(BuNos 140379,140413, 141981/142009, and 143367/143387), and these modifications were to be incorporated. The production aircraft were to be powered by the Wright J65-W-18 turbojet, rated at 7400 lb.s.t. dry and 10,500 lb.s.t. with afterburning. Armament was to be four 20-mm cannon mounted in the lower edges of the air intakes. In addition, four Sidewinder infrared-homing air-to-air missiles or two Sidewinders and two 150-US gallon drop tanks could be carried on underwing racks. In accordance with the new Navy requirement for inflight refuelling capability in all its combat aircraft, a partially-retractable refuelling probe was added in the nose.

In April of 1955, the Navy finally admitted that the Tiger was not an upgraded Cougar, and ordered that the aircraft be redesignated F11F-1 (the designation F10F had been taken by the Jaguar variable-sweep fighter). This redesignation covered BuNos 138605/138608 which had already flown, and subsequent production aircraft were redesignated before their completion. The three batches of reconnaissance versions were redesignated F11F-1P. The name *Tiger* was chosen, continuing the tradition of adopting feline names for Grumman-designed carrier-based fighters.

The first catapult launchings and carrier landings took place aboard the USS *Forrestal* on April 4, 1956. These trials uncovered further problems which resulted in the need for more changes. The range and endurance of the Tiger was found to be inadequate, and the second production batch of Tigers (beginning with BuNo 141728) incorporated additional fuel cells fitted in the intake walls and in the vertical fin, increasing internal fuel capacity from 914 to 1049 US gallons. Also starting with BuNo 141728, sixty-degree wingroot fillets were added to the wing leading edge and a six-foot longer nose was fitted, which had the retractable refuelling probe moved to a position on the starboard side of the nose. This longer nose was to have been fitted with an AN/APS-50 radar set, but this was never actually installed.

The first short-nosed F11F-1s were delivered to VX-3 based at NAS Atlantic City, New Jersey in February of 1957. VX-3 was assigned the mission of carrying out the initial operational evaluation of the Tiger. Three short-nosed F11F-1s were delivered to VA-156 (which was a day-fighter unit despite its Attack designation) at NAS Moffet Field, California in March of 1957. VA-156 soon received a full complement of long-nosed F11F-1s and was the first Tiger squadron to complete carrier qualifications.

The following squadrons ultimately received F11F-1s:

- Pacific Fleet:

  VA-156 (redesignated VF-111 in January 1959), VF-24 (redesignated VF-211 in March 1959), VF-51, VF-121, and VF-191.

11/04/1954

Sea Dart

Convair F2Y (F-7) Sea Dart

Last revised January 8, 2000

The Convair XF2Y SeaDart water-based fighter was the result of a design contest initiated by the US Navy in 1948 for a supersonic interceptor seaplane. The goal of the contest was to develop a high-performance supersonic naval fighter aircraft which could operate in forward areas without the need for land bases. At that time, the Navy assumed that it would be impossible to operate high-performance supersonic jet aircraft from the decks of aircraft carriers. For this reason, the Navy actually stuck with lower-performance straight-winged carrier-based jet aircraft such as the F9F Panther and the F2H Banshee long after land-based air forces had switched over to higher-performance swept-winged fighter aircraft.

Convair entered the seaplane fighter contest on October 1, 1948. Initially, Convair's proposal was for a delta-winged design with a blended hull which rested on the water and rose up onto a retractable step for takeoff and landing. Convair also tested a large number of seaplane designs equipped with hydro-ski configurations.

On January 19, 1951, Convair was awarded a contract for two prototypes of a water based fighter with a delta wing planform, a single delta-shaped tail, and a watertight hull. The aircraft was to take off and land on a pair of hydro-skis that retracted into wells in the side of the lower fuselage. The two prototypes were assigned the designation XF2Y-1 and were issued the BuAer serial numbers 137634 and 137635. The name SeaDart was assigned.

The SeaDart aircraft was to be powered by a pair of 6100 lb.s.t. afterburning Westinghouse XJ46-WE-02 engines. The engines were to be fed by a pair of lateral intakes mounted high up on the sides of the fuselage well above the wings and behind the cockpit, this location being chosen in order to prevent water spray from entering the air intakes during takeoff and landing. The hull of the SeaDart had multiple watertight compartments in the lower fuselage to prevent sinking in the event of a puncture. The lower fuselage of the SeaDart had the V-shaped profile of a boat, as would be expected for a water-based aircraft. Both the elevons and the rudder were hydraulically-powered. The aircraft was fitted with a set of dive brakes on the lower rear fuselage which also doubled as water brakes and as a water rudder while taxiing on the surface. When sitting at rest in the water, the SeaDart floated with the trailing edge of the wing and the elevons being flush with the water, and the leading edge of the delta wing at the juncture of the fuselage being about 18 inches above the water.

The one-piece cockpit canopy structure was hinged from behind the cockpit. When open, there was no windscreen in front of the pilot. The canopy was provided with two small transparencies on either side, separated from each other by a center post which obstructed the directly forward view. By all accounts, the view from the cockpit was rather poor, and would certainly have to had been substantially improved had the SeaDart ever entered service as a combat aircraft.

The aircraft took off and landed on a pair of retractable hydro-skis that extended outward on oleo legs from recesses cut into the lower hull, one ski on each side of the hull. During takeoff, the skis were initially fully retracted into their wells. Then as power was applied and the leading edge of the ski broke the water at 9-11 mph, the skis were extended to an intermediate position until 45-55 mph was reached. The skis were then extended to their fully-extended position, and the aircraft accelerated to a takeoff speed of about 145 mph.

When the aircraft was sitting on dry land out of the water, it tilted backwards on its extended skis, its tail resting on the ground. Each of the twin retractable hydro-skis had a small fixed wheel at its aft end, and there was a small fixed swiveling tailwheel mounted underneath the rear fuselage. This provided for a limited amount of ground maneuverability, which made it possible for the aircraft to enter or leave the water via a long ramp under its own power. However, the aircraft could not take off or land on conventional runways.

The Navy had such confidence with the design that they ordered 12 production F2Y-1 aircraft on August 28, 1952, even before the first prototype had flown. Serials were 135762/135773, which curiously were in a batch earlier than those of the two XF2Y-1s ordered more than a year earlier. Proposed armament for the production F2Y-1 aircraft was a set of four 20mm cannon and a battery of 2.75-inch folding-fin unguided rockets. These aircraft were to be powered by a pair of J-46 afterburning turbojets, each offering a thrust of 6000 pounds. Shortly thereafter, the contract was amended so that the the first four F2Y-1s (BuNo 135762/135765) would be built as YF2Y-1 service test aircraft.

Later, eight more F2Y-1 production aircraft were ordered. Their serials were 138530/138534, plus three others which I don't know. This brought the total SeaDart order to 22 aircraft.

Pending the availability of the J46s, the first prototype XF2Y-1 (BuNo 137634) was fitted with two side-by-side non-afterburning Westinghouse J34-WE-32 engines of 3400 lb.s.t. each. In the late autumn of 1952, the completed aircraft was transferred from the experimental shop at Convair's Lindbergh Field facility to the Convair seaplane ramp area on San Diego Bay. On December 14, 1952, E. D. "Sam" Shannon began taxiing trials in San Diego Bay with the XF2Y-1 prototype. On January 14, 1953, he made an inadvertent first hop of 1000 feet during a high-speed taxiing run. The XF2Y-1 prototype made its official maiden flight on April 9, 1953.

The first flight tests revealed (as expected) that the aircraft was severely underpowered for its weight. In addition, the waterskis vibrated continuously during takeoff and landing, so much so that the aircraft was extremely difficult to control. In order to cure the vibration problem, the skis were redesigned and the oleo legs were improved. This seemed to help somewhat. However, the absence of an area-ruled fuselage (plus the lack of adequate engine power) meant that that the XF2Y-1 could not exceed the speed of sound in level flight.

In 1953, the XJ46 engines finally became available and was installed in the prototype. However, they failed to reach their projected thrust output. In search of more power, the Navy proposed that a single 12,000 lb.s.t Wright J67 or 15,000 lb.s.t. engine be fitted in an improved version of the SeaDart, the XF2Y-2.

On October 14, 1953, the remaining XF2Y-1 (BuNo 137635) was cancelled.

The first YF2Y-1 (BuNo 135762) service test aircraft joined the test program in early 1954. Since the second XF2Y-1 (BuNo 137635) had been cancelled, YF2Y-1 BuNo 135762 was the second SeaDart aircraft actually to be built. It was powered by a pair of afterburning Westinghouse J46 turbojets. In overall appearance, the YF2Y-1 was similar to the XF2Y-1 except for the J46 engines. However, the aft fuselage at the engine exhaust area was significantly different, with the engine nacelles and nozzles extending further aft. The YF2Y-1 differed from the XF2Y-1 in not having wheels on the rear of its twin skis, so auxiliary beaching gear was required during entry to or exit from the water.

Convair test pilot Charles E. Richbourg made the initial flight tests of the number two SeaDart. On August 3, 1954, Richbourg took BuNo 135762 through the sound barrier while in a shallow dive. This made the SeaDart the first (and to date the only) seaplane to go supersonic. Since the SeaDart had been designed before the advent of the area rule, the aircraft experienced high transonic drag and was unable to exceed the speed of sound in level flight. Flight tests indicated some wing spanwise airflow, and a single airflow fence was mounted on each upper wing surface near the tip. No other SeaDart was fitted with wing fences.

1954

Unfortunately, Richbourg was killed on November 4 of that year while demonstrating BuNo
#1 135762 over San Diego Bay to Navy officers and press representatives. It seems that the aircraft had gotten pushed past its safety margin during a low-altitude, high-speed flypast, and the plane disintegrated in midair as a result of pilot-induced pitch oscillations. Bits and pieces of flaming debris fell into the bay. I still remember the rather vivid photos of this accident that appeared in *Life* magazine. All SeaDart operations were temporarily suspended after the crash.

In the meantime, the Navy had been gradually losing interest in the SeaDart project. By this time, the Navy had overcome its earlier reluctance and was already planning for the introduction of supersonic carrier-based fighters, and the need for a water-based supersonic fighter did not now seem to be as critical as before. In addition, the problems with the vibrating waterskis had continued to plague the SeaDart, and seemed to be insoluble. As a result, the Navy cancelled ten of the sixteen production F2Y-1 aircraft in December of 1953, even before the first of the YF2Y-1 service test aircraft had been delivered. The remaining six production F2Y-1s were cancelled in March of 1954. The fatal crash of the first YF2Y-1 aircraft later that year, with the surrounding bad publicity, did not help matters any, and the SeaDart program was relegated to test status only.

Also cancelled was the F2Y-2, which had been envisaged as the definitive production version of the SeaDart. It had a single waterski, an area-ruled fuselage, plus a single afterburning Pratt and Whitney J-75 turbojet of 15,000 pounds of thrust.

In spite of the project cancellation, tests continued with the sole XF2Y-1. During the summer of 1954, the XF2Y-1 was extensively reworked. The aft fuselage was brought up to YF2Y-1 configuration with afterburning Westinghouse J46 turbojets. The aircraft was fitted with a large, single hydro-ski in place of the original pair of skis. The single-ski installation was not fully retractable, since high-speed flight was never planned. The previous twin-ski fuselage wells were not filled in or covered over for the single-ski installation, and during flight, the single ski was held below the fuselage in an external position parallel to the aircraft's longitudinal axis. The rear part of the ski was extended downward for takeoff or landing. The rear part of the single ski had a pair of retractable wheels on either side for use in moving the aircraft into and out of the water, the aircraft resting nose-up on a small tailwheel. Like the dual-ski XF2Y-1, the aircraft could be launched or recovered from the water without the need for auxiliary beaching gear. The XF2Y-1 flew for the first time in this configuration on December 29, 1954, with Convair test pilot B. J. Long at the controls.

The first tests with the single sky encountered the divergent and uncontrollable hydrodynamic longitudinal pitch oscillations. These were corrected by adding a new ski oleo damping device what sensed stroke rate and varied the oleo hydraulic orifices and provided the needed damping qualities. Lateral directional control problems that had been encountered were corrected by doubling the lateral deflection of the elevons relative to the pilot control stick movements. The single ski could even safely handle crosswind takeoffs and landings with a wingtip dragging in the water. The aircraft could even operate in waves of up to 6 to 10 feet in height, far in excess of the requirement. The last single-ski test with the XF2Y-1 took place January 16, 1956, when an open-sea landing and takeoff was carried out. After the completion of the tests, the XF2Y-1 was placed in storage.

The number three SeaDart, YF2Y-1 BuNo 135763 joined the test program in March of 1955. It was the nearest of the three aircraft to a full production model, and carried no special test instrumentation. It flew for the first time on March 4, 1955. It was powered by a pair of Westinghoeus J46 afterburning engines, the same as those retrofitted to the XF2Y-1 when the single-ski was installed. The aircraft featured a revised twin-ski format, with beaching wheels once again as an integral part of the skis. The bottom planform of the ski afterbodies were the same as the best design finally derived on the number two aircraft, which did not have wheels. The afterbodies were tapered and pointed, with a retractable wheel mounted flat on the top surface of each ski afterbody, with a slight overhang on the inside of the bottom planing surface. The afterbodies rotated 90 degrees just aft of the ski main oleo struts. When the aircraft was sitting out of the water on the ramp with the wheels extended, the bottom afterbodies faced outward and appeared as spurs. Upon water entry, the ski afterbodies were retracted inward at the bottom to a 90-degree position, with the wheels safely tucked out of the way on top of the skis. Vibration was still unacceptable with the two-ski example, and after open-sea trials, testing with the second YF2Y-1 formally ended on April 28, 1955. The aircraft was placed in storage and never tested again.

In late 1956, the XF2Y-1 was taken out of storage and the entire large single-ski oleo system was removed and replaced with a small rigidly-mounted hydrofoil ski. Actual flight with such a configuration was not possible, since the rigid mounting and placement of the ski would not permit the ~20 degree nose-up attitude that was required for takeoff. The first test was carried out on March 21, 1957. Violent pounding caused every taxiing run to be aborted at speeds between 50 and 60 knots. Another rigid ski configuration was tested in the autumn of 1957. It too caused too much vibration, and further tests were abandoned. The XF2Y-1 was placed in storage after these tests were completed, never to be flown again.

The other two YF2Y-1 prototypes (135764 and 135765) were completed but never flown.

The four surviving SeaDarts are all preserved in museums. The XF2Y-1 prototype (BuNo 137634) was reportedly at one time with the Maryland Aviation Historical Society at Strawberry Point (I'm not sure where this is, even though I am from Maryland. It might be at the site of the old Glenn L. Martin plant near Baltimore). However, it is now in storage at the Paul Garber Restoration Facility of the Smithsonian Institution in Suitland, Maryland, waiting eventual restoration. It is in terrible shape, with lots of rust, a smashed canopy, and the wings having been cut off by a blowtorch. The 3 surviving YF2Y-1s are with the San Diego Aerospace Museum at Balboa Park (135763), the Wings of Freedom Air and Space Museum at NAS Willow Grove, Pennsylvania (135764) and the Sun n' Fun site at the Lakeland, Florida airport (135765) respectively.

There is a rather odd postscript to the SeaDart story. In 1962, five years after the official termination of the SeaDart project, the Navy was ordered to redesignate all of its fighter aircraft in order to conform to the new tri-service unified aircraft designation scheme. For some obscure reason, the SeaDart was assigned the designation F-7. Why would the Navy bother to redesignate an aircraft which had never entered service? Perhaps some clerk in the Defense Department had some fond memories of this warplane, and decided to honor it posthumously with an official F-number.

Serials of Convair X/YF2Y-1 SeaDart:

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137634/137635       Convair XF2Y-1 SeaDart
                    137635 was cancelled
135762/135773       Convair F2Y-1 SeaDart
                    135762/135765 delivered as YF2Y-1.
                    remainder all cancelled.
138530/138534       Convair F2Y-1 SeaDart
                    cancelled contract.
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Specification for the Convair YF2Y-1 SeaDart:

Engines: Two Westinghouse J46-WE-2 turbojets, rated at 6000 lb.s.t. each with afterburning. Maximum speed: 695 mph at 8000 feet, 825 mph at 36,000 feet. Initial climb rate 17,100 feet per minute. Range 513 miles. Service ceiling 54,800 feet. (these are estimated performance figures, which I don't think were ever achieved in test). Stalling speed 132 mph. Dimensions: Wingspan 33 feet 8 inches, length 52 feet 7 inches (YF2Y-1 no. 3 51 feet 1 1/2 inches), height 16 feet 2 inches (skis retracted) 20 feet 9 inches (skis extended), wing area 568 square feet. Total internal fuel capacity: 1000 US gallons. Weights: 12,625 pounds empty, 16,500 pounds gross, 21,500 pounds maximum takeoff. Armament: The SeaDart was never equipped with any armament.

Sources:

1. The American Fighter, Enzo Angelucci and Peter Bowers, Orion, 1987.
2. United States Navy Aircraft Since 1911, Gordon Swanborough and Peter M. Bowers, Smithsonian, 1989.
3. General Dynamics Aircraft and their Predecessors, John Wegg, Naval Institute Press, 1990.
4. Ray Wagner, American Combat Planes, Third Enlarged Edition, Doubleday, 1982.
5. Convair XF2Y-1 and YF2Y-1 Sea Dart, B. J. Long, Naval Fighters, 1992.
6. E-mail from Steven L. Simpson

THE CONVAIR XF2Y SEA DART

The Martin SeaMaster remains something of an icon of Disney World of Tomorrow "gee-whiz" 1950s technology. It was complemented by another unusual aircraft of the era, the Convair XF2Y "Sea Dart", a delta-winged jet fighter that could take off and land on water.

The Sea Dart grew out of a 1948 request for proposals by the US Navy for a supersonic interceptor seaplane. Although operating from the oceans would allow such an aircraft to operate from forward areas, there was another reason for wanting to build such an aircraft: the Navy wasn't certain that a supersonic aircraft could be operated from a carrier of any reasonable size. Convair's proposal won the competition on 19 January 1951. The contract specified two prototypes of a single-seat delta-wing fighter, to be designated the "XF2Y-1 Sea Dart", that took off and landed on water using two retractable "hydro-skis". The engines were mounted on the back of the aircraft, with the intakes well up above the wings to prevent water ingestion during takeoff and landing.

The Sea Dart had a vee-shaped hull, and its internal spaces were organized as multiple watertight compartments to keep it afloat if battle damaged. It had twin dive brakes on the lower rear fuselage that could be also be used as water brakes or rudders. Flight controls were hydraulic. The Sea Dart could not take off or land on a runway, but each of the hydro-skis had a small wheel at the end, and a third small wheel was mounted near the rear of the aircraft to allow it taxi onto or off of a seaplane ramp. The cockpit canopy pivoted up as a single unit, and featured a rather antique-looking windscreen with twin oval glass panels in a metal frame. Apparently pilot visibility was not very good.

The Sea Dart was originally planned to be powered by twin Westinghouse XJ46-WE-02 engines with 26.68 kN (2,720 kgp / 6,000 lbf) afterburning thrust each. The XJ46 engine, an afterburning derivative of the Westinghouse J34 axial-flow turbojet, was expected to give the aircraft a top speed well in excess of Mach 1. The aircraft was to be armed with four 20 millimeter cannon and a pack of 70 millimeter (2.75 inch) folding-fin air rockets (FFARs), though in fact no Sea Dart would ever be armed. The Navy was so enthusiastic about the Sea Dart that even before it flew, the service ordered a total of four "YF2Y-1" service evaluation aircraft and 16 "F2Y-1" production aircraft.

As the first Sea Dart prototype was finished before the XJ46 engines were available, it was fitted with twin Westinghouse J34-WE-32 engines with 15.11 kN (1,540 kgp / 3,400 lbf) maximum takeoff thrust each. Taxi trials began in San Diego Bay in mid-December 1953, with test pilot Sam Shannon at the controls, leading to first official flight on 9 April 1953.

The Sea Dart was, to nobody's surprise, badly underpowered with its J34 engines and remained solidly subsonic. The hydro-skis turned out to give an extremely rough ride on takeoff and landing, though a redesign effort helped reduce this problem.

The XJ46 engines were installed in the prototype later that year, but they failed to meet their designed thrust levels. The detestable Vought F7U Cutlass carrier would use production J46 engines, and the lack of engine power and poor fuel economy would be high on the list of pilot complaints against the "Gutless", as it was known.

At this point, the Navy began to rethink the program. The second prototype was cancelled, with development moving on to the first service evaluation YF2Y-1, fitted with J46 engines, although the

Navy was seriously looking for a better powerplant. The YF2Y-1 was similar in appearance to the XF2Y-1 but had a longer, redesigned exhaust, and the little beaching wheels were removed from the hydro-skis and the fuselage, meaning it had to be fitted with external beaching gear to be brought up on shore.

The YF2Y-1 began test flights in 1954, and on 3 August 1954, Convair test pilot Charles E. Richbourg took the machine through Mach 1 in a shallow dive. The Sea Dart is believed to be the only seaplane to ever achieve Mach 1. However, as it had been designed before the new "area ruling" scheme was introduced, its supersonic handling characteristics were poor.

The YF2Y-1 was lost in a crash during a low-level demonstration on 4 November 1954, killing Richbourg. This accident essentially killed the program as well.

The Navy was no longer particularly frightened of operating supersonic aircraft off of carriers, and despite improvements in the hydro-ski design, the Sea Dart still suffered from serious vibration on takeoff and landing.

The Navy had begun cutting back the program in December 1953, before the delivery of the YF2Y-1, cancelling ten of the production aircraft. The other six were killed off in March 1954, well before the fatal accident. Following the accident, the program was further scaled back to a test exercise, and plans to produce an "F2Y-2" with area ruling and a single Pratt & Whitney J75 turbojet with 66.71 kN (6,800 kgp / 15,000 lbf) thrust were abandoned. The XF2Y-1 was then refitted with twin J46 turbojets and a single-ski configuration in hopes that would solve the takeoff and landing problems. The fit was strictly experimental. The ski was not fully retractable and the wells for the old twin skis were not faired over. The new single ski had a pair of retractable beaching wheels at the end, allowing the aircraft to beach itself. The modified XF2Y-1 first flew in late December 1954, and after some initial problems the single-ski scheme proved remarkably successful, allowing safe takeoffs and landings even in fairly rough seas.

The second YF2Y-1 performed its first flight in March 1955. It was powered by twin J46 turbojets and had a modified twin-ski system, with pivoting beaching wheels at the end of each ski. The twin-ski system didn't work much better than before, and the aircraft was put into storage at the end of April 1955, never to fly again.

CONVAIR YF2Y-1 SEA DART:

spec	metric	english
wingspan	10.26 meters	33 feet 8 inches
wing area	52.30 sq meters	563 sq feet
length	16 meters	52 feet 7 inches
height, skis extended	6.33 meters	20 feet 9 inches
empty weight	5,725 kilograms	12,625 pounds
loaded weight	9,750 kilograms	21,500 pounds
max speed at altitude	1,325 KPH	825 MPH / 720 KT

service ceiling	16,700 meters	54,800 feet
range	820 kilometers	510 MI / 445 NMI

Performance values are estimates.

The original XF2Y-1 was used for further tests of various ski systems until the fall of 1957, when it was finally withdrawn. Two more YF2Y-1s were built but never flown, and all four aircraft are now in museums. One YF2Y-1 serves as a "gate guard" on a pylon in front of the the San Diego Aerospace Museum at Balboa Park, and certainly provides a distinctive and unusual display.

10/12/1954

F-100A

10/12/54

North American F-100A Super Sabre

Last revised November 27, 1999

The F-100A (company designation NA-192) was the first production version of the Super Sabre. The first F-100A (52-5756) was completed on September 25, 1953, and made its first flight on October 29, George Welch again being at the controls. This was only two weeks after the maiden flight of the second YF-100A prototype, indicative of the speed with which the Super Sabre program was being rushed along.

The F-100A was similar in most respects to the YF-100A, but had a shorter and more stubby vertical tail with increased chord. There was a fuel vent tube mounted on the fin's trailing edge at the midpoint. There was a small rudder fitted to the trailing edge of the fin below the vent tube.

The mission of the F-100A was seen as that of daylight air superiority, and the aircraft was pictured as the natural replacement of the F-86A/E/F Sabre of Korean War fame. The armament of the F-100A consisted of four 20-mm Pontiac M-39 cannon installed in the lower fuselage below the cockpit and carrying 200 rounds per gun. The M-39 had been tested in Korea on modified F-86Fs as the T-160, and fired 1500 rounds per minute at a muzzle velocity of 3300 feet per second.

At the end of November of 1953, the first three F-100As were delivered to George AFB to re-equip the 436th Fighter Day Squadron of the 479th Fighter Day Group of the TAC. This Group became operational with the F-100A on September 29, 1954.

During late 1953, slippages in the Republic F-84F Thunderstreak program caused the Tactical Air Command (TAC) to recommend that a version of the Super Sabre be developed with a secondary fighter-bomber capability. On December 31, 1953 the USAF directed that the last 70 F-100As on the order be modified as fighter-bombers and redesignated F-100C. The fourth production F-100A (52-5759) was chosen for modification as the prototype for the F-100C. The wingtips were extended twelve inches on either side, improving the roll characteristics and decreasing stalling speed. These wingtip extensions were considered sufficiently advantageous that they were incorporated into the F-100A production line beginning with the 101st example.

The first F-100As had been delivered with a short vertical tail. In service, USAF pilots reported stability and control problems with their F-100As, and their suspicion was that the vertical tail was not large enough to maintain adequate directional stability. This problem was especially severe when the underwing drop tanks were being carried. Consequently, most of these early F-100As were never flown to the limits of their performance envelopes.

The 11th F-100A introduced a retractable tail skid to prevent accidental damage to the rear fuselage underbelly during landings at high angles of attack.

The 24th F-100A introduced a yaw damper system. Provisions for a pitch damper were installed in the 154th and subsequent aircraft.

The F-100A had been rushed into service with unseeming haste, often over the objections of Air Force flight crews who found that the Super Sabre had some serious problems that were not being adequately addressed. Disaster struck on October 12, 1954. On that day, veteran test pilot George Welch was carrying out a maximum performance test dive followed by a high-G pullout with the ninth production F-100A (52-5764) when his aircraft disintegrated in midair. Welch was able to eject, but his injuries proved to be fatal since his airplane had broken at the cockpit area and had sent chunks of metal tearing into his body. On November 8, visiting RAF officer Geoffrey D. Stephenson was killed at Elgin AFB when his F-100A went out of control and crashed. On November 9, Major Frank N. Emory's F-100A (52-5771) went out of control and crashed during a practice gunnery mission over Nevada. Fortunately, Major Emory was able to eject safely. On November 10, the USAF grounded the entire F-100A fleet, which by this time numbered about seventy aircraft. A further 108 Super Sabres had been completed and were awaiting delivery at the factory.

After an exhaustive investigation, the source of the F-100A's stability problems was traced to its new shorter tail, which USAF test pilots had suspected all along. A decision was made to switch back to the original taller tail of the YF-100A. 27 percent more vertical tail area was added, which served to delay the onset of instability to speeds above Mach 1.4, which were outside the F-100A's performance envelope. The aspect ratio of the vertical tail was also increased. With these changes, the height of the modified F-100A increased to 15.34 feet. The wingtip extensions planned for the F-100C were adopted as standard for the F-100A, increasing the wingspan from 36.78 feet to 38.78 feet and the wing area from 376 square feet to 385.21 square feet. The artificial feel systems for the aileron and stabilizer powered controls were modified.

These changes seemed to do the job, and the existing F-100As were retrofitted with the changes. The first aircraft to complete the modification program was the 34th Super Sabre, and the first batch of 11 modified aircraft was delivered to NAA Engineering Flight Test. Because of the rapid rate at which production had been built up, it was not

Well into the XP-86 test program, George posed in civilian garb with a Sabre. Where one earth, did he get that suit and bow tie?! After the F-86 was deployed to Japan and South Korea, Welch was sent to Japanese and South Korean fighter bases to perform demonstration flights for new Sabre pilots. According to his youngest son, Jolyon Welch, George wormed his way into flying combat missions. During these missions, Welch is said to have "unofficially" dispatched as many as six MiG-15 fighters in less than 20 sorties! When veteran F-86 pilots were asked if they knew anything about Welch flying in combat, the general response stayed very close to one pilot's answer; "Wheaties preferred to observe his students while on the job." The Air Force has never officially commented on George's training habits.

Having taken the prototype YF-100 Super Sabre (there was no XF-100) supersonic on its first flight on May 25, 1953, Welch reinforced all claims to his being the first man through the sound barrier. This was typical Welch behavior. Unfortunately, George cannot testify for himself. On Columbus Day of 1954, Welch was performing a demonstration flying the new F-100A. His flight card called for a symmetrical pull-up at 1.55 Mach. The maneuver would generate more than 7 Gs. As he began the maneuver, the airflow over the wing suddenly burbled, completely blanking the newly redesigned and smaller vertical stabilizer. The fighter yawed slightly and then suddenly turned partially sideways to the direction of travel. The nose folded up at the windscreen and crushed Welch in his ejection seat. Miraculously, the seat fired and carried Welch clear of the plane as it disintegrated. Ejecting at supersonic speeds is not only hard on the human body, it's hard on parachutes as well. Welch's chute was nearly shredded by the violent blast of air. With many panels blown out, the rate of descent was much too fast to avoid serious injury, or even death. When rescuers arrived at Welch's side, he was barely alive. He died before he could be transported to a hospital. Ironically, Yeager had complained that the F-100A, with its smaller vertical stabilizer, was dangerously unstable. Welch elected to fly it anyway.

In a span of just under 14 years, George Welch had established himself as one of America's greatest aviators. His remarkable accomplishments in World War Two would be enough to cause people to remember him in both books and films. Adding in his

~~RESTRICTED~~ (WHEN FILLED IN)

RE___RT OF AF AIRCRAFT INCIDENT ~~ACCIDENT~~

Use this form in accordance with AF Reg. 62-14 and AF Manual 62-5, "Aircraft Accident Investigators' Handbook." Fill in all spaces applicable. If additional space is needed, use additional sheet(s) and identify by proper section letter and subsection number

11-5 / 6

Section A—GENERAL INFORMATION

A-15-L

1. Place of Accident: State, county, nearest town—Distance and direction to accident: Calif., L. A., Lancaster, 3/4 Mi SE Rosamond Dry Lake
2. Nearest Airport Suitable for landing this plane. Distance and direction to accident: 10 Miles SW AF Plant #42, Palmdale, Calif.
3. Elevation Above S. L. at accident scene: 2241
4. Date of Accident: 12 Oct 54
5. Hour and Time Zone: 1102 PST
6. [X] Day [ ] Night [ ] Dawn [ ] Dusk
7. List Numbers of All Other Aircraft Involved (File separate Form 14 for each aircraft): None
8. [X] Incident to Flight [ ] Not Incident to Flight
9. Classification of Accident: [ ] Major — INCIDENT
10. Clearance: [ ] IF [X] VF [X] Local [ ] Other
If Other— From: To:
11. This was a: [ ] CAP Flight [ ] Air Reserve Flight [ ] ANG Flight [X] Other
12. [ ] Fire Occurred Before Accident [X] Fire Occurred After Accident [ ] Fire Did Not Occur
13. Airfield of Last Takeoff: AF Plant #42 Palmdale, Calif.
14. Duration of Flight Since Last Takeoff: T/O 1045 00:17
15. Mission of Flight (Form 1 Symbol): X-1
16. Activity Aircraft Was Engaged in Just Prior to Accident: Structural Demonstration

Section B—AIRCRAFT

1. Aircraft No.	2. Type, Model, Series and Block No.	3. Major Command	Subcommand	AF Wing
52-5764	F-100A-1	AMC	SMAMA	--

4. ____ Technical Orders affecting this aircraft were not complied with at time of accident. (List number and title of these T. O.'s on separate sheet.)

Group Number and Type	Squadron or Unit	Base
—	—	NAA Palmdale, Calif.

Section C—OPERATOR (Person at controls at time of accident)

1. Last Name (Jr., II, etc.)	First Name	Middle Name	Grade	Component	Serial No.	Nationality and Race	Year of Birth
Welch, Jr.	George	Schwartz	Civilian			USA Cau.	1918

2. Assigned Base: North American Aviation, Inc., Los Angeles International Airport, Los Angeles 45, Calif.

3. Attached Base for Flying	Major Command	Subcommand	AF Wing	Group No. and Type	Squadron or Unit
--AGLE	--AMC	--	--	--	--

4. Original Aeronautical Rating and Date Received: Pilot - Unknown
5. Present Aeronautical Rating and Date Received: Commercial Pilot 71260-41 SEME L & Inst
6. Primary Duty Assignment: Senior Engr Test Pilot

OPERATOR'S FLYING EXPERIENCE (Including Civilian) 5428

7. Type of Instrument Card: CAA — Expiration Date	1/4/55
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours	3702:25
9. Total 1st Pilot Hours	3702:25
10. 1st Pilot Hours Last 90 Days	35:55
11. 1st Pilot Hours Last 30 Days	15:35
12. 1st Pilot Hours This Model (B-25, F-51, etc.)	114:25
13. Other Pilot Hours (CP, C, SC) This Model	
14. 1st Pilot Hours Last 90 Days This Model	24:30
15. 1st Pilot Hours Last 30 Days This Model	11:15
16. Total Time Spent in Air During 24 Hrs. Prior to Accident	1:20

17. List by Type and Model 1st Pilot Experience in Similar Aircraft (e. g., B-26, 50 hrs.): A 301:01; F 105:34; F 77:25; H 12:05; XF-86 141:15; F-106:51

18. Was Operator on Instruments at Time of Accident or Immediately Before? [X] No [ ] Unk [ ] Yes: [ ] Hood [ ] Weather
If above answer is "Yes" or if accident occurred at night or during IFR weather or unknown conditions, fill in items below.

19. Total 1st Pilot Instrument Weather Hours	—
20. Total 1st Pilot Instrument Hood Hours	—
21. 1st Pilot Instrument (Weather and Hood) Hours Last 6 Months	—
22. 1st Pilot Instrument (Weather and Hood) Hours Last 90 Days	—
23. 1st Pilot Night Hours Last 6 Months	—
24. 1st Pilot Night Hours THIS MODEL Last 60 Days	—

Section D—PERSONNEL INVOLVED (Including operator and all other persons, whether in plane or not)

Duty at time of accident (1)	Name (Last name first) (2)	Type of Aero. Rating (Symbol) (3)	Serial No. (4)	Grade and Branch of Service (5)	Component (See AFM 62-5) (6)	Organizational Assignment Command, Subcommand, Group Number and Type, Base (7)	Fatal, Major, Minor, None, Missing (8)	Parachute Used Yes (9)	No (10)
Pilot	Welch, George S., Jr.	PILOT	-	Civilian	-	North American Avn., Inc.	Fatal	X	

AF FORM 14 8 JUN 49 — Previous editions are obsolete. Replaces AF Form 14A, 1 Jan 48, which is obsolete.

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Section E—RATED PERSONNEL AT OTHER SET OF DUAL CONTROLS (Instructor, Copilot, etc.)

1. Last Name (Jr., II, etc.) | First Name | Middle Name | Grade | Component | Serial No. | Nationality and Race | Year of Birth

2. Assigned Base | Major Command | Subcommand | AF Wing | Group No. and Type | Squadron or Unit

3. Attached Base for Flying | Major Command | Subcommand | AF Wing | Group No. and Type | Squadron or Unit

4. Original Aeronautical Rating and Date Received | 5. Present Aeronautical Rating and Date Received | 6. Primary Duty Assignment

FLYING EXPERIENCE (Including Civilian)

7. Type of Instrument Card ______ Expiration Date ______
8. Total Pilot (1st Pilot, Copilot, Command Pilot, etc.) Hours
9. Total 1st Pilot Hours
10. Total Hours, ☐ IP ☐ CP ☐ C (Check applicable one)
11. Pilot Hours Last 90 Days
12. 1st Pilot Hours Last 90 Days
13. Hours Last 90 Days, ☐ IP ☐ CP ☐ C
14. Pilot Hours Last 30 Days
15. Total Pilot Hours This Model (B-25, F-51, etc.)
16. 1st Pilot Hours This Model
17. Hours This Model, ☐ IP ☐ CP ☐ C
18. Total Pilot Hours This Model Last 90 Days
19. 1st Pilot Hours This Model Last 90 Days
20. Hours This Model Last 90 Days, ☐ IP ☐ CP ☐ C

21. List by Type and Model: ☐ IP ☐ CP ☐ C Experience in Similar Aircraft (e.g., B-26, IP, 50 hrs.)

Fill in items below if Instrument and Night Experience of Operator was listed in Section C

22. Total 1st Pilot Instrument Weather Hours
23. Total 1st Pilot Instrument Hood Hours
24. 1st Pilot Instrument (Weather and Hood) Hrs. Last 6 Months
25. 1st Pilot Instrument (Weather and Hood) Hrs. Last 60 Days
26. Total Pilot Night Hours Last 6 Months
27. 1st Pilot Night Hours Last 6 Months
28. Night Hours Last 6 Mos., ☐ IP ☐ CP ☐ C
29. Total Pilot Night Hours This Model Last 60 Days
30. 1st Pilot Night Hours This Model Last 60 Days
31. Night Hrs. This Model Last 60 Days, ☐ IP ☐ CP ☐ C

Section F—DAMAGE

1. Describe Briefly in General Terms the Extent of Damage to the Airplane, Engines, and Propellers.

The aircraft disintegrated in the air and received further damage by impact on the desert. The engine and large section of aft fuselage burned upon impact.

2. Check Proper Damage Classification

None	
Minor	
Substantial	
Destroyed	X

3. ☒ Plane or Wreckage Was Returned to an AF Base NAA, L.A.
☐ Plane or Wreckage Was Left at Scene of Accident

4. Is Plane Damaged Beyond Economical Repair? ☒ Yes ☐ No

5. If Plane Is To Be Repaired, Give Engineering Officer's Estimate of Number of Man-Hours Required for Repair: ______ Man-Hrs.

6. Was Private Property Damaged? ☒ Yes ☐ No
If "Yes," Describe Damages on Separate Sheet Attach. No. 13

7. Give below a considered estimate of cost of this accident to the Air Force:

Cost of Damage to Aircraft	$1,454,283.75
Cost of Damage to Other Government Property	$ None
Cost of Damage to Private Property	$ Unknown
Cost of Injuries	$ None
Cost—Other (Explain)	$ None
Total Estimated Cost of Accident	$1,454,283.75

Section G—SPECIAL EQUIPMENT

1. Check items of special equipment which affected the accident.
☐ Radios ☐ Armament ☐ De-icers ☐ Equipment for Clear Vision from Cockpit
☐ Instruments ☐ Fire Extinguishing Equipment in Plane ☐ JATO ☐ ______

2. Describe Briefly How the Use, Nonuse, Misuse, or Absence of Special Equipment Affected the Accident

Section H—WEATHER (At time and place of accident)

Ceiling	Visibility	Wind Direction and Velocity	Temp.	Dew Point	Other Weather Conditions
Clear	40	SW 7	87	34	None

If weather other than unfavorable wind conditions for takeoff, landing, or taxiing, was a factor in the accident, attach statement of weather officer describing climatic conditions and how they probably contributed to accident.

Section I—CHECK LIST FOR ATTACHMENTS

☒ Form 1 ☒ Clearance ☒ Photographs ☒ Form 14C
☒ Form 1A ☐ Crew Members' Statements ☒ Form 14A ☐ Form 14D
☒ List of T.O.'s Not C/W ☒ Witnesses' Statements ☒ Form 14B ☒ Form 14E
☐

Section J—ACCIDENT TYPE

Check one accident type as "Primary." Check all others applicable as "Secondary."

Primary	Secondary	
		Ground or Water Loop
		Wingtip Landing
		Wheels-Up Landing
		Hard Landing
		Collapse or Retraction of Landing Gear
		Undershoot
		Overshoot
		Nose Up or Nose Over
		Collision With Other Aircraft
		Collision With Ground or Water
		Other Collisions
		Spin or Stall
	X	Fire on Ground
	X	Fire and/or Explosion in Air
X		Airframe Failure in Flight
		Abandoned Aircraft
		Prop or Jet Blast Accident
		Other (List):
		Undetermined

Section K—PHASE OF OPERATION

(Check only ONE)

	Taxiing Incident to Flight
	Take-Off
X	In Flight
	Landing
	Go Around
	Engine Running—Not Taxiing
	Ground Operations
	Undetermined

Section L—CONDITIONS AFFECTING ACCIDENT

(Check all applicable)

	Immediate Forced Landing
	Precautionary Landing
	Fuel Exhaustion
	Engine Stoppage
	Lost
	Pertinent T.O.'s Not Complied With
X	Other (List): Excessive Yaw

Section M—VIOLATIONS

(Check all applicable)

	Improper Taxiing Procedure
	Failure To Use Checklist
	Unauthorized Low Flying
	Instrument Flying on VFR Clearance
	Unauthorized Formation
	Other (List):

Section N—CAUSE FACTOR ANALYSIS

Check one specific cause as "Primary." Check all others applicable as "Secondary." (See AFM 62-6 for definitions)

1. ERRORS OF AIR CREW

Primary	Secondary	
		Misused Power Plant or Power Plant Controls
		Misused Brakes and/or Flight Controls on Ground
		Improper Use of Flight Controls in Air
		Exceeded Stress Limits of Aircraft
		Inattentive To Fuel Supply or Fuel Selector Valves
		Failed to Extend or Retract Landing Gear Properly
		Selected Unsuitable Terrain or Runway for Takeoff or Landing
		Failed To Compensate for Wind Conditions
		Misjudged Distance
		Failed To Level Off Properly
		Failed To Observe Other Aircraft or Objects
		Failed To Maintain Adequate Flying Speed
		Became Lost (Weather average or above)
		Continued VFR Flight Into Unfavorable Weather
		Improper Operation on Authorized Instrument Flight
		Operated Aircraft in Reckless Manner
		Made Inadequate Flight Preparations
		Attempted Flight Beyond Ability or Experience
		Failed To Use or Incorrectly Used Miscellaneous Equipment
		Other (List):

2. ERRORS OF OTHER PERSONNEL

Primary	Secondary	
		Aircraft Inadequately Maintained
		Aircraft Improperly Cleared for Flight
		Weather Incorrectly Forecast
		Improperly Operated Arpt/Airway Facilities
		Improperly Supervised Training (Ground Personnel)
		Improperly Supervised Training (Flight Instructors and Flight Leaders)
		Other (List):

3. MATÉRIEL FAILURE—POWER PLANT

Primary	Secondary	
		Cooling System
		Lubricating System
		Fuel System
		Engine Structure (Includes Jet Engines)
		Engine Control System
		Propeller and Propeller Accessories
		Supercharger (Reciprocating Engine only)
		Ignition System
		Engine Accessories
		Other
		Undetermined

4. MATÉRIEL FAILURE—AIR FRAME

Primary	Secondary	
		Flight Control System
		Wings, Rotors, and Flaps
		Cowling and Fairing
		Fuselage
X		Other Multiple nearly simultaneous failure of numerous airframe components.
		Undetermined

5. MATÉRIEL FAILURE—LANDING GEAR

Primary	Secondary	
		Main Landing Gear
		Nose Wheel or Tail Wheel
		Landing Gear Position Indicators
		Brakes
		Tires
		Other:
		Undetermined

6. MATÉRIEL FAILURE—EQUIPMENT AND ACCESSORIES

Primary	Secondary	
		Automatic Pilot
		Radio Equipment
		Electrical System
		Hydraulic System
		Oxygen or Pressurization System
		Safety Equipment
		Instruments
		Cockpit, Seat, Canopy, Fittings, Doors, Hatches
		Armament
		Other:

7. WEATHER

Primary	Secondary	
		Low Ceiling
		Smoke—Haze
		Rain—Fog
		Snow—Hail
		Icing Conditions
		Unfavorable Wind Conditions for Landing, Taxiing, or Takeoff
		Turbulence in Flight
		Winds Aloft
		Thunderstorms
		Downdraft Updraft
		Other:

8. LANDING AREA

Primary	Secondary	
		Wet
		Soft
		Snow
		Ice
		Rough
		Glassy
		Runway Too Short
		Other Hazard:

9. GROUND EQUIPMENT

Primary	Secondary	
		Airport Facilities
		Airway Facilities
		Arresting Devices
		Launching Devices
		Other:

10. MISCELLANEOUS

Primary	Secondary	
		Bird in Flight Path
		Shot-Off Target in Flight Path
		Other:

11. UNDETERMINED

RESTRICTED (WHEN FILLED IN)

[redacted] (WHEN FILLED IN)

Section O—DESCRIPTION OF ACCIDENT

Tell in narrative form, in as much detail as necessary, everything that is known about the accident. Make certain that items checked on reverse side are justified by this narrative. If fire was involved in accident, explain in detail its origin and progress and steps taken to extinguish it.

On 12 October 1954 at 1045 hours PST, civilian engineering test pilot George Schwartz Welch, Jr., took off on a structural demonstration flight in an F-100A. Subject aircraft was on bailment to North American Aviation, Inc. Serial number of the aircraft was 52-5764. The weather was clear with visibility 30 miles. Take-off and climb out was apparently normal. The pilot was over Rosamond Dry Lake at 47,000 feet and transmitted to the Palmdale Control Tower that he was going into a scheduled test dive. At 22,500 feet, the aircraft was attempting to pull out at a mach of over 1.5 and an indicated air speed of 690 knots. A large ball of fire was noticed in the air and parts of the aircraft were observed falling. Investigation of the wreckage indicated thru oscillograph data that the aircraft was in a high yaw (16°) attitude and had attained a "G" force between 6 and 8.5 "G's". The aircraft disintegrated in flight at 1102 hours PST and the pilot was either drawn or thrown from the plane after receiving major injuries. The parachute of the pilot and tail section both opened and two panels in the pilot's parachute were torn. Mr. Welch was tangled in the risers and contacted the ground in a head down position. The wreckage of the aircraft was scattered over a large area. The pilot was picked up by a rescue helicopter and taken to Edwards AFB Hospital. At the time of pick-up, the pilot was unconscious as he was lifted into the helicopter. Mr. Welch died a few minutes later enroute to Edwards Air Force Base.

THE FINDINGS ARE AS FOLLOWS:

1. Aircraft was on bailment to NAA, Inc., for the purpose of conducting structural integrity demonstration tests.
2. The aircraft was piloted by a properly qualified and cleared civilian test pilot.
3. The subject flight was one of a series of structural integrity demonstration tests.
4. The purpose of the subject flight was to perform a symmetrical pull-up at the maximum possible mach number and a load factor of at least 7.33 positive "G's".
5. The flight was performed as programmed except that during the course of the dive the aircraft yawed beyond the design limitations at the speed attained and subsequently disintegrated.
6. There is insufficient data available in any form regarding the stability of the aircraft in the mach range of 1.2 and higher.
7. The pilot either could not or did not use the escape provisions as provided in the aircraft.
8. The pilot was fatally injured during the aircraft disintegration and was either drawn or thrown from the aircraft.
9. The parachute was probably opened by the airblast of either the parachute pack or the ripcord.
10. There was nothing in the pilot's physical condition or emotional make-up that contributed to the accident.

RECOMMENDATIONS for action to prevent similar accidents:

1. An engineering study program should be immediately inaugurated by WADC to include flight tests and wind tunnel tests to evaluate the overall stability characteristics of the aircraft.

2. All presently imposed flight restrictions should be reviewed as soon as possible to determine their adequacy.

B (1f-A)

Section P—AUTHENTICATION (Each investigating board member must sign below)

1. ☐ Personnel Responsible for This Accident Have Been Offered Opportunity of Rebuttal ☐ No Rebuttal Rec'd ☐ Rebuttal Statement(s) Attached

2. Personnel Responsible Not Available Because of: ☐ Death ☐ Critical Injury ☐ Other (Explain)

Base Submitting Report	Member (Name and Grade)	Medical Officer (Name and Grade)
AFPR, North American Avn., Inc. Los Angeles 45, California	THEODORE S. COBERLY, Major, USAF	[illegible] Captain, USAF (MC) F/S
President (Name and Grade)	Aircraft Accident Officer (Name and Grade)	Recorder (Name and Grade)
ROY R. TURNQUIST, Major, USAF	WILLARD A. WENDT, Major, USAF	ARTHUR T. STEMERMANN, Capt, USAF

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[redacted]

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON

CLASSIFICATION [illegible] [redacted]

Office of The Inspector General, USAF
Norton Air Force Base
San Bernardino, California

AFR 205-1 para 37A
BY M. Vail 21 Oct 60

23 NOV 1954

Report of Special Investigation of Aircraft Incident Involving F-100A-1-NA, Serial No. 52-5764A, near Edwards Air Force Base, California, on 12 October 1954

THE INCIDENT

1. (Unclassified) On 12 October 1954 at 1101 Pacific Standard Time (PST), F-100A-1-NA, Serial No. 52-5764A, assigned to the Air Materiel Command (AMC), Wright-Patterson Air Force Base (AFB), Ohio, and on bailment to North American Aviation, Incorporated (NAA), disintegrated in flight while performing a structural integrity demonstration test. The aircraft wreckage covered an area approximately two square miles, 15 miles southwest of Edwards AFB, California. The civilian test pilot received fatal injuries.

CONCLUSIONS

2. (Confidential) It is concluded that:

a. The primary cause of the accident was airframe structural failure. The failure was the result of a high angle of yaw beyond the aircraft design limits during a structural integrity demonstration test dive (see paragraphs 11 and 14).

b. There are insufficient data available regarding the stability of the F-100 aircraft in the speed range above 1.2 Mach (see paragraph 19).

c. There are insufficient data available to establish the aerodynamic load distribution for the design of aircraft structural integrity at Mach numbers above 1.2 (see paragraph 19).

d. An immediate engineering and flight test program is required to determine engineering changes necessary for correcting known flight instability characteristics of the F-100 aircraft (see paragraph 19).

[redacted]

54SM [illegible]

5.

[redacted]

e. An analysis should be made of the present rudder on F-100A aircraft to determine adequacy of design for deflection and permanent set under loads experienced in flight (see paragraph 18).

RECOMMENDATIONS

3. (Confidential) IT IS RECOMMENDED THAT THE COMMANDER, AIR RESEARCH AND DEVELOPMENT COMMAND:

a. Expedite establishment of an engineering and flight test program to determine engineering changes necessary to correct flight instability characteristics of the F-100 aircraft (see paragraphs 15 and 19).

4. (Confidential) IT IS RECOMMENDED THAT THE COMMANDER, SACRAMENTO AIR MATERIEL AREA:

a. Expedite incorporation, in production and in-service aircraft, of engineering changes necessary to correct instability characteristics of F-100 aircraft (see paragraphs 15 and 19).

ACTION TAKEN

5. (Confidential) Message, SMRL-10-484-E, dated 25 October 1954, was sent from the Air Force Plant Representative (AFPR), NAA, to the Commander, Sacramento Air Materiel Area (SMAMA) recommended that F-100A aircraft be restricted to a maximum airspeed of 1.4 Mach pending further engineering study of directional stability problems. Safety of Flight Supplement, Interim Technical Order, 1F-100A-1M, dated 9 November 1954, supplemented existing airspeed limitations, and prohibited operation at airspeeds in excess of 1.4 Mach pending further study of this difficulty.

6. (Unclassified) Message SMRLQ-10-485-E, dated 25 October 1954, from the AFPR, NAA to SMAMA listed inspection and repair procedures for pulled or loose cherry rivets in vertical stabilizers of F-100A aircraft.

7. (Unclassified) Message SMRL-10-382-E, dated 18 October 1954, from the AFPR, NAA to SMAMA recommended inspection of all F-100A aircraft in service to insure correct installation of the radar access hood, Part No. 192-31002, and to detect cracks in hood hinges, Part No. 180-31093.

8. (Unclassified) Unsatisfactory Reports (UR), Station Serial Nos. 54-1712 and 54-1526, have been submitted by the Air

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Force Flight Test Center, Edwards AFB, California, on the F-100 aircraft rudder assembly, Part No. 1AML-192-24001.

9. (Unclassified) The recommendation contained in paragraph 3 of the report has been forwarded by letter to the Commander, Air Research and Development Command for consideration and reply.

10. (Unclassified) The recommendation contained in paragraph 4 of the report has been forwarded by letter to the Commander, Sacramento Air Materiel Area for consideration and reply.

HISTORY OF FLIGHT

11. (Confidential) The aircraft departed Palmdale Municipal Airport, Palmdale, California, at 1046 PST on a structural integrity demonstration test flight. The purpose of the flight was to perform a symmetrical pull-up at a Mach number of 1.69 with a load factor of at least 7.33 G's. At approximately 1100 PST, the pilot radioed the Palmdale Municipal Airport Control Tower and stated that he was over Rosamond Dry Lake, California at 47,000 feet and ready to proceed with the test. The aircraft was observed to be on a heading of approximately 235 degrees at the time the radio call was made. Immediately thereafter a tight peel-off to the left was executed and the aircraft entered a steep dive on a heading of approximately 150 degrees. The dive angle remained steady to approximately 22,700 feet where the aircraft disintegrated during the high G pull-out. Pieces of aircraft structure and two parachutes were observed descending after the disintegration. One of the parachutes was the aircraft's drag chute; the other parachute was the pilot's chute with the pilot suspended from it. The pilot and the aircraft components landed in open desert terrain. The pilot succumbed as a result of injuries sustained during the aircraft disintegration.

INVESTIGATION AND ANALYSIS

12. (Unclassified) The aircraft wreckage was distributed over an area of approximately two square miles. The aircraft disintegrated into several major components, the fuselage nose section, cockpit, engine section, right and left wings, right and left horizontal stabilizer, rudder, parts of the vertical stabilizer, and pieces of the cockpit. Several of the first portions of the wreckage located along the flight path were skin of the vertical stabilizer and right wing, several pieces of the canopy, left landing gear door, and parts of the radar door and left wing. The engine with the aft fuselage attached was located farthest along the flight

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path. The entire aircraft, except for minor small pieces, was accounted for.

13. (Confidential) Examination of the aircraft components revealed the landing gear, wing flaps, and speed brake to be in the retracted position. A study of the various fractures and deformation of the aircraft wreckage showed that the right and left wing failed in a downward direction, the left stabilizer failed at the root connection from downward loads, and the right stabilizer failed at the root from upward loads. The top fitting of the rudder and lower part of the fin failed from loads acting on the rudder in a direction from left to right. The forward fuselage section from Station 0 to Station 106 failed downward and to the right. The unpressurized fuselage well section to the right of the pilot's cockpit revealed evidence of an internal explosion.

14. (Confidential) An oscillograph had been installed in the aircraft to record flight conditions of aircraft attitude, control surface movements, applied control pressures, speed, altitude, and yaw. Film from the oscillograph was recovered, developed and recorded. A very striking condition was noted in the trace recording of aircraft yaw. The aircraft entered the structural integrity dive with a two degree right yaw. As the aircraft approached the maximum indicated airspeed of 672 knots, yaw was approximately three degrees to the right. During the pull-out, as the G force acceleration increased, the yaw progressively increased until at a value of 8.6G the angle of yaw was 8½ degrees. Approximately one second after attaining 8.6G, the yaw angle to the right increased to approximately 16 degrees and acceleration decreased to approximately 5G. This yaw force was either pilot induced or was caused by unsymmetrical or extreme distortion and deflection of the aircraft fuselage structure. Loss of an aircraft component or inherent lateral instability might have also contributed to the violent yaw. The aircraft's excessive right yaw evidenced by the traces on the oscillograph record is substantiated by the manner in which the aircraft disintegrated. Disintegration of the aircraft occurred when the structure could not withstand the loads imposed by high speed, high dynamic pressure, and excessive yaw.

15. (Confidential) One of the possibilities for yaw is the asymmetric extension of the wing slats. Each wing slat is composed of five interconnected sections. Performance data show that at high values of lift coefficient of the wing, the drag of the wing is lower with the slats extended. These data, however, are for lower speeds and no information is available on slat

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performance at higher speeds. Tests should be conducted to determine the action of slats at high Mach number and high accelerations.

16. (Unclassified) The three inboard slat sections of the left wing were not attached to the wing when located. Analysis of the separation of the slats from the wing disclosed the wing slats separated from the wing in a forward direction. The normal movement of the slat in the track is forward and downward. From this it is deduced that the separation of the slats from the wing was caused by a combination of aerodynamic and acceleration forces and loss of the slat was a result rather than a contributing factor to the accident.

17. (Confidential) The forward fuselage section from Station 0 to Station 106 failed from G force acceleration and dynamic pressure when the aircraft was in the yaw to the right. Evidence of paint smears, imbedded metal, and deformation of the surface of the Nos. 4 and 5 slats of the right wing, disclosed they had been struck by the radar hood located on the nose section of the fuselage. The explosive damage to the right unpressurized well in the area of the cockpit could have been caused by the force of ram air entering this area when the nose section separated from the aircraft. The contractor should investigate the deflection characteristics and strength of this forward section for conditions that would parallel those in the structural demonstration tests, but with the added factor of several degrees of yaw. It was considered likely that because of deflection of the nose, under the forces of right yaw and downward acceleration, the forward fuselage section would deflect, resulting in more yaw to the right. This in turn would result in more load on the fuselage nose section, until the structure reached its ultimate load absorption and failed. This aeroelastic behavior should be investigated by the contractor.

18. (Confidential) The F-100A vertical stabilizer and rudder surfaces were designed and tested for a load criteria resulting from an eight degree yaw at 0.8 Mach number. If loads resulting from the yaw during the pull-out were in excess of this value, the pilot's effort to correct for right yaw would create loads greater than these for which the rudder was designed. This would fail the top part of the rudder in a direction from left to right as it actually failed. With the loss of rudder effectiveness, the aircraft would continue to yaw until disintegration occurred. The trailing edge of the rudder had been subjected to severe buffeting before failure. Retrofit of aircraft for rudder adequacy is dependent upon the findings of studies to be conducted by the manufacturer.

~~CONFIDENTIAL~~ M. Vail AFP 205-1 para 3-11 21 Feb 64

19. (Confidential) Because of deflection of the aircraf at high dynamic pressure and at high speeds above 1.2 Mach, the distribution of loads may shift from the theoretical values assumed for design, which were based on wind tunnel tests only for a Mach of 1.2. An unfavorable variation of load distribution could strain the aircraft to loads greater than originally calculated, and permanent set might occur below the limit load factor. An unsymmetrical deformation caused by variations in manufacture, as well as in maneuvering, could cause control instability. A program to instrument an aircraft to obtain load distribution and deflection at the higher speeds and dynamic pressures would establish the degree to which original values of design are correct. In addition to the above, there is no stability data on the aircraft for values above 1.2 Mach. The manufacturer's stability and control flight tests for higher than 1.2 Mach have not been completed.

20. (Unclassified) Examination of the engine, engine accessories and afterburner indicated that at the time of the accident the engine was developing full power with afterburner augmentation. The hydraulic and electrical systems evidenced no malfunction or failure. Measurement of the hydraulic cylinder for the horizontal stabilizer corresponded to the correct setting for a pull-out maneuver. The above items and maintenance of the aircraft were not cause factors in the accident.

21. (Unclassified) The pilot did not have sufficient time in which to use the normal canopy and seat jettisoning mechanisms to escape from the aircraft. It is indicated that the canopy came off as a result of fuselage structural failure. The pilot's lap belt release mechanism had been manually opened either by the pilot or by being struck by a foreign object. It is most probable that the pilot was thrown from the cockpit when subjected to the negative G forces that failed the wings. After leaving the aircraft the pilot's parachute was deployed and opened by the dynamic air forces.

22. (Unclassified) Examination of the pilot's flight records revealed that he was adequately qualified to perform the mission. He had been an engineering test pilot for NAA since 1944 and possessed a total of 3702:00 hours flying time, including 943:00 hours in jet fighter type aircraft. He had flown the F-100A for a total of 114:00 hours. Weather was not a factor. At the time of the accident, the weather was clear with 40 miles visibility.

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by Unif ... 21 Oct 60

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SUBSTANTIATING DATA ON FILE IN THE DIRECTORATE OF FLIGHT SAFETY RESEARCH

23. (Unclassified) The following substantiating data pertaining to special investigation of aircraft incident involving F-100A-1-NA, Serial No. 52-5764A, are on file in the Directorate of Flight Safety Research and can be examined upon request:

a. Incident statistics

b. Orders directing the investigation

c. List of personnel participating in the investigation

d. Statements of incident witnesses

e. Control tower operator's statement

f. Investigating board proceedings

g. Messages SMRL-10-484-E, dated 25 Oct 54; SMRL-10-382-E, dated 18 Oct 54; and SMRLQ-10-485-E, dated 25 Oct 54, from the Air Force Plant Representative at NAA to SMAMA

h. Unsatisfactory Reports Station Serial Nos. 54-1712 and 54-1526, on rudder assembly Part No. 1AML-192-24001

i. Statements on examination of emergency escape equipment and pilot's parachute.

j. Medical examiner's statements and Forms 14A and 14B

k. AF Form 14E, Report of Emergency Parachute Jump

l. List of technical orders not complied with

m. Weight and balance

n. AF Form 14C, Engineering Officer's Report

o. Aircraft Forms 60A and 60B, and flight and maintenance records

p. Bailment agreement and procurement specification for flight testing aircraft

q. Estimate of private property damage

r. Weather report

M. Vail AFR 205-1 para 3 21 Oct 60

[redacted]

[redacted]

s. Report of crash investigating teams, NAA and WADC

t. Oscillograph record of flight

u. Map of incident area showing flight path of aircraft

v. Wreckage distribution

w. Photographs

RICHARD J. O'KEEFE
Brigadier General, U. S. Air Force
Director, Flight Safety Research
The Inspector General

m. Vail AFR 205-1 para 39A
21 Oct 60

[redacted]

ACCIDENT BOARD PROCEEDINGS

The meeting of the Aircraft Accident Investigating Board appointed by Letter Orders 7781, Hq SMAMA, dated 12 October 1954, was called to order at 1010 hours on 21 October 1954 to investigate the aircraft incident involving F-100A, Serial Number 52-5764. The following members were present:

Voting Members

Major R. H. Turnquist	Acting Board President
Major T. S. Coberly	Board Member
Major W. A. Wendt	Accident Investigating Officer
Captain A. T. Stemmermann	Board Member
Captain C. T. Terry	Medical Officer
1st Lt. J. J. Simpson, Jr.	Alternate Accident Investigating Officer

Non-Voting Members

Colonel P. P. Douglas	Directorate of Flight Safety Research
Captain C. W. Patterson	Directorate of Flight Safety Research
Mr. S. B. Berman	Directorate of Flight Safety Research
Mr. A. E. Hovey	IG SMAMA
Mr. E. L. Odem	IG SMAMA
*Mr. A. G. Coffman	Asst Director Plant Protection, NAA

Technical Advisors

Major G. L. MacDonald	WADC F-100 Project Officer
Mr. R. Hollingsworth	WADC
Mr. K. F. Hecht	WADC Aircraft Laboratory
Mr. L. B. Reynolds	WADC Structures Laboratory

*Mr. Coffman was voted in as a non-voting member during the testimony of Mr. Berman and was not present prior to that time.

The Board President stated the following, "All statements will be made a part of the record. If statements are pertinent to the accident, they should be recorded. It is requested that off-the-record comments or informal conversation be avoided. Everyone is requested to speak slowly and clearly and to state his name when interrogating the witnesses. If the recording secretary misses a statement, she will ask to have it repeated."

Each witness was advised as follows: "The purpose of this investigation is to determine all factors relating to the incident and in the interest of accident prevention to avoid recurrence. It is not the purpose of this board to obtain evidence for disciplinary action nor to determine pecuniary liability nor to revoke a commission or remove a person from the active list (as covered by AFR 36-2).

Each witness was sworn in with the following: "Do you swear that the evidence you give in the aircraft incident now under investigation shall be the truth the whole truth and nothing but the truth, so help you GOD?"

Major Turnquist: We will start the board of proceedings by calling the first witness. Major Wendt, will you please call the first witness?

Major Wendt: Major Turnquist, this is Captain Buck of the 93d Bomb Wing - He was in the B-47 and observed the flight.

Major Turnquist: Explained the purpose of the meeting as above.

Captain Buck was sworn in as a witness.

Major Turnquist: May we have your full name?

Captain Buck: Captain Wendell R. Buck.

Major Turnquist: Your organization?

Captain Buck: 93d Bomb Wing, Castle Air Force Base.

Major Turnquist: Your age?

Captain Buck: 30.

Major Turnquist: Your experience - You are a rated pilot in the Air Force?

Captain Buck: Yes, I am a rated pilot in the Air Force. I have been rated since 1943.

Major Turnquist: You were an eye witness to the accident, I believe. Would you please tell the board just what you saw.

Captain Buck: Starting right from when I first saw the airplane?

Major Turnquist: Yes, if you would please.

Captain Buck: I saw the airplane four or five minutes before he started to dive. He was parallel to our course. We were proceeding from San Bernardino up to Palmdale towards Bakersfield and Fresno. The reason we first noticed the aircraft was that we noticed the contrails he was leaving. We were at 25,000 feet, and we estimated him to be probably around 50 because of the pretty heavy contrails he was leaving. He was parallel to our course until we passed Palmdale radio and then two minutes after we passed Palmdale radio, he started a slight turn to the left. I would say that he was gradually passing in a normal turn and I would say he had completed about 60° of turn. Then there was an abrupt wing over and he reversed his course about 180°. That was when he started his dive. On his dive he came back towards our direction and came down at our right one or two miles off our right wing. He left contrails we estimated for about 16,000 feet of his dive. The contrails left a stream from 40,000. We were at 25,000 feet. We followed him because we happened to be able to see him when he started his dive and naturally coming straight down. At around 15,000 feet there was just a ball of fire with black smoke around it. Right after that we saw two chutes. There was a larger orange chute and to the left of it, a smaller white chute. The white chute looked like it was a little bit lower than the other one. Immediately after the explosion we called Palmdale radio, we happened to be on that frequency, and gave them the information. I guess that is about all.

Major Turnquist: What was the first indication that the airplane was in difficulty?

Captain Buck: None until the actual explosion.

Major Turnquist: That was the first indication? You didn't see any pieces of the airplane in the air, or other debris?

Captain Buck: No.

Major Turnquist: Did you see the attitude of the airplane when the explosion occurred?

Captain Buck: Actually, you couldn't see too much from our level. To the best of my knowledge, his wings were straight and level all the time.

Major Turnquist: After you saw him go into the dive, was there any pull-out?

Captain Buck: As far as I am concerned, I didn't see any type of pull out; that's about all.

Major Turnquist: Would any of the other members of the board like to question Captain Buck?

Major Coberly: I would like to clarify in my own mind the relative position of the ~~airplane. I understand from your testimony that he was initially paralleling your~~ course to the right, that he executed approximately 60° of turn to the left toward your course and after entering the dive was again paralleling your course, in the opposite direction to which your were going.

Captain Buck: Right. In other words, he was parallel in our course. He started to turn in front of us and way above us.

Lt. Simpson: You say you followed him - did you follow him with your eyes or your airplane?

Captain Buck: I followed him after the explosion and circled the area and saw the chutes open.

Lt. Simpson: Did you get off your course at any time?

Captain Buck: After the explosion.

Lt. Simpson: Were his wings straight and level?

Captain Buck: I could not say if they were straight and level - no indication from where we were.

Major Coberly: You stated in your testimony that as soon as you saw the two parachutes that it was your impression that the orange colored chute was above the white colored chute.

Captain Buck: Yes, the white chute was to the left and a little bit lower.

Lt. Simpson: Did you notice the airplane roll at all immediately prior to the explosion?

Captain Buck: No, it was not apparent.

Captain Terry: Did you at any time see the canopy leave the ship?

Captain Buck: No.

Captain Terry: Did it continue burning after the explosion?

Captain Buck: There was just a ball of fire. I saw just one piece. If there were other pieces, they were too small to see, they could have been on the other side of the ball of fire. There was smoke around the ball of fire and they may have fallen off the other side of the ball of fire. We were to the left but I do remember the one piece.

Lt Simpson: Did you follow the parachute down?

Captain Buck: Yes, as far as I could see it.

Captain Terry: Was there anything that give you the impression that the pilot was moving or were you able to actually see him?

Captain Buck: No.

Captain Terry: Was he in the chute?

Captain Buck: Yes, in the orange chute looked like the body of a man. I thought it might be in the seat but it was too long to be in the seat.

Mr. Hecht: Could you give an estimate, perhaps with respect to the plane falling and the distance between it and the chutes?

Captain Buck: I estimated the airplane to explode at 15,000 feet maybe between 15 and 20,000 and I saw the chute at 12 or 13,000 but it was below the ball of fire.

Major Turnquist: Captain Buck, did the ball of fire seem to completely envelop or did i precede or follow the airplane?

Captain Buck: It seemed to be the center of the airplane.

Major Turnquist: Any further questions? If not, you are excused and thank you very much. Should we keep Captain Buck available for further questioning? It would be appreciated. Captain Buck, if you stand by.

The nest witness was called.

Major Wendt: Major Turnquist, this is Captain Knapp, an eye witness to the accident, who was at the Flight Test Center (North American) when the accident occurred.

The witness was advised of the purpose of the investigation and was sworn in.

Captain Knapp: I am Robert H. Knapp.

Major Turnquist: You are, Captain Knapp, now assigned as an industrial trainee at North American, is that correct?

Captain Knapp: That is correct. We are on training with industry on a piloted weapons system, namely the F-100.

Major Turnquist: You are on training with the F-100, then. What is your age?

Captain Knapp: 32.

Major Turnquist: You are an officer in the U.S. Air Force and a rated pilot. How long have you been rated as a pilot?

Captain Knapp: Since November 1942.

Major Turnquist: Captain Knapp, would you tell us in your own words just what you saw?

Captain Knapp: Yes, sir, how far do you want me to go back? The entire incident? In other words, we were watching George take off for the flight. Previously we had watched him run the 50,000 test. We had listened on the radio to all of his conversation on that particular flight and when he went up on this structural demonstration flight, we were once again in the tower when he took off. It was a normal take-off and at the time, George requested to know if it should be an afterburner climb or not. It was a normal climb out to altitude. I could not see his contrail on this particular flight because we were on the second floor of the tower. Shortly after take-off, Mr. Richtor from Palmdale said that transportation was ready for us to go out to the runway to see the anti-skid tests. As we came around the corner of the building going up the ramp, sometime, I can't tie it down exactly. For some reason, I looked in the sky. I don't know whether I heard the sonic boom first or whether I looked up and felt it. I do feel that I felt the boom and then looked up and saw the explosion in the air. We immediately ran up to the fire truck which was on the north end of the ramp to try to attract their attention. Approximately two minutes later we were looking through glasses - the man along side of me was looking through glasses and we saw the two chutes. The most significant thing that I noticed first was the fact that I thought I saw a contrail that had tied right onto the explosion. In other words, tied right onto the end of the contrail was the explosion. In other words, this puts the contrail down at the explosion level. I could not tell at this particular time whether the contrail was level and the airplane had exploded in level flight or whether he was coming down - realizing now that we were 12 miles away from the explosion. It was hard to determine on a contrail whether it is coming down or not. Later in the day, I felt that if George was making his turn as prescribed that he was below contrail level so this would put what I thought was a contrail down below the level of a contrail. This is what I saw - other than seeing the pieces fall and observing one white chute. I did not see the orange chute or a chute of the other color - white - I did see. I estimate 15 minutes for the white chute to hit the ground.

Major Turnquist: Where did the explosion seem to take place in relation to the airplane? Did it completely envelope the airplane?

Captain Knapp: It is hard to say. My impression is that there was a stream with a small hook on the end of it and then a poof which was the explosion. I feel that I did see the airplane in the white puff. This is not positive - this is split second timing and I am not positive. But I am positive of a hook on the end of a smoke trail and I am positive of a lingering stream, whatever it might be.

Major Turnquist: Do any of the other members of the board have any questions?

Major Coberly: What was the position of yourself with relation to the direction of flight of the aircraft? Was the airplane coming toward you, crossing your path at right angles or what was the angle?

Captain Knapp: It would be hard for me to say. I would assume that he was going perpendicular to my line of sight. In other words, I saw the whole contrail with the hook on the end of it.

Major Coberly: Could you tell whether the contrail was completely perpendicular or was it at somewhat of an angle to you?

Captain Knapp: I couldn't tell. It was sometime afterwards that I analyzed what I had seen.

Major Coberly: Could you see any break in this contrail or did the contrail appear to be streaming?

Captain Knapp: I saw what appeared to be disruptions in the contrail or this stream similar to the way that gun fire - when you see them from behind they kind of puff out. It wasn't a real smooth textured contrail.

Major Coberly: Speaking principally of a deviation in the direction of a contrail, did the contrail appear to go like this (gestures) and then go like this (gestures)? Did he come across horizontally and then go down or - did it go across the sky? What is this hook that you describe?

Captain Knapp: The hook I definitely saw. I saw his flight path from some altitude down to the hook and the hook was horizontal. You could see his dive and then you could see this very little short hook, how large it was I don't know - a very short hook and then a puff.

Major Wendt: It is my understanding that later in the day you asked the weather station and asked about contrail altitude.

Captain Knapp: That is correct. If I remember correctly, he gave the 36 to 47,000 foot levels as the span for the contrail level. It might have been 32,000. I have it in my witness's statement.

Lt. Simpson: Would you say the hook came from his pulling out or while the plane was in level flight?

Captain Knapp: I would assume that the hook was his pullout. When I first saw it, it looked like a turn but I mean here is this contrail (gestures) and you see this little hook (gestures) which made me feel when I saw it that it was not a normal horizontal contrail because from the contrail level I couldn't see the turn on the end of it. From the position that I was to it, the contrail had to be coming in a downward flight of some degree. I wouldn't even estimate the angle of degree of the dive. It was definitely behind the airplane and with the hook on it. The hook was very short, very short in relation to the whole rest of the stream, behind the airplane.

Major Turnquist: Any other questions?

Captain Terry: I understand that you were present before take-off? You were familiar with the pilot?

Captain Knapp: Very much so. As much as I could be in the six months that I have been here.

Captain Terry: Was there any reason to believe that there was anything wrong physically or mentally with the pilot prior to take-off?

Captain Knapp: No, you bring up a point. George had just come down from his 50,000 foot mission, got off his partial pressure suit, and he had wanted to run on of these anti-skid tests. Part of the conversation that went on while he was in the air was the fact that should we run this test before lunch or after lunch? This was the anti-skid test. Previous to this time, previous to take-off, he went out in the normal hurried routine of a fighter operation. He was briefed, he knew exactly what he was going to do; he went directly to the airplane and while he was walking to the airplane we went into the mezzanine tower, the radio control room there. At this point he was taking-off. It was very quick, normal, routine flying out of Palmdale. Get these things done. He made the statement to me, well, he said, it will only take a couple of minutes to make this flight, then we can make the anti-skid landing. It appeared from my point of view that it was just a normal operating procedure. The talking that went on previous to his flights was entirely normal.

Major Turnquist: Any further questions? Will you be available throughout the day, Captain Knapp? If so, would you please let the secretary know where we might contact you?

Major Cowerly: I would like to make a note here - we should recall Captain Buck and ask him about the "hook" in the contrail as reported by Captain Knapp. I saw or heard no report of any streaming nor anything of that nature behind the airplane from the B-47 pilot, Captain Buck, as he left the contrail level. I don't believe we specifically asked him that question.

Major Wendt: This is Major Green, the AF Plant Project Officer at Air Force Plant 42, Palmdale.

Major Turnquist explained the purpose of the board and swore the witness in.

Major Green: I am Robert T. Green, Major, USAF.

Major Turnquist: What is your present title at Palmdale?

Major Green: Project Officer, AF Plant No. 42, Palmdale, California.

Major Turnquist: Your age:

Major Green: 31.

Major Turnquist: You are a major in the Air Force - a rated pilot - how long have you been rated as a pilot?

Major Green: 8 years.

Major Turnquist: You were present at Palmdale when the accident occurred: Did you actually witness the accident?

Major Green: No.

Major Turnquist: What action did you take after the accident was reported to you?

Major Green: Chronologically, I departed my office to our field operations and requested the tower to notify George and Edwards to request helicopter support. One fire engine was dispatched and the airport manager, Mr. Kitchings, departed for the scene of the accident. The ambulance was called in that Edwards ambulance and fire crash equipment had been dispatched. Two Navions had already departed from North American. I requested one to pick me up in front of the tower and then went to our tie line to the tower and stood by with our spotter who kept me informed as to the progress of the mission. The Navions made contact immediately with the pilot, rather they sighted him and followed him down. Two chutes were visible at this time. Originally, upon arrival at field operations I had the Palmdale radio notify flight service immediately. My preliminary report was a mid-air collision because of the two chutes. Again the Navion reported they had made contact with, circled the pilot and had landed the field near the pilot. About this time, we had another emergency reported, a YC-130 reported both outboard engines feathered, requesting emergency landing instructions, so I left field operations and went to a vantage point to coordinate this emergency landing. After that was taken care of, I returned to field operations and was notified that a helicopter had arrived and one Navion pilot had gone in the helicopter with Welch who was being taken to Edwards AFB. Shortly after that, we had the information that one of the Navions had cracked up on take-off. I notified North American Aviation and departed flight operations and went over to North American. Do you want me to continue along this line - a lot of this might not be relevant.

Major Turnquist: I think we should get along to anything you might have observed that might help us.

Major Green: I think that my personal observation would be nil as to the exact chronological happening in the air. In other words, the first thing that I witnessed was the two chutes in the far distance and the smoke from the crash which was extinguished a short time later. Other than the crash operations and into the first phase of the accident investigating, I have nothing.

Major Turnquist: We will then proceed with questions from the board members.

Major Coberly: At the time that you first saw the two chutes, could you differentiate any difference between the two chutes, as to appearance, etc.?

Major Green: Yes, there was a color difference. One was smaller and falling a little slower.

Major Coberly: At the first time you observed the, did one appear to be higher?

Major Green: I think the white one was a little higher. Since I was about 10 miles away I didn't spend much time watching the chutes, being occupied with other things.

Major Turnquist: Any other questions?

Major Wendt: One question, the contrail report was sent to us through your office; do you recall or do you know or did you find out what the contrail level was that day? We have not received them as yet.

Major Green: If I recall it was about 33-34,000 feet and I sent two copies to Major Turnquist via the NAA shuttle run. I did not maintain a copy so I do not have it for you today.

Major Turnquist: That will be all, Major Green, if you will remain in the area and please let the secretary know where we can reach you.

Captain Buck was recalled to the stand.

Major Coberly: After the time that the F-100 left the contrail level in his dive, did you observe any streamers from the airplane?

Captain Buck: To me it just looked like a jet pulling power. Not much - just a trail.

Major Coberly: Was there anything which you could interpret as fuel coming out the airplane or leaving a trail that would be obviously visible from the ground?

Captain Buck: No, I had the ground between me and the airplane until just before the explosion. There was a dark stream.

Major Turnquist: Was it dark black?

Captain Buck: Not black.

Major Turnquist: Grey?

Captain Buck: Grey, towards black.

Major Turnquist: That was just prior to the explosion?

Captain Buck: When he first started his dive, he left a heavy contrail. He just trailed off. It was abrupt. He was coming down so fast. I could see the airplane and also just a trail of dark stream - just like a jet engine pulling out power. I don't think it was fuel.

Major Turnquist: I think it is significant to note for the record that Captain Buck is a B-47 pilot and is familiar with the appearance of jet exhaust.

Colonel Douglas: Would you go through this again from the time the contrails broke until the explosion? Exactly what you saw so far as the trail behind the aircraft.

~~Captain Buck: Yes sir, first, the heavy contrails and as he left the contrail area,~~ they rapidly diminished. Fast diminishing, because he was travelling fast. I could see the airplane heading out of the contrails. The contrails continuing and changing to a slight bit of dark. I thought it was a jet pulling close to 100% power.

Colonel Douglas: Was this trail that occurred after the contrail level; did it disappear fast?

Captain Buck: The actual contrail flight that he did leave up there that high was heavy until he got out of the area where he would leave contrails and then it diminished pretty fast. Then it levelled off and also a slight stream of smaller proportion like a jet pulling full power.

Major Turnquist: If there aren't any further questions, - thank you for coming back, Captain Buck.

Major Coberly: The reason that I asked Captain Buck to come back was to make sure that we understood the relative position of the contrail and the shape that it had and also any information that he had regarding the streamer from the airplane after it left the tropopause area and the contrail feathered out - to try to obtain an explanation of this hook which Captain Knapp described. I would like to mention this now as others of you may have some pertinent questions that I can't think of. It appears to me that perhaps Captain Knapp was not aware of the direction, north or south, that the pilot was making in his dive. What he may have seen and interpreted as the hook of the pull-out was the 60° turn in the contrail level and the abrupt dissipation of the contrail as he dived from the tropopause level. I bring this out so that if anyone has questions he cares to bring out before either of the witnesses or subsequent witnesses to either confirm or deny the existence of this feathery trail which Captain Knapp testified that he saw up to the moment of the explosion, I know from past experience that contrails observed from the ground are extremely deceiving and unless you have prior knowledge of the exact heading of the airplane and its attitude as to diving or climbing, it is very difficult to interpret the maneuver.

Major Turnquist: Ted, does the F-100 have a characteristic trail of smoke when it is in afterburner?

Major Coberly: The F-100 does not leave as heavy a trail as does the J-47-17 (F-86D). The products of combustion are somewhat heavier than normally seen in an F-86D. There is some visible jet exhaust from the J57 engine when it is operated in afterburner. Just how heavy this is, I'm not prepared to say.

The next witness - Mr. Berman was brought in.

Major Turnquist explained the purpose of the meeting and swore the witness in.

Major Turnquist: May we have your name for the records?

Mr. Berman: Sidney D. Berman

Major Turnquist: Your present assignment, Mr. Berman?

Mr. Berman: I am Chief, Aeronautical Engineer, Directorate of Flight Safety Research, Deputy IG, USAF.

Major Turnquist: Your age?

Mr. Berman: 50.

Major Turnquist: Your experience?

Mr. Berman: I graduated from MIT in 1927 with a SB degree. I work for Sikorsky Aviation and was project engineer for the S41 from there I worked with General Aviation as structural engineer. Then with Fairchild Aviation as Assistant Chief of Aerodynamics and structures. Then with CAA as Project Engineer. Then with Bureau of Aeronautics, USN, as Chief of Structures, Preliminary Aircraft Design. Then Chief of the Technical Section of the Bureau of Safety Investigation for the Civil Aeronautics Board and now this position.

Major Turnquist: Will you tell the board what your findings have been?

Mr. Berman: Well, I have investigated quite a number of accidents. I believe I have investigated more accidents that any man in the country and frankly this particular accident of the present board is puzzling. I have made a comprehensive investigation of all factors of the structures that I could think of that would have a bearing on this accident and I, at this time, have no definite conclusions as to the cause of the accident. I do have a feeling from evaluation of the facts and circumstances and wreckage distribution and the manner in which various parts of the aircraft separated and from studying of the records of the oscillograph that the airplane at a high Mach number at a high "Q" has an inherent lateral instability which made the nose of the airplane yaw. I believe that one of the factors that could cause the accident is that under this yawing condition to the right high forces are imposed on the rudder systems and I understand that at the particular Mach and "Q" to which George put this airplane the structural integrity of the rudder system was not evaluated for these loads derived at these values. Examination of the upper hinge of the rudder shows that it failed to the right. In other words, the rudder failed to the right which is the correct motion of failure for left rudder to counteract a right yaw. There are failures in the rudder torque tubes, that is the lower torque tubes. There are failures in the rudder connections to the torque tubes as well as failure in the actuating load to the rudder torque tube. These failures are indicative of extreme loads being exerted. When all of these extreme loads were exerted on the rudder, the rudder failed. In this connection, this would force the rudder back to the right which would then increase the rate of yaw of the airplane nose to the right, which is verified by the oscillograph, the particular chart in the oscillograph. The airplane now would just naturally keep on yawing to the right and at the high Mach number and the high "Q" value, the airplane would just structurally disintegrate.

Major Coberly: At the present time, is it your feeling that disintegration was to be expected?

Mr. Berman: From my present knowledge of the study I have made in this accident, it is my feeling that the factor I have just mentioned is the most likely item as the cause of the accident. Now, there are factors I can speak about at this time. There is a feeling among members of the group that perhaps the cause for the right yaw was a symmetric opening of the wing slats. This naturally can cause a yaw either to the right or to the left dependent on which one or group of slats opened. There are five slats on each of the right and left wings. We are very fortunate in this accident to have an oscillograph from which readings can be made of various attitudes of the airplane, forces and deflections of various surfaces and just roughly, when the pilot pulled out of his dive to an acceleration of 3 G's. His yaw angle, taking into account the presumed off-set of 2° at the start of the run and all my readings now will be with the 2° off, would be approximately 1 1/2° yaw. At a load factor of 6½G's the yaw increased to 3°. At the maximum G's pilot pulled of 8.6, his yaw would be approximately 6½°. From this point, in about one second his yaw increased to approximately 14°. The speed in the beginning of his pull-out would be approximately 672 knots indicated and would drop down. It doesn't show it on the oscillograph. It was a blank from that point on, but would drop down to about 640 perhaps. His altitude wherein he obtained the 8.6G's would be about 23,000 feet. All of these figures will be obtained accurately on the chart and evaluation of the oscillograph. The only reason I am mentioning this data here is that it is obvious that either something happened to the airplane or the airplane is unstable laterally at high Mach and high G's. Several thoughts will propound it. As to what made the airplane yaw to the right, a logical explanation could be that the slats, one or more extended. We have aeronautical data which gives as parameters CL and CD that at a constant value of high CL the drag due to extended slat is less than with slat closed. However, there is a lower value of CL wherein these two curves cross and the reverse is then true. In other words, at a lower value of CL then with the slat extended you may obtain a higher value of drag. The exact curve for CL and CD in relation to whether or not the slats are extended or closed for the higher speeds at which this airplane was flying is not available. It is my suggestion that tests, either wind tunnel or otherwise, be obtained to evaluate what happens at the highest speeds. Another factor I would like to talk about at this time is that the 3 inboard slats of the left wing left the wing itself before impact with the ground. The interpretation of whether the clean airplane in the region of the minus slat affects drag is not available by the company's aerodynamic engineers. It is not known at this time whether the wing with the slats entirely gone would increase the drag or decrease the drag. I made a comprehensive investigation of the direction of the forces that resulted in the slats leaving the wing. Normally, when the slats are extended they move in a forward downward direction in relation to the leading edge. These three slats when they left the wing, left in a direction almost straight forward no downward component or very little compared to the normal downward component. This indicates to me that the reason these slats left the wing was due to a combination of acceleration and airloads on them. The import of this, I would like to say, is that it would in my mind throw out as one of the possible causes the slats leaving the wing. It, to me, is the result of something else happening. Another factor we gave considerable thought to is whether or not the radar door left the airplane first that caused the sequence of events. The company engineers studied this door very carefully and they came to the conclusion and after they showed me their evaluation I agreed finally with them that the radar door failed inwards or in other words due to positive pressure on the outside of the door itself. The entire radar nose section of the fuselage, the forward section, left the fuselage in a downward movement to the right. This is obvious on analysis of the fractures of the longerons and the tear out of the rivets and the skin. There is evidence that at least portions of the radar door contacted slats 4 and 5 of the right wing. There is still question as to the possibility of failure of the entire nose portion of the fuselage as being the trigger that set off the sequence. Another possibility that was given considerable study is that the nose wheel door opened in flight and being hinged on the right hand side, it is a symmetric door, would continue the yaw of the airplane and would add to the original yaw. From indentations and matchings of deformations in slats 4 and 5, also of the right wing with the nose landing gear door - it seems that this also hit the door during flight. There are also indications to show that the nose wheel door was forced against the retracted nose wheel strut or the nose wheel strut was pushed against the nose wheel door while both were in a retracted position which would lead one to think that although the door hit the wing, it was not the primary cause. I believe the items I mentioned are the main topics that were investigated as to possible explanation for the continuing sharp increase of yaw to the right. I would like to mention another item which I would suggest would bear looking into, and that is, that the deflection of the various control surfaces and the aircraft itself under high G load and high Mach number during flight, for example, at approximately the load factor of $6\frac{1}{2}$ I believe the records show that downward movement of the left stabilizer during pull-out of about 11", I just give that as an example, the wing would deflect upwards a considerable number of inches. The fuselage may have a torque movement in it due to some slight unsymmetrical load. It may have or would have, in this case, an upward bending, the point I would like to mention is that the aircraft now is a strange deflected and twisted object so that stability that we have at lower values would now maybe go into an instability there which could likely cause the yaw. Upon examining the airplane wreckage and looking at several F-100 aircraft in the shop, although the structure test and structural analysis and load criteria have been passe, I personally would suggest a reevaluation in certain parts of the aircraft structure for the combination of load on the structure due to values of "Q" at various degrees of yaw and G's, a combination effect. It seems to me that the rudder, the skin of the rudder, should be stiffened up against the obvious weakness of failure and fatigue which had already occurred on two aircraft. The rudder was tested in static condition, I understand, and passed very well, but the effect of buffeting loads on the skin was not accomplished in the test and the spans of the skin itself over the forward and rear spars and over the ribs is pretty flexible and should be stiffened against the buffeting load. I would like to mention that the rudder on this particular airplane did not fail in the skin portion forward of the rear spar, however, I would personally like to see more material placed on the upper and lower longerons of the fuselage forward nose section in the area where the break occurred in this particular plane.

Major Turnquist: Does that summarize your findings, Mr. Berman?

Mr. Berman: Yes, it does.

Major Turnquist: I wonder if we might refrain from asking Mr. Berman questions now until we have had a chance to interview Dr. Lombard.

Major Turnquist: Thank you very much, Mr. Berman; we would like to talk to you later.

The members of the board voted to permit Mr. Coffman of North American Aviation to participate in the board proceedings as a non-voting member.

Major Wendt brought in Dr. Lombard.

Major Turnquist stated the purpose of the investigation and swore the witness in.

Major Turnquist: May we have your full name, Dr. Lombard?

Dr. Lombard: Charles F. Lombard.

Major Turnquist: May we have your present position?

Dr. Lombard: I have a prepared statement here; I have to turn in data on myself quite frequently; it includes military experience.

Major Turnquist: Does that include your age and experience?

Dr. Lombard: That includes my education, age, etc.

Major Turnquist: Fine, we will make that part of the record.

Dr. Lombard: My age - I was born August 17, 1907.

Major Turnquist: Doctor, you examined the body shortly after the accident and also performed the autopsy?

Dr. Lombard: No sir, I examined the body, the helmet, the flying suit superficially, I did not assist in the autopsy.

Major Turnquist: Dr. Terry, was there some way you wanted to approach the investigation?

Dr. Terry: I would suggest sir, that we ask Dr. Lombard everything he knows about the pilot insofar as injuries sustained, etc.

Dr. Lombard: I have prepared a statement which I am prepared to sign.

Major Turnquist: I think that would be fine insofar as the record is concerned. ~~Could you give us a summary of your findings? I believe Dr. Terry has some specific~~ questions.

Major Wendt: The extent of injuries are in our Forms 14. Do you want to go into extent of injuries or do we want to discuss whether his injuries could have occurred in two separate accidents?

Major Turnquist: I believe that was the most important point, don't you Dr. Terry?

Dr. Terry: If Dr. Lombard should bring out the injuries as they occurred, I feel that it would serve our purpose.

Major Coberly: It is my correct understanding that it is of interest to the board to determine through the testimony of Dr. Lombard the possible sequence of events as they occurred as reflected in the condition of the pilot's body and the protection afforded him by the various protective devices. Is that the board's interest?

Major Turnquist: Dr. Terry has some specific problem areas he would like to discuss.

Dr. Terry: I believe Major Coberly has expressed the interest of the board. For that reason, I feel that Dr. Lombard should testify in entirety where for some reason there might be some misunderstanding on my part.

Major Turnquist: Sir, would that be agreeable to you?

Dr. Lombard: Yes, I believe the statement could be read; I have gone over it rather carefully. I have tried to analyze the facts the best I could.

Colonel Douglas: I believe it would be wise for Dr. Lombard to read his statement and then the members of the board could question him.

Dr. Terry: Dr. Lombard, would you like to give your estimation of the time that death occurred in relationship to the fatal injuries based on the reports, instances, etc.

Dr. Lombard: That would be very hard to give because unconsciousness and death are not exactly the same and circulation to the brain could continue for some time in a rather feeble manner and still be sufficient for the brain to function and yet circulation could be so impaired that those areas mentioned as on the thigh and shoulder and on the thorax would not develop because of poor circulation.

Captain Terry: Well sir, we have statements from witnesses who state that Mr. Welch moved, moaned, and breathed after he was on the ground.

Dr. Lombard: Could be.

Dr. Terry: Complete circulation wouldn't stop until after death; unconsciousness wouldn't stop circulation to certain part of the brain.

Dr. Lombard: Failure of that certain part would stop circulation - no, if it had some means of conducting the blood or some means of conducting such as via the heart.

Captain Terry: I think sir, you understand my position; I am merely trying to point to members of the board that we all have theories concerning this. As I mentioned yesterday, I took the X-Rays to an orthopedic surgeon and got his impression about the swelling around the site of the fracture. He pointed out that it would be difficult, in his opinion, to base the time sequence in the injuries on the swelling in that particular area because of collateral circulation. Do you concur with that sir?

Dr. Lombard: I can answer that very easily by saying why didn't these areas here in the thighs swell when they had direct circulation whereas this area in the arm, according to testimony by Colonel Stapp, had a severed artery or a smashed artery so the collateral circulation would act more in the right arm than direct circulation would act in the leg? I think the legs which would have circulation would have shown swelling and inflamation.

Dr. Terry: Was your examination after embalming?

Dr. Lombard: It was after embalming.

Dr. Terry: Do you feel that any area that was traumatized would permit more embalming fluid to escape from the vessels out into the tissue into the broken arm. In other words sir, do you feel there would be any distortion after embalming if you had a broken artery in a particular area? Do you feel that you get the true picture in that area?

Dr. Lombard: I understand your question, Dr. Terry, the part of the difficulty of embalming had to be repaired after the post occluded circulation in that arm because of the pressure of crushing injuries in the subclavian area so that I feel that the swelling was not due to embalming fluid because they were very unsuccessful in embalming, and likewise I believe that the thighs and the injury on the left shoulder would likewise have shown the swelling if it was embalming fluid.

Major Coberly: I would like to ask this question. Dr. Lombard, do you feel that the superficial injuries which occurred while the pilot was in the airplane occurred a significant period of time prior to his fatal injuries? That is significant to the accident.

Dr. Lombard: I feel that they did. I don't feel that the time can be stated as separated by 15 or 20 seconds. I believe that they occurred at two different times and as such are significant as it might indicate where to look for trouble in the aircraft and in the escape method.

Major Turnquist: Is there a possibility that these injuries could have occurred within one second? Would the time exceed one second?

Dr. Lombard: I feel that it might well exceed one second.

Major Coberly: In view of the fact that our evidence and the oscillograph data and witness's testimony show that from the time of initial break up until the time of the appearance of the parachute that only a very few seconds, possibly 4 or 5 seconds at the most, transpired, do you feel that this would not be compatible with your theory of the train of events?

Dr. Lombard: I do not feel that it would be incompatible for the simple reason that we do not know at what time during the escape from the aircraft the injuries occurred; the final fatal injuries, and they could have occurred sometime later while he was in the parachute.

Major Coberly: Do you or do you not concur with the theory advanced by Colonel Stapp in his testimony at the preliminary hearing of the NAA crash committed that the injuries in all probability occurred during the time that the pilot was still in the seat?

Dr. Lombard: I don't believe that I can concur or non-concur. I have no opinion on that.

Colonel Douglas: Are we bringing in Colonel Stapp's testimony? If it is mentioned, the report will have to be attached.

Major Coberly: Sir, we are attaching some of the material from the North American preliminary meeting which will include Colonel Stapp's report.

Major Wendt: His report is included in Inclosure 17 of Form 14.

Major Turnquist: Major MacDonald, did you have a question?

Major MacDonald: Yes sir, I am wondering if the reported head-down position during his parachut descent would have affected the flow of blood to the arm break in question; he was reported in a head-down position.

Dr. Lombard: Presumably it could, in some manner, I don't know what I could tell you about that.

Major MacDonald: The point, I am trying to make Doctor, isn't it possible that his arm being up, opened the arteries?

Dr. Lombard: I don't believe that I could answer that.

Major Coberly: I see nothing incompatible in the theory of two separate injuries. The timing between the two separate injuries would appear to be significant only if it could be determined that it is impossible for them to occur any sooner than a cert period of time. And this appears to be area of medical opinion that is subject to debate and I don't know that the board would gain anything from the further pursuit of this particular line of questioning.

Major Turnquist: Any further questions for Dr. Lombard?

Colonel Douglas: Dr. Lombard, did you notice any indication of wind burn or broken bones on Mr. Welch's body that could be attributed to the opening of the parachute at the high speed or attributed to ejection from the aircraft at high speed?

Dr. Lombard: Noticeable on his legs were these two deep impressioned areas that were evidence of extreme opening loads.

Colonel Douglas: Do you believe that from the injuries, the pilot could have sustained the injuries on ejection?

Dr. Lombard: It seems to me as tho if he hit part of the aircraft on ejection, the injuries would have been more severe. I have viewed bodies of men that have left aircraft at 300 or 400 miles per hour that had injuries as extensive as this and it is definite in my mind that if he had hit the aircraft on bail out, the injuries would have been more extensive. So that there is the possibility in my mind of some object falling through his parachute after this.

Major Turnquist: Do I understand that you feel the opening chute and the contact of the straps across the chest cause the fatal injuries.

Dr. Lombard: In my estimation it cannot be ruled out.

Major Wendt: May I introduce a statement by Colonel Stapp just included in Attachment 17 to Form 14 where Colonel Stapp points out that this type of injury could only have been suffered while the pilot was in the seat. This is the thing that confuses me. He also stated that the ribs were broken by straps in this area. The doctor stated that, it is my understanding, that these injuries could have happened by the opening of a chute or by a falling object.

Major Coberly: Dr. Lombard's testimony was ~~that this could not be ruled out.~~

Major Wendt: In other words, there is enough evidence that it could not be ruled out.

Mr. Hecht: Only one point that I would like to clarify, he being ejected or being thrown out while he was coming down, couldn't he have come into contact with a piece of the airplane?

Dr. Lombard: I can't say how it happened that these injuries occurred at two different times. One original set of injuries occurred first and then another occurred - any time during the escape from the aircraft.

Major Turnquist: Any further questions - if not; thank you, Dr. Lombard.

The meeting adjourned for lunch at 12:30.

The board reconvened at 1311.

Major Wendt escorted Mr. Kemp of North American to the board.

Major Turnquist explained the purpose of the meeting and swore the witness in.

Major Turnquist: For purposes of the record, your name, please.

Mr. Kemp: Mr. Robert H. Kemp.

Major Turnquist: Your position, Mr. Kemp.

Mr. Kemp: My position is Project Engineer on F-100 airplanes.

Major Turnquist: Could you please tell the board of your position in relation to the accident:

Mr. Kemp: I was assigned the responsibility of conducting the preliminary investigation. Actually, on Tuesday of last week we had Mr. Spivak go with a group of his people to the Lancaster area to establish as much as we could of the location and any general observations which our specialists could come up and survey the location of the wreckage.

Major Turnquist: For the record, your age?

Mr. Kemp: 36.

Major Turnquist: Your experience.

Mr. Kemp: I have been with North American 15 years.

Major [illegible]: Would you [illegible] tell the board as far as is [illegible] present time your present conclusions with any evidence you have to support these conclusions.

Mr. Kemp: As far as investigation, we haven't come to any conclusions as to the cause of the accident. Our investigation disclosed a number of instances of what we feel are effect but the primary cause I don't believe we can say we know as yet. Actually up to this point we know from oscillograph data that was found on the scene that presumably as a result of yawing the airplane disintegrated or came apart in the air. This can be ascertained from the data. Copies of these data have been made available to all AF personnel. There are no effects that we can ~~determine from the descent of the airplane. For example, the wing failed in down bend.~~ We do know that the horizontal stabilizers failed with the right side failing in up bending on the left hand in down bending. We know that in disintegrating large portions of the airplane actually broke off from the fuselage forward of station 106. The radar access door appears also to have left the airplane. There is small evidence that this might have struck the left wing. This is not too conclusive. We know from our examination of the main landing gear area that both main gear strut and main gear door were up and locked at the time of the accident. The nose landing gear appears to have been subjected to violent side motion. Now, whether this pressuring was concurrent with the breaking off of the forward fuselage, we don't know. We, likewise, know the nose gear door was up and locked. This is evident from the actual damage incurred on the door. There is a knurled nut on the landing gear. This nut left a knurled impression in the door itself. This dent from the knurled nut showed that the landing gear actually had impressed on the door itself and was probably a cause for opening the door. We currently have removed from the debris all the parts in the forms of hydraulic trim actuating devices, that is, any moving part that we could to check for operational characteristics and also check for position at the time of the accident. These are in our lab now. As this data is available it will be turned over to the Air Force personnel. Mr. Reynolds, I wonder if you could give us the possible cause of yaw that you might know of at this time, anything you might know about rudder, position of slats, in addition to nose wheel door and radar door. There might be a possibility of your knowing at this time?

Mr. Kemp: One thing I should point out is that the oscillograph records are roughly about 13 seconds long. Now we can presume that the oscillograph stopped when the electrical power was shut off to them. From the records we have studied at this point the airplane yaw reached serious proportions prior to the oscillograph having shut off. There are two possible ways the oscillograph could have been shut off. One, if the nose of the airplane was torn off the instrument would be separated from its power source and would stop. Two, if the radar access door was blown off the electrical connections would be stripped from the instruments by the airloads.

Mr. Coffman: You stated that there could be two reasons for the oscillograph stopping? Doesn't it stop when the pilot releases his grip on the stick?

Mr. Kemp: It is my understanding that it can be initiated by a trigger on the stick. To stop the instrumentation, you have to reach to an instrument control panel and actually turn it off.

Major MacDonald: May we have your impression of the rudder failure. Apparently it started pretty early in the picture.

Mr. Kemp: The rudder trailing edge failure seems to be a characteristic flutter type failure. This can be better born out as we investigate the rudder flutter. The free casting that houses the rudder hinge point is broken away. The lower rudder torque tube was broken off the rudder base casting. The ears on the bottom of this torque tube failed. The fitting on the airplane to which the rudder torque tube attaches has an ear on it that ties it to a check shaft from the rudder actuating cylinder device and that gear has failed. The rudder damper doesn't appear to restrict the angle of travel of the rudder. When we found the upper stabilizer, the upper rudder hinge point was still a part of the upper rudder structure. However, the rudder was one of the last items we were able to find in the area of the wreckage and it appears to be in the wreckage of the debris somewhat earlier. I can't say when.

Mr. Berman: Could you give us your interpretation of these breaks?

Mr. Kemp: There is a mark on the rudder as though another piece of the aircraft may have hit it while the trailing edge was still attached. This may have caused some failure. There is some evidence of failure of the associated torque tubes for torsional bending. This, however, may be impact damage. Our lab people are checking the torque tubes.

Major Coberly: Do you believe it is significant that you found that rudder in a specific place in the wreckage or is the rudder shaped so that it could automatically rotate and drift to most any part of the area?

Mr. Kemp: It is almost an aerodynamic shape; however, with the construction such as it is, it is dynamically balanced with a very heavy leading edge; therefore, it is my guess that the rudder wouldn't have drifted in an auto rotation manner such as a slat would. A rudder would have a tendency to fall per the laws of gravity.

Major Coberly: That answers my question.

Major Turnquist: We can conclude that it was first, a structural failure and then, a fire.

Mr. Kemp: I would like to bring out some points relative to the final damage. Actually, we know that a relatively large portion of the fuselage is intact. This would be a portion of the fuselage from station 222½ aft. This is directly behind the pilot's compartment and the ammunition bay, where there is a manufacturing joint. Now, this whole piece of wreckage actually had been severely burned. This ties in with the belief that it fell as a ball of fire. In going over that wreckage at both the scene and here, it was determined by our Power Plant people, that the engine could have been running or turning over during descent. This motoring over was indicated by the fact that the blades on the inside of the compressor section were shingled back. Power plant people state definitely that there was no failure of the engine as such. Engine and accessories were running during descent and fell in the rear section of fuselage. When the airplane broke in two at station 222½, it would open up the No. 1 fuel bay and actually scatter fuel over this entire area. Contrary to that though, there is no sign that any heavy pieces of airplane fell through the fire. The tip of the vertical stabilizer showed evidence of burning outside of glass harness cover.

Major Turnquist: Would that lead you to think that the stabilizer was on the airplane when the fire occurred?

Mr. Kemp: That could have occurred as the pieces fell through the burning debris. The other major element was the pilot's helmet; one-half of the pilot's inner liner was burned.

Mr. Berman: Would you say that the vertical stabilizer showed evidence of fire?

Mr. Kemp: Yes.

Mr. Berman: Do you agree that there was evidence in the fire on the vertical stabilizer?

Mr. Kemp: Yes, there was a portion of the stabilizer that was subjected to fire as it was broken from the airplane, that is in line with our thinking.

Mr. Berman: we can say positively that it was not subjected to fire during flight but after disintegration.

Mr. Kemp: That stabilizer tip is in the lab being checked.

Mr. Hecht: Would you think that the stabilizer tip might possibly have fallen through burning debris because of the fact that the burning debris had a heavier mass drag ratio?

Mr. Kemp: I couldn't answer that.

Major Turnquist: How about falling through a ball of fire?

Mr. Kemp: The vertical stabilizer was badly broken up into four major components; the vertical stabilizer tip; the stabilizer mid section; the rudder itself and the lower portion of the stabilizer which remained attached to the back of the airplane itself. Nothing that remained to the rear section showed signs of burning. The intermediate section showed no evidence of burning. The tip itself did show evidence of burning; that is why I drew the conclusion that it fell through the ball of fire.

Mr. Berman: I was going to suggest; parts do fall off the airplane when it disintegrates and in descent pass through the ball of fire and that is why it was subjected through the ball of fire. This tip fell off the aircraft without having been subjected to fire and passed through the ball of fire.

Mr. Kemp: That matches what I am trying to say. They opened up a fuel cell; it is logical to assume that we do have an area subject to a large quantity of fuel which would actually ignite and burn. The initiation of this fuel therefore, for a moment would add to the volume of fire.

Colonel Douglas: May we conclude from this that the center portion of this vertical stabilizer and possibly the rudder were not on the airplane and separated during descent.

Mr. Kemp: No, I don't think so; we are not in a position to make that conclusion.

Major Coberly: I would like to go back to shifting of nose gear in its restricted position and the dropping on to the nose wheel door; do we have any data which tells us how much lateral acceleration or how much of a yaw we must have in order for this nose gear to become unlatched.

Mr. Kemp: Such information could be worked up.

Major Coberly: The reason I mention this is because one of the possible factors considered is the yaw was accelerated by the opening of the nose wheel door and if we could find out to what degree of yaw we were getting prior to unlatching of nose gear; it would help us to either confirm or deny this factor.

Mr. Kemp: To go into that point a little bit further, inside the nose wheel there is a structural empennage which shows evidence of the gear having hit it from either side. This is actually borne out through the skin mark on either side and on each wheel door that would gradually allow the nose gear to jump off [illegible]. How much of a load it would take to get the gear off, I couldn't answer you now. The only thing was actually that we know when the nose gear actually hit the door that it was an angle that was not normal by the nose gear and the nose gear would be about 15°. From that, I would say that the nose gear moved beyond the limits of its normal fitting. It hit the door and forced the door open. This would indicate to me that there had been some other reason and yaw in the nose gear door itself.

Mr. Reynolds: Deflection of the fuselage is an affecting factor on the position of the nose gear rather than G loads or the weight of the gear.

~~Major Wendt: Something I did not quite follow you on;~~ Were there burn marks on the rudder:

Mr. Kemp: Not to my knowledge.

Major Wendt: Could I assume that the rudder left the tail section before this ball of fire occurred:

Mr. Kemp: The rudder left the center portion of the stabilizer what appeared to be after the ball of fire.

Captain Terry: As the forward portion of the fuselage broke off, could you determine which way it fell - right or left?

Mr. Kemp: I am not too sure that I can give you a real straight answer. Our fuselage group has made a detailed analysis of this and it is not too clear to me at this time.

Major Wendt: Can Mr. LoPresta answer that?

Mr. Kemp: Probably.

Lt. Simpson: If the rudder was deflected, is there any way you can tell which way it left? Can we go under the assumption that it did not go through the ball of fire? If the rudder is deflected, could you tell in which direction?

Mr. Kemp: Our empennage people are currently trying to develop that and have not come up with anything at this sitting. with an accurate sequence of its leaving.

Mr. Hecht: You mention the mark along the rudder, which side?

Mr. Kemp: Let's see - it would be on the left side but I would have to make sure. I don't know if that has been determined as yet.

Mr. Reynolds: Concerning the separation of the nose and fuselage, were there any fuel tanks in that area?

Mr. Kemp: There are no fuel cells in the airplane forward 222½ or is contained within the fuselage. No wing tanks were utilized on the demonstration run - all fuel contained aft of the pilot's compartment.

Major Turnquist: If there are no further questions, Mr. Kemp will be excused. Thank you, Mr. Kemp.
Major Wendt brought in the next witness.

Major Turnquist explained the purpose of the investigation. No further witnesses were sworn in however.

The next witness was Mr. B. J. Storms.

Major Turnquist: Your name, please?

Mr. Storms: B. J. Storms.

Major Turnquist: Your position, please?

Mr. Storms: Chief, Technical Engineer

~~Major Turnquist: Your age, please?~~

Mr. Storms: 39

Major Turnquist: Your experience?

Mr. Storms: Fourteen (14) years with North American Aviation.

Major Turnquist: Would you tell the board just what you have determined as far as conclusions or possibilities of what might have been the causes for the accident?

Mr. Storms: At the present time, I don' have any conclusions since we do not have any data as to the parts not coming off. For a while we won't be able to have anything definite until we have the word on parts coming off - such as gear door, slats, etc.

Major Turnquist: Have you narrowed your investigation down to say a series of possibilities?

Mr. Storms: There is a possibility - we had the word today that the left hand inboard slats could have left the airplane causing the high degree of yaw; also the nose gear door could have left the airplane causing the radar cover to have left and caused the yaw. There seems to have been some difficulty with the trailing edge of the ruder. As far as I know none of these possibilities have been verified. The next night, it was determined that the nose gear door did not come off.

Major Turnquist: Would you care to elaborate?

Mr. Storms: There is also a possibility of instability but we do have data on 1.2 Mach number and flight test data and we do not expect abrupt discontinuities in the data - we would not expect to fall off at 1.5 - from the curve as speed increases:

1.2 1.64

Mr. Berman: We have the data at 1 2 and 1.6L M At what Mach number did the accident occur?

Mr Storms: 1.5

Mr Berman: Do we have data pertaining to the high deflection at high "Q" and high M numbers in the wings and surfaces and the structures themselves?

Mr. Storms: I am quite sure that the data could be worked up by the Structures group.

Mr. Berman: On the series of F 89 accidents - when we questioned the analysis as to actual distribution of loads we are getting on the wings, we had a variance of 35-50% variation from that for which the airplane was originally designed. Characteristically, that data was taken from wind tunnel data on the F-100 was taken so it is quite likely that as we are examining the F-100 to find out what the actual distribution of loads are on our wing and tail, it would be quite different from what we calculated.

Mr. Storms: Complete disagreement. I don't think that the F-89 should enter into the picture. The F-89 had difficulties in the subsonic region. We have already passed that region so obviously the F-89 experience does not apply either directly or indirectly. Air loads have been measured on all models to verify that. I believe there is a big difference on the F-100 series as far as that goes. I believe all data now existant has shown that the maximum change in the co efficient occurs around the Mach No of 1, the changes are gradual. As you get below Mach 1, the changes are very gradual. All the F-89 difficulties came about because the calculations were not in agreement with the actual flight data. These loads have been measured and the conditions is actually a lower load condition. I don't see that the F-89 experience particularly applies at all.

Mr. Berman: I pose one more thought. The wind tunnel data that we did develop for the F-100 - we make a similarity between the deflection and the angle of attack and resultant distribution and if we don't have a similarity how can we tell what the controlability will be?

Mr. Storms: I believe, if I remember correctly, the loads were worked up for a more deflected aircraft in a series of coefficients. Based on that, deflections were calculated and loads calculated for an elastic airplane not for a solid airplane.

Mr. Berman: We are coming to the point do you believe in running flight evaluation tests to obtain what actual load distributions are or on a proto-type airplane

Mr. Storms: That is a broad question.

Major Turnquist: We are getting away from our direct line of thought

Mr. Berman: May I interject a thought. This airplane had a yaw to the right. We are in agreement that it may have an instability factor. We are trying to get at the root of how the yaw got into the airplane. Did the initial loads that were calculated differ from the original design?

Major Turnquist: We are considering instability as one of the possible causes in this area. I am sure that as a result of this investigation the Joint Project Office will consider all of the facts

Mr. Storms: Relative to instability. At the present time we have no reason to believe that the instability exists in this speed range.

Colonel Douglas: Mr. Storms, in your job as engineer, for North American Aviation, do you have occasion to talk with test pilots?

Mr. Storms: From time to time

Colonel Douglas: Do you talk with all assigned test pilots?

Mr. Storms: At various times

Colonel Douglas: The reason I am asking you have no data to cause you to think that you have an instability problem?

Mr. Stroms: Directional instability at these Mach numbers? You must differentiate from directional control - a shift in trend is not instability.

~~Major Coberly: Are you prepared at this time to make any statement as to possible~~ causes of this accident?

Mr. Storms: Not at this time.

Mr. Coffman: A short time ago you said that yaw caused the airplane to come apart. Is that your personal opinion or that a series of yaws?

Mr. Storms: The only conclusion that we have reached is that the airplane yawed to approximately 16° for reasons unknown. In my opinion, that would normally cause the airplane to come apart.

Mr. LaPresta was called to the stand.

Major Turnquist explained the purpose of the investigation.

Major Turnquist: Your name, please, for the record?

Mr. LaPresta: Antonio LaPresta.

Major Turnquist: Your position?

Mr. LaPresta: Assistant Chief of the Structures.

Major Turnquist: Your age?

Mr. LaPresta: 44

Major Turnquist: Your experience?

Mr. LaPresta: A little short of 19 years with North American Aviaton

Major Turnquist: Mr LaPresta, will you summarize whatever findings you have arrived at, enumerating a number of possibilities that might have occurred or caused the incident and any substantiating data

Mr. LaPresta: The biggest bit of evidence now [illegible] from the flight records that were salvaged from the wreckage. In these records we find this high angle of yaw at this high Mach number. The angle of yaw that the records show [illegible] the design limits at this Mach number. From there we feel the forces [illegible] by this high angle of yaw caused the structual disintegration. At the [illegible], what caused the angle of yaw, I don't know. The evidence which indicates that the evidence of angle of M yaw are such things as this: we find that the front end of the airplane left forward of station 106 the failure at this station is known to have occured from left to right.

Major Turnquist: Can you narrow that down to any possibilites?

Mr. LaPresta: What caused the yaw - a question of aerodynamics.

Major Coberly: We are also interested aside from the break-up of the airplane in the probability of the escape of the pilot and you say that this nose section broke off at station 106.

Mr. LaPresta: Just forward of the pilot's compartment right in the middle of the windshield.

Major Coberly: Do you have any comments regarding the breakup of the canopy or have you drawn any conclusions from this?

Mr. LaPresta: I have personally drawn no conclusions insofar as the crash of the canopy rails. Both rails seem to have gone to the right again. We have a couple of fittings that fit under some rollers that keep the canopy bolted down. One of these fittings was definitely brinolled which was indicated that it was forced out of it's reacting fitting. Then the two rails, the skin at the back end had failures which indicated up and to the right.

Major Coberly: Have you concluded as to whether or not this failure occured simultaneously with the breaking at 106?

Mr. LaPresta: I have no thought in that manner

Mr. Coffman: Do you have any opinion as to whether the pilot was still in the cockpit in the seat at the time the canopy rails went up to the right?

Mr. LaPresta: No. I don't - haven't any opinion on that at all.

Mr. Berman: Can you tell us for the record, what values of yaw and Mach the airplane was designed for?

Mr. LaPresta: I did not look this up. My recollection is that the critical condition for the vertical tail was 8° yaw and about .8 Mach number. At the high Mach Number the yaw angle according to our data is pretty small and was not a critical condition.

Mr. Berman: In the static test of fuselage did you derive load, G forces and yaw values?

Mr. LaPresta: No, we test for both the normal forces and the yaw forces. These tests have been completed successfully.

Mr. Berman: What variations of yaw did these tests show?

Mr. LaPresta: I don't remember, Sid. I just don't remember what the critical condition was.

Major MacDonald: Some of the earlier witnesses have mentioned fragmentation particles which flew off the airplane and did some superficial damage, etc. Could the "Q" have produced enough fragments in the shear web under the console medical authorities have said that some fragments hit Welch and broke his arm and I was wondering if possibly the nose section could have failed in pressurize the shear web under the console? Is there anything to make you believe that this could have caused the shrapnel? Did you account for most the sheet metal in that area?

Mr. LaPresta: I can't answer that last question.

Major Turnquist: How about the first one?

Mr. LaPresta: Well, I know this much. That first of all, he was certainly at a high speed which gave him a very high "Q". I also know that when you have a structural failure, that pieces fly - rivets, pieces of skin - they will fly to beat the band - they have a lot of energy in them. It is quite possible that some of this stuff out of this compartment, since the fron bulkhead which had been torn apart would cause the "Q" pressure to build up in this forward part of this lower right hand compartment, that as these pieces break they will fly and it is possible that things would have thrown back from that compartment.

Major Turnquist: Mr. LaPresta, could you give us a rough estimate of how many seconds or fractions of seconds would take fro the airplane to break up after that yaw?

Mr. LaPresta: I don't believe I can answer that. I do know that structures can break up awfully fast. For instances, when we were static testing the wing in our lab we had a camera that I believe was around 200 frames per second and we had this pointed right at the upper surface of the center section. We suspected that this was a weak place in the wing - the most likely place that it might fail so we wanted to see if we could photograph the failure as it developed. I know looking at that film, one frame we had a perfect piece of structure, the next frame it was all gone. So structure can go very, very fast.

Major Turnquist: Would you estimate that the airplane broke up in a second?

Mr. LaPresta: I wouldn't know what to say.

Lt. Simpson: I remember looking at the wreckage, speaking of station 106 as forward, what is the station aft under where the pilot is where the ball of fire occurred?

Mr. LaPresta: Behind the pilot?

Lt. Simpson: Right.

LaPresta: 222

Lt. Simpson: Is that airplane in three sections now. Up to 106, 222, then aft.

LaPresta: That part to 222 aft in the part that was burned I can't say that all the structure from 222 back was in the fire. I do know that it is all mangled.

Lt. Simpson: Is it possible that station 106 failed from left to right and as that started to break up, particularly with the speed that structures can fail, it could have caused that explosion while the pilot was still in the forward section. In other words, station 106 failed left to right, it may have lifted the canopy which failed left to right, the explosion could have been while the pilot was still in the cockpit of the airplane. We have thi pieces there.

Major MacDonald: Which of the fuel lines would be in that area?

Mr. LaPresta: 106.

Lt. Simpson: 106 wouldn't break in that area but we don't know how fast [illegible] happened. It could have been fast enough for the pilot, who certainly couldn't think fast enough to try to leave the airplane although there was an indication that he did.

Major Wendt: We can try to compare that with these gentlemen that he never tried to eject.

Lt. Simpson: The airplane is broken in three pieces, right?

Mr. LaPresta: Basically.

Major Coberly: What is the direction of the failure in 222? Can you determine in what direction that failed?

Mr. LaPresta: The aft part is burned; the forward part is pretty badly mangled and frankly I have no thoughts as to how that piece came off It is so badly mangled, this piece from 105 to 222, that we don't know.

Major Turnquist: Any more questions?

Mr. LaPresta: I would like to bring up one more point, and that is, the horizontal tail that failed - the left side failed apparently from a down load and the right side as well as we can tell from an upload. What I wanted to bring out is that it is my opinion that this tail was still on while the wing was still on and the fuselage was more or less intact, except for the part forward of 106. It would take some reacting force to build up a load on the tail; therefore, this stuff up ahead I believe was more or less intact except for the extreme forward part of the fuselage.

Major MacDonald: One more question, if I may? Do you have any idea how the heavy score marks got on the upper side of both stabilizers? The heavy score marks I believe were 30^{o} off each other in axis - none of which aligns with the line of flight.

Mr. LaPresta: Well, Mac, you are ahead of me. I sent that one piece to the lab for an analysis for what these marks are and I haven't got an answer on it yet.

Mr. Coffman: This is the 48th flight on this plane. I presume some of the previous flights were structures flights - was this high angle of yaw noticed on any of the previous flights?

Mr. LaPresta: On Flight 33 which was a build-up to this maneuver indicated an angle of yaw - I don't know whether to say 5^{o} or not because I don't believe anyone has decided what zero is but the maximum angle indicated on the record is 5^{o}.

Major Coberly: And the design limits were 8^{o}.

Mr. LaPresta: At a much lower speed.

Major MacDonald: Was there any curiosity about this 5° - did anybody investig that?

Mr. LaPresta: I have not heard of anything along that line, Mac.

Major Turnquist: I would like to make something a matter of record here. How close on previous flights have we come to the conditions that existed on this flight in Mach number and G forces?

Mr. LaPresta: Again - going back to flight 33 - my recollection is that he would get up to 1.47 Mach number and a load factor of 6.9 at an altitude - I believe - in the neighborhood of 23,000 feet - plus or minus a thousand feet as I recall it. On this particular flight he was shooting for 7.33 load factor at the maximum Mach number possible, at an altitude of 23,000 feet.

Major Turnquist: Was it correct that this was the most severe test of the airplane that has been accomplished to date?

Mr. LaPresta: As far as symetrical forces, yes. At the time that he was at this 5° angle of yaw, he was at a Mach of 1.4, I believe. I am going only from memory on the record. He had been to a higher Mach number prior on this same flight but the Mach number had dropped off while the yaw was building up.

Lt. Simpson: Was it a right yaw, sir?

Mr. LaPresta: Yes, sir.

Mr. Reynolds: 6.9 G and 1.4 Mach number occurred simultaneously and indicated an air speed of 640 knots - on flight 33.

Mr. LaPresta was excused.

Reconvened at 1500.

Major Wendt: Do you think we should get some NAA people who were at the scene of the accident?

Mr. Reynolds: I was interested in NAA flight test people who were at the scene - people who had things to do with the tests being conducted.

Mr. Coffman: Believe it would be a waste of time. There was only one man who was there. He was nine (9) miles from it and too far to see clearly.

Major Turnquist: We have statements from all of those people.

Major MacDonald: Don't believe NAA people could add anything.

Major Turnquist: I believe Mr. Reynolds had some specific questions that he wanted to ask.

Mr. Reynolds: In the nature of clarification of a few of the statements, we had some discussion of the slats as they affected the drag of the airplane and I believe that the only thing to say is unsymetrical deflection of the slats might have contributed to yaw. The whole thing would be based on one side coming out and not the other.

Mr. Berman: I believe I covered that in the text.

Mr. Reynolds: Mr. Berman was speaking of deflection of the airplane causing the yaws. You might say now that there is nothing to indicate that in any way this could occur. We were supposed to have wing deflection measurements and tail deflector measurements during all of these tests. The company has indicated that there is nothing in the data to indicate the reason for yaw during pull out and that is something that I believe is going to have to be left to investigation flight-wise, possibly wind tunnel-wise. Investigation, for example of such things as landing gear doors coming open, slats opening in pull out, etc. The wind tunnel data that we have so far at 1.2 Mach number indicates that when extrampolated above that to the neighborhood of 1.5 indicates that the slats did not open. However, this has not been verified by flight investigation.

Mr. Berman: I didn't mean to give you or anybody else the impression that I read any positive indication in the records that deflection was the cause. I mentioned that only as a discussion for future thought in revising the regulations. The neglect of taking into account deflection on distribution of loads both code-wise and span-wise may be somthing requiring further study by WADC. I believe there is a present gap in the design of our finished airplane and the knowledge of what the loads actually are on the finished airplane from interpretation of wind tunnel data.

Mr. Reynolds: We realized this situation over two years ago and started a new policy of measuring flight loads of every plane as early as possible in the development stages. For various reasons it was decided to let this airplane go ahead with the normal structural demonstration without this flight load program. In this case, it had to do with timing, delivery of airplanes to the service. The lab held out for flight load maximums in the F-100 airplane. As a result of a decision of higher headquarters not to make these measurements, we were told that we could do this on the F-100C. So far as recommending that we change our policy, we had done this a couple of years ago. In this instance we weren't able to follow it.

Major MacDonald: I would like to say here that the NACA people here have agreed to give us this type of data on the airplane which they now have and are set up for. I don't remember exactly what the scheduling is on that but Colonel Buzze made a visit out here about three months ago and made an agreement with the NACA people and we will be receiving that fairly soon from their airplane.

Mr. Berman: I was in ignorance of that item, and I thought that there was a gap in there and I only mentioned that fact that there is a possibility of due to deflection and due to the fact that we know and manufacture one wing will deflect more than another wing under load, that that could be an item to give you an unequal yaw. That fact in itself is there - so in combination, with load, deflections, manufacture tolerances, unequal deflections under the same load for various series of wings. I just thought I would put that in. Now another item that I would like to talk about would be the item of creep. At high Mach numbers of 1.1/2 or 2 we have aerodynamic heating. Aurodynamic heating then raises the temperature to approximately 1½ or 200° F and at that temperature 75 ST loses 10% in strength - also yields a little bit or creeps. All those items you see -

but I left that item of creep out purposely. There are different things like that which can enter into the problem.

Mr. Reynolds: Aerodynamic heating then and creep is not considered a problem up to Mach 1.1/2 as you mention - you can get up to approximately 200° at Mach 1.7 - which still not weaken the internal structure. We did not analyze for aerodynamic heating in the structure subsequent to the engine compartment.

Major Coberly: What we are saying here is, in effect, that the state of the art at these Mach numbers range is pretty much an unknown factor at this time and this ~~is pretty well obvious to everybody~~ that is connected with the business. There are all sorts of possibilities in this Mach number range that could certainly contribute to this type of thing. I don't see that we are going to gain too much by this going into a lot more detail. Toward the end of your testimony, Mr. Berman, you stated that there were several areas on the aircraft where you considered the design structure was dubious.

Mr. Berman: No, I don't believe I said dubious - I said I would like to see it increased.

Major Coberly: In your opinion, it should be strengthened.

Mr. Berman: Just from the appearance point, I don't know the actual loads on it.

Major Coberly: Are these areas where we have deviated from good engineering practice?

Mr. Berman: No, I wouldn't say that. I have been an aeronautical engineer for over twenty-five (25) years and I think I have developed a sense of proportion in different aspects of aircraft structure - what the area should be, the mass of metal that would take certain loads. Personally, you have to design some aspects of the structure not for margins of safety but from what it is going to do in service. As for instance, the skin on you rudder. They static tested that rudder and it held up beautifully under the static test. Yet a couple of days ago I saw two rudders that holes in the skin near the trainling edge due to buffeting. The static tests showed it to be wonderful - it had very little twisting in static test - it held the load but it doesn't hold up in service. We have to design not only for margin of safety but also for service and the buffeting and treatment it gets - that's what I meant.

Major Coberly: I appreciate that.

Mr. Berman: I feel most satisfied that we have positive margins of safety in the structure. I am confident that the North American engineers have done a good job in structurally designing it for margins of safety. But I still feel that the structure should be re-evaluated in view of the mission and the performance of the airplane on top of margins of safety.

Major Coberly: There are two things which you mention specifically which you consider necessary to be strengthened by design change were (1) rudder and I think the fact that we have had these failures certainly indicates that something will have to be done and the other thing (2) the structure along the fuselage longerones in the neighborhood of station 106. How much and where should this be strengthened?

Mr. Berman: It is not up to me. You have a channel section in there and that channel section is a thin channel - may be three (3) inches and at the end may be one-half ($\frac{1}{2}$) inch. It has rivet holes through it on the left hand upper side. We have a beautiful sheer failure - 45° failure intention in the region through the rivet holes. I feel sure that in the analysis of static test it was satisfactory but just the thinness of the metal - not enough mass - I would like, if I were doing it, I would put more metal on it. I can't tell you how much to put into it you understand.

Major Coberly: ~~If we include in our findings that it is the opinion of yourself~~ that these particular areas are weak and should be strengthened; then I think we should be in a position to ------.

Mr. Berman: I don't want that word "weakened" - because I'm sure it has margins of safety. Because I feel sure that from the loads that NAA developed - the basic load criteria and the stress analysis and the static tests that it showed a positive margin. It is not weak in that respect. But I would say reevaluate it in addition to margins of safety. Another phase I could mention ------.

Major Coberly: I don't understand the reevaluation of margins of safety. Do you mean to reevaluate the margins of safety we are building in the aircraft?

Mr. Reynolds: I would like to add something. As far as the rudder is concerned, we have good reason and cause to have that beefed up some from buffeting loads, fatigue, etc. As far as the fuselage is concerned I don't see how we would have cause to have the contractor redesign or restrict it. The airplane failed in a load it was not designed for.

Major Coberly: Then, how can we report as one of our observations that it would be better if it were strengthened?

Major Turnquist: I believe we are going a little afield again. These two rudder failures that you mentioned, aren't they going to be reported through normal routine channels, through an incident report, a UR or something of that nature? I don't know that they are part of the accident investigation.

Mr. Berman: May I just mention one thing. I would like to state again that in view of the known loads on the airplane that I feel that the upper longerons at station 106 has a positive margin of safety as designed. In view of further additional loads that were imposed on the airplane when I mentioned this morning that it looked light I don't mean weak and I don't think I said weak and I mentioned that I would, if I were designing it, made it heavier notwithstanding what the margin of safety shows. Instead of having 5 margin of something I would have made it heavier and I don't see how the board can recommend to North American to increase the margin at that point because there is no regulation requiring them to do that.

Mr. Coffman: Nothing more than a suggestion. In view of Mr. Berman's comments I would like to suggest that you call Mr. Slincker or Mr. LaPresta back to see if Mr. Berman's suggestion have been refuted by someone or by the Air Force or perhaps ------.

Major Turnquist: I feel that these are normal day-to-day problems that come up in the project office. I feel that we are getting just a little bit afield. Does anyone disagree with that?

Major Coberly: The reason that I brought these things up was because this was an area upon which Mr. Berman completed in his testimony and stating that he had gone out into the plant and had seen these particular things which I believe that he would have done differently and I felt that if this becomes a part of our report, we must make some concrete recommendations based on the observations of Mr. Berman in his capacity as technical representative to this board. Now, that was my reason for bringing this particular matter up. I felt that not only the observations but the recommended corrective action might be forthcoming.

Major MacDonald: Ted, we will have recommendations concerning this accident for the next three or four months.

Major Coberly: But we are concerned particularly with the observations that are recorded in our board proceedings and recommendations which this board makes on the basis of things which it can consider conclusive at this time.

Mr. Berman: May I make a suggestion. I feel sure that for the flight load criteria and the static stress analysis for that particular section does show cause for margin of safety. Other engineers do things differently - maybe I should not have mentioned that particular item.

Major Turnquist: Is there any value in pursuing it any further?

Major Coberly: This answers my question.

Major Turnquist: Any further question?

Colonel Douglas: One thing that Mr. Berman hasn't brought out is the closeness of the oxygen line and the hydraulic line in the depressurized section on the right hand side of the cockpit which was a quality control item.

Major Coberly: Is this in accordance with the print or is this improper manufacture?

Major MacDonald: I believe there is a deviation for space and closeness in that area and it was found to be 6" between the oxygen line and the hydraulic line. Believe the Mil Spec calls for that.

Mr. Berman: I looked at three aircraft in the ship; one of three had about 1/2" separation, the other about an inch, and the third one I looked at about 1-1/2".

Major Coberly: The comment was made that this was a quality control item. Is this according to the print or is a matter of design?

Mr. Berman: I did not check the print. I only brought out the fact that the Mil Spec required 6" and Major MacDonald said that it had been given a deviation.

Major Turnquist: Thank you very much, Mr. Berman.

Maj. MacDonald was called to the stand

Maj. T: Major MacDonald, as a member of the board, I wonder if you would give us the benefit of your observations. Try to limit the findings to this accident.

Maj. Wendt: Your position.

Maj. W: I'm Maj. MacDonald - F-100 Project Engineer, WADC since the project was initiated. Age - 43. I'm not a rated military pilot but I have all but the airline transport qualifications in CAA, and I have been flying off and on since 1926. Knowing what the WADC people are going to cover I will skip that. One ~~point that I thought might be of interest to make was that there was some evidence~~ that the fuselage tumbled at one time. This is after-the-fact tumbling, probably, deduced from the fact that the spring tabs which hold the drag chute are bent up at random. One time presumably right after the wings failed in down bending, the fuselage was actually tumbling. This is probably not too pertinent to the general problem. Another item that was in question was the integrity of the landing gear switches as regards to G load. Could it have snapped down and started the gear cycling and thus explain the apparent opening of the nose gear door? This was investigated on a centrifuge over in the lab on three production switches and the G's required to operate the switches was in the order of 15-17 G's so apparently the switch gets a clean bill of health. About the only thing else I would have would be to recommend that the board findings leave a considerable lattitude to WADC in the implementation of the necessary corrective action.

Maj. Coberly: My testimony goes back to the testimony of Capt. Buck who was probably the first person to see the two parachutes and Capt. Buck testified that at the time he first saw the two parachutes the chute with the pilot in it was higher than the white chute. Does this give us any clue as to the sequence of departure and breakup of subsequent part of the aircraft. You have seen something on the drag chute door letting the drag chute out.

Maj. MacDonald: The little spring tabs that retain the cable along the side?

MAJ. C: Yes.

Maj. MacDonald: With all the distortions that would be in there and the fact that the pilot's section from 106 to 222 had gone with associated jerking of the deployment cable and with the associated tumbling, I don't know whether you could make a real good deduction from that or not.

Maj. C: Would you consider it a logical assumption that at this particular time at least the pilot had gotten out before the drag chute was deployed? Giving certain weight to his perspective that he might not have known which was higher than the other.

Maj. MacDonald: I just don t know what to tell you on that. You don't know what the individual gyrations of the short section of the fuselage were and you don't know whether the drag chute deployed immediately, maybe it was flanked off when the fuselage tumbled here Maybe it didn't get the pilot's chute out immediately There are so many interrelated factors. We had talked that over this morning and I haven't resolved in my own mind that there was any significance to this.

Maj. T: Maj. MacD, you heard Mr. Storm's testimony and you heard the possibility which he listed which might have caused the yaw which resulted in the break up of the airplane. Could you offer any comments to that list?

Maj. MacD: It would be presumptuous to disagree or add anything to Mr. Stone's testimony, but my personal feeling was that in view of the yaw that was demonstrated in flight 33 which was the build-up flight, since there was apparently no airplane damage it would almost to me, come back to a problem of either airplane deflections or slats. If I were to make a flat guess, I would choose the slats.

Maj. T: Do we have any other questions?

Mr. Reynolds was called to the stand.

Maj. T: For the records, would you give your name, position and experience.

Mr. Reynolds: L. V. Reynolds, presently in charge of structural flight demonstrations for the Structures Branch, Aircraft Lab, WADC. I have been in that position for the last 12 years and conducted and been responsible for all structural flight demonstrations on AF airplanes during that time. Prior to that time I have worked in the static test lab and had experience along those lines, stress analysis of structures of airplanes.

Maj. T: Could you give us the benefit of your findings after working with NAA personnel?

Mr. Reynolds: At this point I don't think I should go into too much detail but just to look at the overall picture and see maybe some of the things that have not come out that I have noted. Did you get a pretty good picture of the yaw angle?

MAJ. T: I believe we did get some of it from the oscillograph records.

Mr. R: I might give you a slight history of this airplane and the program we are running. Prior to the accident, the airplane had completed the low altitude high indicated speeds portion of the demonstration including pullout to G's as high as 8.2 as the maximum. These had all been symetrical pullups that had been done previously covering the lower Mach number ranges from approximately .8 through .95, 1.04, 1.09, and we had been up to 1.47 in a dive brake extension maneuver where there wasn't any G purposely pulled, where the test was to go up to the max Mach number again at 20,000 feet and extend the dive brake. The airplane itself got 3.8 G from the dive brake extension without help from the pilot. That is most of the testing that had been run prior to this accident with the exception of the build up flight which was mentioned earlier here for this max Mach number pullup the one in which the accident occurred. The flight 33 was the build-up for that. He had been scheduled to go to 6.9 G at the max Mach number under the same conditions as Mach number and altitude which is supposed to be 23,700 feet. He got 6.9 G concurrently with 1.4 Mach Number in the build-up flight and 640 knots equivalent airspeed at 22,700 feet. There were no failures on the aircraft as far as anybody has found. He had a peak yaw at 6.93 - well, the gross reading was 5½° with 2° off center at the start. So I called it 3½° net. During both the build up and crash flight, the noticeable increased in yaw did not start until he got to 3G the difference being in the two here that the yaw increased in a faster rate during the crash flight pullout than it did on the build up. You could possibly lay that to the fact that G was built up faster in the crash flight than it was on the preliminary flight. There may be a corelation between rate of application of G and the rate of yaw during the pull out. Now, in the crash flight the airplane yawed some during the dive, about a net of 10° at the beginning of the pullout. Then at peak G, it had 7.6 indicated, which if corrected for the off center at the beginning of the flight, would be 5.6. At a point about half a second later it had 8° net yaw. Then at that point the yaw really started going. It increased rapidly. It was about at that point or a fraction of a second before that the pilot started kicking much stronger pedal force. During the dive and up to the peak G in the pull out he had pedal force of approximately 40 pounds to 50 pounds which is the maximum where the boost is affected. In other words, he had full boost throughout the latter end of the dive. As far as sequence of events or the break-up of the airplane we have been given pretty much of an account of how all the parts failed. The sequence part of it is still a matter of conjecture in everyone's mind. No one will make any definite conclusions. I cannot either make any definite conclusions. The possibilities of things that could have started the severe yaw after the pull out are as far as I know the same as what other people have mentioned. It could be a possibility of the slats breaking off of the left hand wing and also the possibility of either the nose wheel door or the radar door striking the wing. However, it was originally thought that these had struck the wing and fractured the leading edge, thereby producing an outstanding increase in yaw. It has been proven to my satisfaction by the investigation effort so far, that the nose wheel door was punctured by a nut on the bottom of the nose wheel that must have been in place at the time the severe yaw occurred. In other words, it is not the triggering device for the severe yaw. As far as the slats were concerned on the left wing, there was some indication that they came off straight forward then down on the track, which would have had to happen during the pull out. In order for the slats to have been broken it would have been necessary for them to have struck something during the beginning when the airplane was near maximum G. There is the possibility of course that these slats could have failed after the wing broke off the airplane. This is of course possible when you consider the G forces that the wing may have gone through. There was failure in the rudder control system in that part which is connected between the actuating control and the rudder torque tubes. It was failed. Also the rudder failed. It appears that the torque tube failed and there was a failure near the top of the rudder. From the position of the rudder found in the wreckage, which was earlier in the flight pattern, and that fact that due to the heavy leading edge it would probably have dropped straight down, it looks like the rudder came off earlier in the break-up. One of the theories is that the pilot suddenly realized that he had an extreme yaw and then have pushed the rudder with a high force of 162 pounds. The pilot gave it a high maximum effort on the peddle which could have caused his rudder control to fail thereby releasing the rudder from its position then there was a sudden increase in yaw and tied in with that of course is that every indication that the rudder came off at an earlier point. This is another possibility of how this thing may have started, as pointed out by the sequence of events.

Maj. Turnquist: From the last part of your statement, did I understand that the pilot might have overcontrolled and the rudder failed?

Mr. R: What I intended to say is that the pilot's attention was primarily on the G load and for some reason here in this flight he did not do anything about correcting the yaw during the pullout. It happened too late and it was over. This failure in the rudder control system then could have been caused by break-up of the airplane but the most plausible thinking is that it might have been caused by the pilot. This is my opinion due to the fact that the rudder system is designed for 180 pounds pedal force regardless of how you get it. This is a pilot limitation, it should have been good for that.

Maj. MacDonald: Doesn't it seem that a yaw would have been apparent to the pilot?

Mr. Reynolds: He was well occupied during the high "G" part of the pull out. He didn't make any attempt to correct yaw.

Col. Douglas: How may G's did he pull during pull out?

Mr. R: Last part of record was 8.6 - it is very hard to read. The company will not make a definite statement on the number - probably between 7.5 and 8.6.

Col. D: Medical Officer of the Board, what is the average maximum G's the average man can sustain without blacking out?

Capt. Terry: There is quite a variance - talking to some of the pilots around here about the maximum number of G's. It varies but we believe that the average is around 3 or 4 - average maximum.

Berman: It all depends upon the time. You can stand 40 G's for 1/60th of a second or 2/10th. You stand varying degrees of G's in relation to the time.

Col. D: Is it possible that if Mr. Welch did blackout because of excessive G's during this period of time, only a matter of seconds, that the aircraft could have gone into the extreme yaw to the right at which time he had rudder travel to the left? What are the average G's that the average man can pull?

Dr. Terry: There is individual difference - depends on the time intervals that the G is applied - I still maintain 3 or 4 G's to be maximum.

Maj. MacD: There was a steady pull-out - the whole operation from 4 to 8 G's would have taken 3 - 4 seconds.

Col. Douglas: It is my personal experience that I black out from anywhere from 4 - 5 G's. I personally feel that if you check it for 8-9 G's a pilot needs 2 seconds to clear blackout.

Maj. MacDonald: A blackout is, correct me if I'm wrong doctor, a decrease of the blood supply to the brain.

Dr. Terry: Yes, and we believe it would be more pronounced after you had started out. You would black out during the dive.

Reynolds: May I add something, Welch had not been using a G suit. I don't believe he usually used one, at least that was my impression. I know that a person who does this sort of thing can build up a resistance to it. They devise ways and means of withstanding high G's as they get used to it.

Capt. Terry: You can take these measures and still blackout.

Maj. Turnquist: We will take the position that we cannot rule out the possibility of the pilot's not blacking out?

Capt. Terry: We can take a brain test - something that is difficult to do.

Maj. T: The evidence will not be too conclusive?

Capt. Terry: No it will not be conclusive but it will help determine whether there was a lack of oxygen supply

Reynolds: In general conclusion, first off, I don't think anyone at this time can make any conclusion. The airplane had yaw at this speed beyond the design requirements and in combination with speed, the vertical tail is designed for .8 Mach number and 8° of yaw. The airplane is not designed for high yaw angles at high speed. So you could say the break up was to be expected at this speed because the airplane was outside the design limits of the airplane. For some unknown reason the airplane is yawing at unusual angles at high speeds in these pull outs. As near as I can determine the airplane did not develop unusual yaw angles in the previous lower altitude load at Q indicated. I feel that the yaw angle was so much higher in comparison to the design yaw angles that I could have expected almost anything to fail. The horizontal tail of the left stabilizer failed downward which could be expected from a high yaw load to the right which increases the down load on the left side. The load tends to shift to the left side so that was in accordance with what you could expect from a high yaw to the right. The nose failed to the right which is also to be expected from a high yaw angle to right and everything indicated that the airplane broke up as could be expected in an excessive yaw angle at high speed. As I said before this is way outside of design structure requirements. Now you find this - the airplane yaws excessively in its pull out, something happened to make it yaw even more after the pull out and there are three possibilities, there is no way of telling for sure which one of these things it was. I recommend the following line of action (1) to determine why the airplane yaws to the excessive angles during pull outs (2) to evaluate the amount of yaw at various speeds on the actual airplane. Attempt to find out why it yaws and then develop some means of modification or correction to reduce this yaw to the amounts that the airplane was designed for, evidently something must be done to beef up the structure.

Berman: Your own structures lab at WADC - you are in charge of structural integrity?

Reynolds: On all airplanes of the AF.

Berman: You made a statement that interested me. You mentioned that it was your belief that this flight should have been instrumented to determine the wing deflections.

Reynolds: It was scheduled and included in the program that the airplane would have cameras to record deflections of the wing and tail. This is supposed to be part of the test data to be included.

Berman: Do you know why these flights were not so instrumented?

Reynolds: We had a record of the left side of the horizontal tip. I believe that our lab tests people should get with the aircraft lab, WADC, and the project office at an early date after we have had a chance to discuss this thing with other branches at the field on this stability problem and reasons why the airplane yaws at high speed. I think at this time the main thing that we can say that the Contractor should figure out why this airplane yaws. I don't feel that there is any small structural part failing first that can be definitely stated at this time that caused the trouble of the airplane.

Maj. T: This, then concludes your testimony?

Reynolds: Yes.

The next witness was Mr. A. F. Hecht, [illegible] - I am responsible for [illegible] and testing of engineering escape equipment - I have been with design and development of escape equipment since 1948.

Mr. Hecht - read his statement which was introduced as evidence.

Maj. Coberly: Does examination of the seat give any indication that the seat apparently came out with the pilot in it.

Hecht: It could have conceivably come out concurrently with or immediately after the pilot.

Maj. Coberly: Did the seat indicate pressure marks?

Hecht: The seat is pretty well mashed. It is in better condition than any other part of the aircraft. There are actual punctures of certain elements of the seat, noticeably in the arm rest and the lower support tubes. There are indications that the canopy rails failed upward and to the right.

Maj. MacDonald: Is there evidence that the rails struck the seat?

Hecht: It is believed - based on knowledge of the seat - it is probable that the rail struck the seat. We must assume that the canopy came off first. I tried to establish that as a basic fact to begin with before continuing with any analysis.

Reynolds: I thought I noticed somewhere in the reports of the people from the company some sort of buckle in the back of the seat.

Hecht: As I have gone over this we are trying to determine the types of loading which could cause this. It has been born out that these tubes could fail under high G load, initially it was not designed to withstand high accelerations with the injection. I don't want you to misunderstand.

Maj. T: Was the buckling in the seat caused by the impact with the ground?

Hecht: It is probable that it did occur on contact with the ground. The marked upper section was probably caused when struck by the canopy rail as it came off.

Dr. Terry: Is there any way you can determine whether or not the seat was at any time saturated or immersed in JP4?

Hecht: This could be done. Are you thinking in terms of the previous statement that the suit smelled of kerosene?

Dr. Terry: The suit was very wet with JP4; however, the pilot was not burned.

Hecht: We could definitely ask the personnel to come up with this.

Maj. MacDonald: I looked over the seat - just after the accident and I do not recall evidence of any fuel on it.

Capt. Terry: Could it be definitely determined?

Hecht: It is possible through chemical analysis. I could check with company personnel.

Capt. Terry: Is there a statement in that preliminary report that we have, I believe it is in attachment 17, that he could possibly have gone through a spray of fuel while he was in the air?

Coffman: You made a statement that after the right wing was pulled away the fuel could have sprayed out from the upper tank?

Reynold: Possibly.

Coffman: It had 1750 pounds of fule in the wing?

Reynolds: Am I right in assuming that you can make no conclusions as to whether the pilot was or was not in the seat when it came out of the airplane?

Hecht: It was highly possible that he was still in the seat at the time something struck him.

Maj. Coberly: You feel that the bend in the seat back did not come at that time?

Hecht: Now it might have been that this object that came across and struck him might have been falling in some manner and something coming back after striking him could have hit the seat.

Reynolds: What is the feeling about the fact that the nose section could have broken off while the pilot was still in it?

Hecht: The sequence of structure failure - as the nose came off first this could have caused the canopy to fail and also come off.

Dr. Terry: My feeling is that he was injured after the nose section came off and apparently he was struck by some object that had mass, hit his arm and kept going. All his injuries were injuries that were caused by a destructive force. I feel whatever struck him had force and continued going. I feel that he was in the seat at the time of those injuries. There are no fragments around the sites of these injuries. Apparently whatever hit him kept going.

Richard Hollingsworth was called next, Assistant Chief, Manual Flight Control Section, Aircraft Lab, WADC - Mr. Hollingsworth - I have been involved in mechanical actuators and flight controls for roughly 3 1/3 years - age 25. Mr. Kemp pointed out that a complete analysis has not been made of all components. Most of them have been removed and are being checked. The aileron actuators to date have not been checked. The items that have been checked, trim fittings for all purposes appear to be reasonable, the aileron and rudder fittings are where they should be. The stabilizer trim was approximately 7%, 9° nose down which is reasonable because of the flight conditions and the fact that he was making a high "G" pullout. There was no evidence of failure of any of the flight control cables so far as can be determined other than caused by airplane breakup. The rudder and stabilizer actuator involved appear to be satisfactory. We could find no discrepancies. The aileron actuators externally appear to be satisfactory - we should know in the morning. In so far as I could tell I could see there were no discrepancies in the flight control hydraulic system. There was a point of this fitting on the speed brakes. I don't really care to make a statement on that. Apparently the speed brakes were not operated anyway. The only thing I can report insofar as the oscillograph records show that when he required flight controls he got them in accordance with force and deflections - no reason to report any malfunction.

Mr. Hollingsworth concluded his statement.

The meeting was adjourned at 1730.

The Aircraft Accident Investigating Board reconvened at 0917 hours 22 October 1954, with the following members present:

VOTING MEMBERS

Major R. H. Turnquist	Acting Board President
Major T. S. Coberly	Board Member
Major W. A. Wendt	Accident Investigating Officer
Capt. A. T. Stemmerman	Board Member
Capt. C. T. Terry	Medical Officer
1/Lt. J. J. Simpson	Alternate Accident Investigating Officer

NON VOTING MEMBERS

Col. P. P. Douglas	Directorate of Flight Safety Rese
Capt. C. W. Patterson	Directorate of Flight Safety Rese
Mr. S. B. Berman	Directorate of Flight Safety Rese
Mr. A. G. Coffman	Ass't. Director of Plant Protecti NAA

TECHNICAL ADVISORS

Major G. L. MacDonald	WADC - F-100 Project Officer
Mr. R. Hollingsworth	WADC
Mr. K. E. Hecht	WADC Aircraft Lab.
Mr. L. B. Reynolds	WADC Structures Lab.

Each witness was advised as follows:

"The purpose of this investigation is to determine all factors relating to the incident and in the interest of accident prevention to avoid recurrence. It is not the purpose of this board to obtain evidence for disciplinary action nor to determine pecuniary liability nor to revoke a commission or remove a person from the active list (as covered by AF Regulation 36-2).

The first witness was a member of the Board, Mr. A. G. Coffman, Assistant Director Plant Protection, North American Aviation, Inc. Age 41, 18 years experience - 13 at NAA - 5 years with FBI.

Maj. Turnquist: Will you present your findings on the foreign objects found on the trucks?

Mr. Coffman: In bringing the wreckage from Palmdale to Los Angeles we moved it in three trucks and made every effort to keep same sequence or proximity of parts as they were picked up. When unloading the trucks, the following articles foreign to the airplane were found: A 1/8" drill bit. This was found on truck #263 driven by Cecil Glossin. Mr. Glossin does not know where the bit came from nor is there any indication it was in the airplane. A lab examination shows there was no indication of recent abrasions or scratches indicating contact with moving parts such as a cable and there was no indication that it had been subjected to recent electrical current. The Contractor feels that this fell out of someone's pocket while loading the truck. A small cloth bag of assorted bolts was found on truck #720. It was found that this sack of bolts was placed on the vehicle by J. F. O'Brien to be used in locking slings to pick up the wreckage. The 3/8" open end and box wrench was found on truck #766. This was found under the right hand intermediate fuselage panel on this truck. This panel does not contain any secondary structure or bracing that would give an indication of where it could have been lodged. The truck was broom cleaned before loading hence we have concluded that it fell out of the airplane wreckage or fell from someone's pocket but the latter is improbable. We made lab tests and found the following: The wrench was bent in a vise which is customarily done by electrical installation technicians in order that they may more easily reach terminal busses. The vise marks clearly show on the wrench under the microscope. The box end of the wrench has been broken off but the same is a very old break inasmuch as there is corrosion on that end of the wrench. There are no marks on the wrench that would indicate that it had been wedged against flight control mechanisms such as a control cable; also microscope examination indicates that there has been no electrical arcing or any recent contact with electrical current. The wrench bears the initials CHS. We have 16 employees with those initials, three of whom work in departments which had assembled or done test work on the F-100. None of the 16 employees claim this was their wrench and none have tools of a similar nature. We are continuing our investigation from the initial assembly of the intermediate fuselage in a continued effort to ascertain the origin of this wrench. We feel from the use of this type of wrench, that it was in the airplane at the time of the crash. We feel again, however, that it had absolutely no bearing on the crash in view of the lack of marks of electrical arcs on the same.

Dr. Terry: Do the employees have their own personal wrenches which they keep in their own tool boxes?

Mr. Coffman: Yes and there are just about every type of wrench that can be found from Sears Roebuck up to the most expensive type to be found. Drills are furnished by the company but they are expendable. They merely turn in a broken one to get a new one after basic issue.

The witness was dismissed since there were no further questions from Board Members.

The second witness was Mr. James F. Hegenwald, Jr., WADC Specialist in Emergency Escape and Crash Protection. Age 32 years. Years of experience - 9 years.

Major Turnquist: Have you read Mr. Hecht's statement that was presented before the board on 21 October?

A. I have.

Major Turnquist: Do you concur in his statement or do you have anything that you would like to add?

A. In great part I do agree to Mr. Hecht's statement. As a matter of fact, the one element of disagreement I believe would be in the area of the lap belt having been opened by a blow. I feel the preciseness of such a blow could hardly have been brought about by an accident of this type.

Major Turnquist: Do you have any theories of how the belt may have been opened?

A. I have one - that the pilot opened the belt himself.

Major Turnquist: Do you have any further statements that you would like to make?

A. No. I am in agreement with Mr. Hecht's statement.

Major MacDonald: As I recall Mr. Hecht's statement he felt there was no particular correlation with the crippling injury to the seat back and the heavy impact which crushed George's back. I do not believe I read it in the statement.

A. My answer to that again, Major, is that the crippling of the back seems to bear out the original statement by doctors that the blow was a massive blow from above and in front with George in the seat.

Major Turnquist: Do you have any theories as to when the lap belt might have been opened prior to the break up period? Do you have any theories on the result of your investigation or discussion with flight test personnel?

A. Yes, I do have a theory. As soon as the pilot realized that the aircraft was breaking up and possibly upon his seeing portions of the structure within his ejection path he was able to open his belt and was immediately withdrawn from the cockpit by negative G's.

Major Wendt: Jim, that does not fit with the statement that he was struck while in the seat. From the injuries received I do not believe he could have opened the lap belt after he received the injuries.

Major MacDonald: Also at the G's to which he was subjected at that time. Opening of the lap belt is a very precise movement. The injuries to the pilot were from the right side apparently at this point.

Mr. Hegenwald: The lapbelt may be opened by the left hand. Insofar as negative G's creating an inability to open the lap belt, there are two instances on record in F-86D piloted aircraft in which the pilot attempted to eject utilizing the seat with ejection controls identical to those of the F-100A. The hands could not be placed upon the controls due to negative G's but in both instances the pilot released his lap belt and was withdrawn from the cockpit.

Mr. Hecht: In the two recorded instances of the F-86D what type of lap belt were they wearing?

A. They were wearing the B-18.

~~Mr. Hecht: Do you think that the B-18 is a much easier belt to operate manually?~~

A. I indicated that a moment ago, I do not believe that the blow opened the belt.

Mr. Hecht: Would you consider it logical then that a lap belt which is more difficult to be opened manually, could be opened with the left hand which is not a normal motion for opening this lap belt?

A. In the case of George Welch, I know he indoctrinated himself for manifold emergencies, and the answer is that the belt could have been opened by him with equal facility with either hand.

Major Coberly: Mr. Hegenwald, did I understand your theory of the sequence of events that initial breakup alerted the pilot to his danger, and he released his lap belt and was subsequently struck a damaging blow before leaving the seat and cockpit?

A. Except for that period subsequent, I agree with your statement.

Lt. Simpson: Dr. Terry, you stated yesterday that you felt Mr. Welch was in his seat when he was struck that damaging blow but yet there was no compound breakage. Is it at all possible, if he were in his seat and supported by that mass that this damaging blow would have caused compound breakage, and also if he was in back of a mass he would not have received a compound fracture as shown on the pilot's body?

Dr. Terry: Well, I cannot be sure. A compound fracture is any fracture which the bone penetrates the skin. I do not see the correlation.

Major MacDonald: Bearing in mind that the airplane was in violent yaw and in a very rapid transition from high positive G's to high negative G's, do you believe it is possible for the pilot to have reached down and unlatched the belt?

Dr. Terry: The answer is no.

Col. Douglas: Mr. Hegenwald, have you had the opportunity to see the records of the oscillograph and the cameras as they were completed?

Mr. Hegenwald: Only in a secondhand way.

Col. Douglas: The reason I asked the question is that in a study of the data it appears that there is approximately a time lag of about 2 to 3 seconds in which the aircraft started into a violent yaw until the aircraft disintegrated. You made the statement that you thought the pilot had been alerted in sufficient time to open the belt. Do you feel qualified to make a statement on approximately how long you thought it would take to open this belt manually?

Mr. Hegenwald: If the airplane were in a violent yaw would the pilot's inability to stabilize the airplane have alerted him to an impending catastrophe and when structural breakaway occurred in the vicinity of the windshield and or canopy? Let us assume it takes him two seconds.

Col. Douglas: Have you talked with Welch about the technique in using and the construction of the automatic lap belt?

A. Yes, he was thoroughly acquainted and a firm advocate of the automatic lap belt.

Col. Douglas: Have you heard Mr. Welch state that on occasions during flights he manually opens a lap belt before performing part of the test flight?

A. No.

Col. Douglas: Have you talked with Welch about the use of a G suit?

A. No, that is not my field, sir.

Mr. Hegenwald was dismissed as there were no further questions.

The third witness was Mr. Frank W. Peterson, Surface Control Specialist, age 34. Experience - 12 years at NAA in engineering.

Major Turnquist: Have you read Mr. Hollingsworth's statement?

A. That is correct.

Major Turnquist: Do you know anything that you would like to add to his statement, or would you state that you do or do not agree with it?

A. The secretary read me the notes he had dictated, and also I read the notes he had written. I do not pick up in his notes anything that I would disagree with.

Major Turnquist: Is there anything that you would like to add?

A. There is only one thing in his notes that I would comment on. That is the trim position of the stabilizer was approximately 7 degrees leading edge down instead of 9 degrees. He is going to correct that. We had first thought it was 9 degrees before we had taken the actuator to the lab.

Major Turnquist: Could you give us a statement whether or not these control surfaces or actuators might have contributed to the accident?

A. No. We have checked the stabilizer hydraulic cylinder and it will operate in the desired range until it comes up to the end of the piston rod. The rudder cylinder has been checked and still operates but the end of the cylinder has reached 9 degrees due to the key that locks it in place, but it failed due to something twisting it when the structure broke up. The aileron cylinders, as soon as the hydraulic pressure was applied, positioned themselves normally which add to the factor that the aileron actuator and feel bungee are all tied into one assembly with the hydraulic cylinder.

Col. Douglas: Did you examine the rudder damper?

A. Yes. The gage showed that it had fluid. The lab checked the damper and it showed that the left rudder would be restricted to about 12 degrees and the right rudder to about 37 degrees, and when the damper was disassembled I have not seen the actual parts but I have been told that the shaft had been twisted due to some high inertia or aerodynamic force on the rudder when the airplane was breaking up. I understand that checks had been made on previous flights that proved that the rudder had full travel and the parts had not been tampered with or disassembled since these checks.

Major Coberly: Did I understand that the throw of the rudder was restricted by the damage to the damper or was the damper inherently restricted by the rudder?

A. The damper as it stands now will restrict the throw of the rudder, and I feel that when the ship was breaking up the rudder, due to some high inertia forces, twisted the shaft due to the fact that the damper was in an unnatural position due to the restriction. It received forces greater than it could stand. As a matter for the record, I think we should point out that although left rudder travel was restricted about 12 degrees, the oscillograph record shows, I think, not more than 5 degrees left rudder was called for or used. I think from this we can assume that regardless of when this damage occurred to the damper it would not have affected rudder control on this flight.

Col. Douglas: Do you know of any questions on the F-100 aircraft where the rudder damper was malfunctioned?

Mr. Peterson: I do not know of any malfunctions, but there are some people in surface control that would be more qualified to tell you about the damper malfunctions; Cecil Craigo could give you a better story. He is our hydraulic supervisor and has been following this damper program very closely.

Major MacDonald. There was some question about the rudder dampers on the production airplanes and those are subject to a T.O. from SMAMA.

Major Coberly: For fear that we might confuse the rudder damper and the yaw damper, the T.O., to my knowledge, was issued for the yaw damper and not the rudder damper.

Major MacDonald: The information we received did not concern failures, but rather the sub-standard performance of a few rudder damper units and the inspection was a one time inspection only to remove and replace those dampers which were considered to be suspicious.

Major Coterly: I would like to recommend to the Board that we ascert... number of this TO, and further ascertain whether or not the TO had be... complied with on the subject airplane.

Mr. Peterson was dismissed.

The next witness was Roy E. Ferren, Asst. Chief, Flight Test; Age 41 years, experience with North American over 17 years.

Col. Douglas: Mr. Ferren, would you please tell me what your specific duties are as Asst. Chief Flight Test?

Mr. Ferren: I assist the chief and take over when he is not there.

Col. Douglas: What do you do when he is not there?

Mr. Ferren: Make all decisions when he is not there, and conduct flight test programs on the airplanes assigned to us.

Col. Douglas: Do you review the flight test programs before the pilots fly?

A. We have a weekly scheduled meeting with the responsible senior flight engineers and other supervision in which we discuss the programs for the past week and determine programs for the next week. We also discuss the individual programs as they are brought to our attention by the flight engineer or his supervisor.

Col. Douglas: Do all test pilots who work for NAA come under your jurisdiction and control?

A. Only the engineering test pilots as opposed to production test pilots. We are only in control of the engineering test pilots for engineering work, and they come, under the organization chart, under Mr. Hollinger and myself.

Col. Douglas: At the completion of a particular flight during the phase of a test program, how is information derived from the pilot, as to what takes place on a flight?

A. The pilot's report, the radio log, and the flight engineer's handbook. I could expend a lot of time, Colonel, explaining the program.

Col. Douglas: Do you receive any instructions or directives from the AF about test programs on the aircraft?

A. Yes and no. On some programs we receive instructions telling us how they want some things, and in some cases none at all. Two extreme examples, Colonel, were those when we run a cooling spec outlined in the contract. We guarantee cooling performance in accordance with the spec. The other extreme is a compressor stalling program, then we receive a wire stating exactly what you want; those are the two extremes.

Col. Douglas: Is the section in which you are Assistant Chief responsible to insure that the aircraft perform all the test work required?

A. Yes.

Col. Douglas: Is your company responsible for the Phase I test of the F-100?

A. Yes.

Col. Douglas: Have you heard any of your test pilots, or have you read any statements by the test pilots, that would indicate to you that the F-100 has some yaw characteristics?

A. We have stated in several of our pilot reports and progress reports that the directional stability of the airplane could be improved.

Col. Douglas: Do you recall any recommendations as to improving the stability?

A. There were many of them.

Major Turnquist: I would like to clarify one thing in the record. Colonel Douglas asked you how much direction or instruction you receive from the AF.

A. I attempted to give an example. We are required when we sell you an airplane to complete certain specifications which have been written and agreed upon by Hq. AMC and all Commands. The best example is the cooling specs but before we build the airplane you resolve as to what temperature and altitudes we fly the airplane.

Major Turnquist: Do I understand that if your instructions are in the form of specifications and TO's and are complied with that the AF does not have to give detailed instructions?

A. The instructions are in the specifications.

Col. Douglas: Do you have control of all aircraft that are on bailment?

A. Only of aircraft bailed to the engineering section.

Col. Douglas: Do you have any instructions from the AF on how those aircraft will be flown on bailment to NAA?

A. Only what is in the bailment agreement.

Major Coberly: The agreement spells out the purpose for which the aircraft is bailed.

Major Wendt: Could you give us a brief run down on why George may not have been wearing a G suit?

A. Yes. I believe Welch had been through the centrifuge at USC and he was well aware of his G tolerance. He was the type of individual which I believe the medical records will show as having a tendency to less susceptibility to black out as is the case of persons who are rather small in stature. George did not wear a G suit when the acceleration points to be obtained on a given test were of short duration. This was the type test he was performing on the subject flight. George did wear a G suit when he was performing tests during which he was subjected to accelerations over extended periods such as in a high G descending spiral. This is the same policy as that followed by Edwards AF Base test pilots. They leave it up to the individual pilot as to his tolerance and what test he is doing as to whether he wear a G suit. Records show he was in possession of his faculties and flew correctly. He made a flight the morning before with pressure suit on and had removed it and made this one with ordinary flying clothes.

Dr. Terry: Have any of your pilots reported difficulty in handling controls under high G conditions, and is the additional pilot force occasioned by the increased weight of the pilot's arm caused by G considered in the instrumentation?

A. Pilot difficulty has never been noted in any reports. We are aware of the problem of increased weight of the pilot's arm under accelerations and take this into consideration in our instrumentation.

Major Coberly: Mr. Ferren, from your knowledge of the events leading up to this flight, do you have any information which would be significant for the consideration of this Board, or do you have any questions?

Mr. Ferren: I think I possibly can clarify a point to Colonel Douglas as to how we run this program. We have so many types of programs and the structural demonstrations program is set up after long conferences with the AF as to what points we are required to get. The structures and aerodynamics groups determine the critical points to be tested and this information is sent back to AMC where it is reviewed and additions and deletions are made. After the critical points have been agreed upon by ourselves and AMC we add certain build-up points which are below the final demonstration points. The final demonstration points and the build-up points are then combined in a flight program for the structural demonstration. The airplane is then instrumented to the satisfaction of ourselves and the Air Force because we are required to furnish proof in the way of data of the final points obtained. We then run the flight for the build-up point. We take the data and reduce it and give it to the technical and structures section who review the point and give us approval to continue. This is the way we handle our demonstration. We have a written OK from structures to proceed to the next point.

Col. Douglas: It has been stated before the Board that the aircraft in which George Welch crashed was not instrumented as called for in the contract?

A. That is news to me.

Col. Douglas: I am wondering if you agree or disagree with that.

A. On what basis was this statement made? If there any piece of paper w e put this in?

Col. Douglas: The statement was made there were supposed to be cameras placed to take photographs of each wing.

A. There were cameras. This was not required by the Air Force. It was our desire. All we had to furnish the AF was the G, speed, Mach number and altitude.

Mr. Berman: Roy, I understand on the last flight that only deflections were photographed of the left stabilizer not the wing.

A. This is not true. We recovered the film for the wing but it was not developed because it was burned.

Mr. Berman: I spoke to Mr. Spivak this morning and in the conversation he verified that they did not take any photographs of deflections on the wing because they did not think they needed any; it was only set up for the stabilizer. I am just repeating what he told me.

Major Coberly: The instrument records will show what data was provided for on the instant flight. This can be obtained if it is considered significant in this Board's consideration.

Mr. Ferren: I know the answer, Ted. The airplane was instrumented for wing and tail deflection. We were able to recover the instrumentation for the tail but not the wing.

Mr. Ferren was dismissed.

Mr. Hollingsworth, Technical Advisor to the Board, presented the following:

I just talked with Craigo. He is most familiar with the flutter damper. His opinion is that the first 23 of the rudder flutter damper had cast housings in which the hydraulic seals were conducive to leakage. This is leakage of the hydraulic fluid. Subsequent to the 23rd, the housings have been machined and there has been no problem. All but 6 of the cast housings were found here at NAA, and a one time TO was issued with serial numbers to pull the other six from delivered airplanes and return them to NAA. The rudder flutter damper on Welch's airplane was not among these. It was machined. As additional information, the dampers are periodically checked at 25 hours and if they need servicing two consecutive times they are replaced, and there are no known failures to date.

Mr. Hecht, Technical Advisor, introduced the following evidence:

In reply to a question that Capt. Terry posed to the Board yesterday regarding the possibility of the presence of JP4 fuel on the ejection seat, I have discovered the following: it was checked at the scene by NAA people and it was determined at that time that there was no JP4 present on the seat.

The next witness was Donald Rogerson, Asst. Chief, Power Plant Engineer at NAA. Age 36 - experience in the power plant - 14 years.

Major Turnquist: Could you give us a statement as to whether or not it is your opinion that the engine was operating properly at the time of the incident, and your evaluation as to whether or not the power plant contributed to the incident?

A. Based on our preliminary examination of the remains of the power plant plus our detailed examination of the component parts of the power plant installation after it had been removed to the Los Angeles area, it was the opinion that the engine and associated components were operating normally in the full or nearly full afterburner position at the time the airplane disintegrated.

Mr. Rogerson further testified that the conclusions of his group were based on the following factors:

a. There was no evidence of centrifugal failure of any of the rotating parts of the engine. The control components which are motor driven and not subject to shifting during impact, were all in the full open or nearly full open position, and that the afterburner exhaust nozzle was fully open, and that the damage incurred by the blades of the rotors indicated that they were revolving at considerable speed upon impact. He further testified that it is the official NAA engineering position that the power plant in no way contributed to the incident.

Major Turnquist asked if any members of the Board had any further questions and no member of the Board desired to interrogate the witness. He was excused and the next witness called.

The next witness was Arthur E. Jones, Pratt & Whitney Representative at NAA. Age 47 - experience approximately 14 years.

Major Turnquist: Do you feel that the engine was a factor in the incident, or that the engine was operating properly at the time of the incident?

A. It is our opinion, after going over this with the members of NAA engineering department, that the engine was operating normally at the time of the accident. We feel actually that the engine did not contribute to the incident.

Col. Douglas: Did you participate in the investigation of the engine with the NAA engineers?

A. Yes, I did.

Col. Douglas: Have you read the statement that is now being typed in final form about the analysis of the engine?

A. Yes.

Col. Douglas: Do you agree with it in its entirety?

A. I agree substantially with the major parts that I have read. Would you like me to explain this by saying that I did not examine some of the airframe components included in the report, therefore, I am not qualified to comment on that portion of the statement.

Col. Douglas: Have you read the report that is being typed that deals strictly with the analysis of the engine?

A. Yes. I agree with that.

Col. Douglas: That is what you would be willing to affix your signature to?

A. There is a little difficulty there. Pratt & Whitney have regulations which require submitting to the home office for review prior to affixing signatures. There are cases where we can sign documents if preceded by a qualifying statement that the concurrence is subject to subsequent disapproval by the home office.

Major Turnquist asked the Board if it was agreeable to accept Mr. Jones' conditional concurrence in NAA's report with this provision, and it was agreeable with the Board.

Mr. Jones was dismissed.

Major Coberly: In view of the fact that none of the regular Board Members were at the scene of the accident on the day of the accident or the subsequent day, I would like to ask any of the representatives of the other commands who were at the scene of the accident if they have anything which they observed during their visits to the scene of the accident which is significant and which has not been given in testimony before this Board.

Major MacDonald: I reached the accident scene at 1330 hours and spent the entire afternoon looking the area over. Our preliminary studies did not show anything in conflict with the reported comments to date.

Col. Douglas: I do not have anything to add as the result of my observations during that time. It has been covered by the witnesses before the Board.

Mr. Barman: I have nothing more to add.

Mr. Coffman: Not at the scene of the accident.

Lt. Simpson: Negative.

Major Turnquist: We will now adjourn this part of the Board proceedings as nothing further is required. We will reconvene executive members of the Board and the representatives from the Directorate of Flight Safety Research. This afternoon. Adjournment was at 1130.

On 22 October 1954 the Board reconvened at 1230 in executive sessio to discuss the findings to date. The following were present:

Col. P. P. Douglas
Mr. S. D. Berman
Major R. H. Turnquist
Major T. S. Coberly
Major W. A. Wendt
Capt. A. T. Stoermerman
Capt. C. T. Terry
Lt. J. J. Simpson

At 1445 Mr. H. A. Storms, Jr., presented the oscillograph recordings and interpreted them to the Board.

The Board adjourned for the day at 1600.

On 25 October the Board reconvened in executive session and Major Wendt introduced the following attachments as evidence:

Attachment No. 1	Maintenance Forms in lieu of Form 1
Attachment No. 2	List of TO's not complied with
Attachment No. 3	Clearness
Attachment No. 4	Witnesses' Statements
Attachment No. 5	Photographs
Attachment No. 9	Special Orders on Board
Attachment No. 10	Statement of Tower Operations
Attachment No. 11	Weather Data
Attachment No. 12	Weight & Balances (Form F)
Attachment No. 13	Estimated Damage to Private Property
Attachment No. 14	Wreckage Distribution
Attachment No. 15	Bailment Agreement
Attachment No. 16	CCN 139
Attachment No. 17	NAA Preliminary Report
Attachment No. 18	Preliminary NAA Report from Mr. Kemp to Mr. Spivek
Attachment No. 19	Preliminary Message of Incident
Attachment No. 20	Mr. Lewis' Statement
Attachment No. 21	Statement on Parachute
Attachment No. 22	Mr. Reynolds' Statement (WADC)
Attachment No. 23	Mr. Hollingsworth's (WADC) Statement
Attachment No. 24	Mr. Hecht's (WADC) Statement
Attachment No. 25	Dr. Lombard's Statement & Background
Attachment No. 26	Oscillograph of Flight No. 33
Attachment No. 27	Oscillograph of Flight No. 48
Attachment No. 28	Form 14C

The Board discussed the required inspection of the Radar access door and the 1.4 Mach limit placed on the aircraft.

Capt. Terry introduced the Forms 14A and 14B and discussed them in detail with the members of the Board. The Board accepted his findings.

Capt. Stoermerman introduced the Form 14E.

The Board adjourned at 1030.

The Board participated in North American Aviation Inc's final meeting on the F-100 crash.

Tuesday, 26 October 1954, the Board convened in executive session at 0900 with the following present:

Col. P. O. Douglas
Mr. S. D. Perman
Major R. H. Turnquist
Major T. S. Coberly
Major W. A. Wendt
Capt. A. T. Stemmerman
Capt. C. T. Terry

The Board completed its deliberations and completed the Forms 14.

The restrictions on the aircraft and other recommendations were discussed.

The Board adjourned at 1230.

Roy H. Turnquist
ROY H. TURNQUIST
Major, USAF
President

Willard A. Wendt
WILLARD A. WENDT
Major, USAF
Aircraft Accident Officer

Theodore S. Coberly
THEODORE S. COBERLY
Major, USAF
Member

Charles T. Terry
CHARLES T. TERRY
Capt, USAF (MC)F/S
Medical Officer

Arthur T. Stemmermann
ARTHUR T. STEMMERMANN
Capt, USAF
Recorder

NORTH AMERICAN AVIATION INC

PROCUREMENT SPECIFICATION

FOR

FLIGHT TESTING

AN

AIR SUPERIORITY FIGHTER AIRPLANE - DAY

AF MODEL F-100A

(NAA MODEL NA-192)

CONTRACT NO. AF-33 (600)-6545

(MODEL SPECIFICATION NO. NA-51-594, DATED 24 AUGUST 1952,

REVISED 1 MAY [illegible])

File No. [illegible] Report No. NA 51-858

NORTH AMERICAN AVIATION, INC.

MUNICIPAL AIRPORT LOS ANGELES 45 CALIFORNIA

ENGINEERING DEPARTMENT

PROCUREMENT SPECIFICATION

FOR

FLIGHT TESTING

AN

AIR SUPERIORITY FIGHTER AIRPLANE - DAY

AF MODEL F-100A

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CONTRACT NO. AF-33 (600)-6545

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REVISED 1 MAY 1952)

PREPARED BY

B. N. Kronberg

B. N. Kronberg

APPROVED BY

G. R. Mellinger

G. R. Mellinger
Chief of Flight Test

C. J. Hansen

C. J. Hansen
Assistant Chief Engineer

No. of Pages Date 24 August 1951

REVISIONS

DATE	REV BY	PAGES AFFECTED	REMARKS
1 May 1952	BK, MA	Noted	Revised to cover accumulated changes in the Model Specification.

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AIR SUPERIORITY FIGHTER AIRPLANE - DAY

AF MODEL F-100A

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CONTRACT NO. AF-33 (600)-6545

(MODEL SPECIFICATION NO. NA-51-594, DATED 24 AUGUST 1951,

REVISED 1 MAY 1952)

1. Scope and Classification - This specification covers flight testing and associated ground testing requirements of the Air Force for the AF Model F-100A "Air Superiority Fighter Airplane - Day", NAA Model NA-192.

2. Applicable Specifications and Other Publications - The testing requirements of the following publications are applicable to and form a part of Phase III of this specification to the extent specified herein (See Appendix I, Deviations). In the event of discrepancy between the testing requirements of this specification and any other specification or publication, the testing requirements of this specification shall prevail.

AMC Manual No. 80-1, Handbook of Instructions for Aircraft Designers, Ninth Edition, Revised January 1951.

Air Force Specification No. 1815-B, entitled "Flying Qualities of Piloted Airplanes", dated June 1948.

Military Specification MIL-I-5072, entitled "Instrument Systems; Pitot-Static Tube Operated, Installation of", dated 17 October 1949.

Air Force Specification No. 1816, entitled "Spinning Requirements for Airplanes", dated 15 June 1945.

Military Specification MIL-T-5522, entitled "Test Procedure for Aircraft Hydraulic Systems", dated 3 January 1950.

Military Specification MIL-H-5440, entitled "Hydraulic Systems, Design, Installation and Tests of Aircraft, (General Specification for)", dated 9 January 1950.

ANC Bulletin ANC-12, entitled "Vibration and Flutter Prevention Handbook", dated April 1948. (Applicable to Phase I)

Military Specification MIL-I-6051, entitled "Interference Limits and Methods of Measurement; Aircraft Radio and Electronic Installation", dated 28 March 1950.

Army-Navy Aeronautical Specification AN-C-106, entitled "Compass Swinging; Aircraft", dated 28 June 1943.

Army-Navy Aeronautical Specification AN-T-64, entitled "Test Procedure for Aircraft Pressure Cabins", dated 2 December 1944.

Army-Navy Aeronautical Specification AN-T-50a, entitled "Heating and Ventilating Equipment, Test Procedure for Aircraft", dated 3 December 1946.

Military Specification MIL-T-5842, entitled "Transparent Areas, Anti-Icing, Defrosting, and Defogging System, General Specification for", dated 1 September 1950.

Air Force Specification No. 7116 (1), entitled "Radio Compass AN/ARN-6; Bench, Pre-Flight and Flight Tests of", dated 16 July 1946, including Amendment No. 1, dated 13 June 1947.

Military Specification No. MIL-R-6335, entitled "Radar Identification Set AN/APX-6, Bench, Pre-Flight and Flight Tests of", dated 20 February 1951.

Military Specification No. MIL-A-6224, entitled "Antennae for UHF Airborne Communications Equipment General ~~Specification for Design of", dated 25 September 1950,~~ including Amendment No. 1, dated 13 December 1950.

Military Specification MIL-T-6816, entitled "Test Procedure for Aircraft Carbon Monoxide Detection and Control", dated 6 July 1950.

Military Specification No. MIL-P-5902, entitled "Purging Systems, Aircraft Fuel Tank, Internal and External, General Specification for", dated 1 June 1950.

Military Specification No. MIL-T-7378, entitled "Tank, Fuel, Aircraft, External, Removable, General Specification For", dated 5 January 1949.

Memorandum Report No. WCNEI-525-460, entitled "Test Procedure for Turbo-Prop and Turbo-Jet Aircraft Power Plant Installations", dated 15 June 1951.

3. Requirements - The tests specified herein shall be performed on the "Air Superiority Fighter Airplane - Day" test airplanes; except that where similarities exist between the "Aerodynamic Prototype Air Superiority Fighter Airplane - Day" airplane, the "Armament Prototype Air Superiority Fighter Airplane-Day" airplane, and the "Air Superiority Fighter Airplane - Day" airplanes, the tests conducted on any one airplane shall apply to all other airplanes and need not be repeated.

3.1 Phase I Requirements

3.1.1 Ground Tests - Ground tests shall be conducted to determine the final weight and cg location, fuel and oil tank calibration and schedule, surface controls and system friction, control feel and response characteristics, and landing gear surge tests. Functional tests shall be conducted to establish that all equipment and airplane normal and auxiliary systems are satisfactory from a standpoint of flight safety. Canopy and seat ejection tests shall be as specified in the contract (Reference Report No. NA-51-851). Engine runs shall be conducted to insure that critical engine, accessory, afterburner, and structural temperatures are within safe operating limits. Checks shall be made of the fuel and lubricating systems, engine electronic and auxiliary controls, engine thrust with and without afterburner, carbon monoxide concentration and operating characteristics of engine and accessories, as required to insure safety of flight. Ground vibration tests shall be conducted in accordance with ANC Bulletin ANC-12 to determine the important natural frequencies and modes of critical structural components of the aircraft. Measurements shall be made of the frequency and deflection configuration of important vibration modes.

3.1.2 Taxi Tests - The airplane shall be subjected to braking tests, normal and cross-wind taxi tests, nosewheel lift-off, turning and steering and other ground handling checks, including taxi tests up to approximately 50 knots with the canopy in the "open position" for taxiing.

3.1.3 Phase I Flight Tests

3.1.3.1 Flight Vibration Tests - Flight vibration tests shall be made by the pilot of the nature and severity of vibration experienced during take-off, climb, level flight speeds up to the maximum permissible speed, dives up to the maximum permissible speed (within placard limits of the airplane), accelerated maneuvers, approach glide, and landing. Quantitative measurements shall be made if excessive or unusual vibrations are exhibited during the qualitative tests.

3.1.3.2 Functional Tests - Operational checks shall be made on the landing gear, speed brake, wing slats, canopy, cockpit heating and ventilating, cabin pressurization, normal surface control power system, auxiliary ram air operated surface control power system, and other tests of a similar nature, as required to insure safety of flight. Checks shall be made on carbon monoxide concentration, engine and accessory operation, critical engine and structural temperatures, afterburner operation, and other tests of a similar nature, as required to insure safety of flight.

3.1.3.3 Stability and Control Tests (Phase I) - Preliminary stability and control checks shall be made with emphasis on the critical configurations for the following tests:

Static longitudinal, static directional and lateral stability.

Dynamic longitudinal, dynamic directional and dynamic lateral stability.

Horizontal tail and rudder control power and forces.

Effectiveness of trimming devices and effect of the speed brake on trim.

Aileron control effectiveness.

Accelerated and unaccelerated stalling characteristics, stall warning and maximum lift coefficient.

~~Dive tests to establish an envelope of speeds and Mach~~ numbers, as required to insure safety of flight.

Qualitative tests to check lateral and longitudinal stick centering, lateral and longitudinal control surface response versus minimum practical stick and pedal movement, roll and pitch sensitivity at high altitudes, maneuvering forces, landing and take-off forces, system friction and play, and control action in simulated rapid evasive maneuvers.

3.1.3.4 Performance Tests (Phase I) - Preliminary performance checks shall be made, with emphasis on the critical configurations for the following tests:

Selected level flight speeds at three selected altitudes.

Rate of climb versus altitude at estimated best climbing speed.

Range data from the above.

Conduct a typical endurance problem for primary mission.

Preliminary check of take-off and landing characteristics, including checkout of parabrake installation.

Service Ceiling.

Turning radii tests and tactical suitability tests at high altitude and high Mach number.

Afterburner and engine thrust checks.

Airspeed, altitude and free-air temperature system calibrations.

3.1.3.5 Preliminary Structural Demonstration (Phase I) - Preliminary structural integrity flight checks shall be made, as deemed necessary by the Contractor, to establish an envelope of speeds, Mach numbers and load factors, as required to insure safety of flight. (See Phase III for Final Demonstration.)

3.2 Contractor's Phase II Requirements - Maintenance and servicing of the test airplane and associated test equipment during 25 flight hours of testing by Air Force pilots shall be provided.

~~3.3 Phase III Requirements - Phase III tests shall be~~ conducted to show compliance with the specifications and publications listed in Section 2 to the extent specified herein (See Appendix I, Deviations). Those tests conducted during Phase I need not be repeated during Phase III and the data obtained during Phase I shall be utilized to show compliance of the test aircraft with specifications and publications listed in Section 2.

3.3.1 Stability and Control Tests - Stability and control tests shall be conducted to show compliance with applicable test requirements of Specification 1815-B, as modified by the Model Specification. 1

3.3.2 Power Plant Installation Tests - The power plant installation shall be tested in accordance with the requirements of Air Force Memorandum Report WCNEI-525-460. Carbon monoxide tests to demonstrate compliance with the concentration limits specified in the HIAD shall be conducted in accordance with Specification MIL-T-6816. Overheat detector system tests shall be conducted in accordance with the procedure recommended by the Contractor and the vendor of the detector equipment. Tests shall be conducted to check nitrogen gas purging of the fuel cell interior vapor space in accordance with the testing requirements of Section 4.5 of Specification MIL-P-5902. Over-all sound level measurements shall be made in flight at the head level of the pilot. Frequency-band sound level tests shall be not required. 2 to 25 26 27 28 29 30

3.3.3. Droppable Under-Wing Fuel Tank Tests - Flight testing of the droppable under-wing fuel tanks shall be conducted in accordance with Specification MIL-T-7378. Fuel cell qualification and laboratory tests shall be as specified in the contract and shall not be considered as a requirement of this Specification (Reference Report No. NA-51-813, entitled "Procurement Specification 275-Gallon Fuel Tank-Droppable Under Wing for the Air Superiority Fighter-Day"). 25

3.3.3.1 Performance - Performance tests shall be conducted to determine the loss in airspeed due to the tank installation.

3.3.3.2 Stability - Stability and control tests shall be conducted in accordance with Specification No. 1815-B in configurations P, CR, L, PA and WO to determine directional, longitudinal and lateral stability in accelerated or unaccelerated flight with empty tanks installed and repeated with full tanks installed.

3.3.3.3 Buffeting - Flight tests shall be conducted up to a Mach number of 1.0 with tanks installed to check buffeting and trim characteristics. (Reference Deviation No. 101 of Model Specification NA-51-594.)

3.3.3.4 Tank Drop Tests - One full tank shall be dropped from one wing at the maximum speed attainable at the test altitude with tanks installed, using military power, and one full tank shall be dropped from the other wing at a speed of 1.5 times stall speed at sea level. The tests may be performed during the same flight. The test altitude shall be approximately 10,000 feet. The above tank drop tests shall be repeated, using empty tanks.

3.3.4 Structural Integrity Demonstration

3.3.4.1 Clean Airplane (Without external stores)

3.3.4.1.1 Forward cg Condition - The following maneuvers (3.3.4.1.1.1 through 3.3.4.1.1.4) shall be performed with the airplane in the clean condition (without external stores), at a flight weight of approximately 23,900(*) pounds and a flight cg location of approximately 29.5 percent mac. More than one maneuver may be performed during the same flight, if performed with minimum delay.

3.3.4.1.1.1 Limit g Pull-Out at Maximum Mach Number - Dive and pull-out to obtain 7.33 g at the maximum Mach number at which it is possible to obtain that load factor, within tolerable buffet and satisfactory control characteristics, as initially decided by the test pilot and verified by the Air Materiel Command's Representative. The maximum structural design Mach number for the test weight and configuration shall not be exceeded.

(Continued on page 10)

(*) Or take-off gross weight (clean) minus the weight of fuel required to climb to the test altitude, whichever weight is lighter.

The limit conditions for this test consist of diving the airplane through at least 10,000 feet pressure altitude at a dive angle of approximately 60 degrees to the horizontal, with all drag increasing devices set for minimum drag, and pulling-out at the highest altitude at which the specified load factor can be attained.

3.3.4.1.1.2 Pull-Out (Maximum q) - Dive and pull-out to obtain 7.33 g at the maximum possible calibrated airspeed (within design limits) at a pressure altitude of approximately 3,000 feet or the lowest safe altitude, as limited by safe terrain clearance required to perform the maneuver, whichever altitude is the higher. Limit design Mach number for the test altitude or maximum Mach number attainable at the test altitude, as limited by buffeting or satisfactory stability and control, whichever Mach number is the lower, shall be attained during the dive preceding the pull-out.

3.3.4.1.1.3 Rolling Pull-Out (Maximum Wing Torsion) - Perform a rolling pull-out to the right from a steady left-turn established at 4.88 g and the calibrated airspeed corresponding to the design speed for maximum wing torsion. The specified load factor shall be maintained while the rate of roll is built-up, with rudder fixed in trim position, to the maximum attainable with an abrupt application of a 30-pound side force on the stick, full aileron deflection, or maximum aileron boost, whichever shall first occur. The airplane shall be rolled from the initial bank to at least the same degree of bank in the opposite direction (Altitude of performing maneuver shall be the altitude for specified speed and Mach number).

3.3.4.1.1.4 Push-Down - Push-down to attain minus 3.0 g at the calibrated airspeed corresponding to the level flight high speed at 12,000 feet pressure altitude (Altitude of performing push-down optional).

3.3.4.1.2 Aft cg Condition - The following maneuvers (3.3.4.1.2.1 to 3.3.4.1.2.3) shall be performed with the airplane in the clean condition (without external stores), at a flight weight of approximately 21,850 pounds and a flight cg location of approximately 35.0 percent mac. More than one maneuver may be performed during the same flight, if performed with minimum delay.

3.3.4.1.2.1 Pull-Out (High Angle of Attack) - Pull-out to obtain 7.33 g at the minimum airspeed at which it is possible to attain the specified load factor (Altitude of performing pull-out optional).

3.3.4.1.2.2 Rolling Pull-Out (Maximum pb/2V) - Perform a rolling pull-out to the right from a steady left turn established at 4.88 g and the calibrated airspeed for maximum wing tip helix angle pb/2V (or the minimum speed required to maintain the specified load factor, if greater). The specified load factor shall be maintained while the rate of roll is built-up, with rudder fixed in trim position, to the maximum attainable with an abrupt application of a 30-pound side force on the stick, full aileron deflection, or maximum aileron boost, whichever shall first occur. The airplane shall be rolled from the initial bank to at least the same degree of bank in the opposite direction (Altitude of performing maneuver shall be altitude for maximum pb/2V).

3.3.4.1.2.3 Speed Brake Operation - Open the speed brake at a pressure altitude of approximately 3,000 feet or the lowest safe altitude, as limited by safe terrain clearance required to perform the maneuver, whichever altitude is the higher. Limit design Mach number for the test altitude or the maximum Mach number attainable at the test altitude, as limited by buffeting or satisfactory stability and control, whichever Mach number is the lower, shall be attained prior to opening the speed brake.

3.3.4.2 Airplane with Empty 275 Gallon External Wing Tanks

3.3.4.2.1 Forward cg Condition - The following maneuvers (3.3.4.2.1.1 through 3.3.4.2.1.4) shall be performed with empty 275 gallon tanks installed, at a flight weight of approximately 24,546 pounds (*) and a flight cg location of approximately 29.5 percent mac (use external wing tank fuel to climb to the test altitude). More than one maneuver may be performed during the same flight, if performed with minimum delay.

3.3.4.2.1.1 Limit g Pull-Out at Maximum Mach Number - Dive and pull-out to attain 6.0 g at the maximum Mach number at which it is possible to attain that load factor, within tolerable buffet and satisfactory control characteristics, as initially decided by the test pilot and verified by the Air Materiel Command's Representative. The maximum structural design Mach number for the test weight and configuration shall not be exceeded. The limit conditions for this test consist of diving the airplane through at least 10,000 feet pressure altitude at a dive angle of approximately 60 degrees to the horizontal, with all drag increasing devices set for minimum drag, and pulling-out at the highest altitude at which the specified load factor can be attained.

(*) Or take-off gross weight (clean) minus the weight of fuel required to climb to the test altitude, whichever weight is the lighter.

3.3.4.2.1.2 Pull-Out (Maximum q) - Dive and pull-out to attain 6.0 g at the maximum possible calibrated airspeed (within design limits) at a pressure altitude of approximately 3,000 feet or the lowest safe altitude, as limited by safe terrain clearance required to perform the maneuver, whichever altitude is the higher. Limit design Mach number for the test altitude or maximum Mach number attainable at the test altitude, as limited by buffeting or satisfactory stability and control, whichever Mach number is the lower, shall be attained during the dive preceding the pull-out.

3.3.4.2.1.3 Rolling Pull-Out (Maximum Wing Torsion) - Perform a rolling pull-out to the right from a steady left turn established at 4.0 g and the calibrated airspeed corresponding to design speed for maximum wing torsion, or limits of controllability, whichever speed is the slower. The specified load factor shall be maintained while the rate of roll is built-up, with rudder fixed in trim position, to the maximum attainable with an abrupt application of a 30-pound side force on the stick, full aileron deflection, or maximum aileron boost, whichever shall first occur. The airplane shall be rolled from the initial bank to at least the same degree of bank in the opposite direction (Altitude of performing maneuver shall be the altitude for the specified speed and Mach number).

3.3.4.2.1.4 Push-Down - Push-down to attain minus 3.0 g at the calibrated airspeed corresponding to the level flight high speed at 12,000 feet pressure altitude (Altitude of performing push-down optional).

3.3.4.2.2 Aft cg Condition - The following maneuvers (3.3.4.2.2.1 through 3.3.4.2.2.2) shall be performed with empty 275 gallon tanks installed, at a flight weight of approximately 22,250 pounds and a flight cg location of approximately 35.0 percent mac. More than one maneuver may be performed during the same flight, if performed with minimum delay.

3.3.4.2.2.1 Pull-Out (High Angle of Attack) - Pull-out to attain 6.0 g at the minimum airspeed at which it is possible to attain the specified load factor (Altitude of performing pull-out optional).

3.3.4.2.2.2 Rolling Pull-Out (Maximum pb/2V) - Perform a rolling pull-out to the right from a steady left turn established at 4.0 g and the calibrated airspeed for maximum wing tip helix angle pb/2V (or the minimum speed required to maintain the specified load factor, if greater). The specified load factor shall be maintained while the rate of roll is built-up, with rudder fixed in trim position, to the maximum attainable with an abrupt application of a 30-pound side force on the stick, full aileron deflection, or maximum aileron boost, whichever shall first occur. The airplane shall be rolled from the initial bank to at least the same degree of bank in the opposite direction (Altitude of performing maneuver shall be altitude for maximum pb/2V).

3.3.4.3 Airplane with Full 275 Gallon External Wing Tanks

3.3.4.3.1 Forward cg Condition - Take-off with full internal fuel and full 275 gallon external wing tanks installed (take-off gross weight of approximately 28,561 pounds and take-off cg location (gear up) of approximately 32.7 percent mac) and perform the following maneuvers (3.3.4.3.1.1 through 3.3.4.3.1.7) as soon as possible after take-off, consistent with the test conditions. More than one maneuver may be performed during the same flight, if performed with minimum delay.

3.3.4.3.1.1 Limit g Pull-Out at Maximum Mach Number - Dive and pull-out to attain 6.0 g at the maximum Mach number at which it is possible to attain that load factor, within tolerable buffet and satisfactory control characteristics, as initially decided by the test pilot and verified by the Air Materiel Command's representative. The maximum structural design Mach number for the test weight and configuration shall not be exceeded. The limit conditions for this test consist of diving the airplane through at least 10,000 feet pressure altitude at a dive angle of approximately 60 degrees to the horizontal, with all drag increasing devices set for minimum drag, and pulling-out at the highest altitude at which the specified load factor can be attained.

3.3.4.3.1.2 Pull-Out (High Angle of Attack) - Pull-out to attain 6.0 g at the minimum airspeed at which it is possible to attain the specified load factor (Altitude of performing pull-out optional).

3.3.4.3.1.3 Rolling Pull-Out (Maximum Wing Torsion) - Perform a rolling pull-out to the right from a steady left turn established at 4.0 g and the calibrated airspeed corresponding to design speed for maximum wing torsion, or limits of controllability, whichever speed is the slower. The specified load factor shall be maintained while the rate of roll is built-up, with rudder fixed in trim position, to the maximum attainable with an abrupt application of a 30-pound side force on the stick, full aileron deflection, or maximum aileron boost, whichever shall first occur. The airplane shall be rolled from the initial bank to at least the same degree of bank in the opposite direction (Altitude of performing maneuver shall be the altitude for specified speed and Mach number).

3.3.4.3.1.4 Push-Down - Push-down to attain minus 3.0 g at the calibrated airspeed corresponding to the level flight high speed at 12,000 feet pressure altitude (Altitude of performing push-down optional).

3.3.4.3.1.5 Rolling Pull-Out (Maximum Rolling Velocity) - Perform a rolling pull-out to the right from a steady left turn established at 4.0 g and the calibrated speed for maximum rolling velocity (or the minimum speed required to maintain the specified load factor, if greater). The specified load factor shall be maintained while the rate of roll is built-up, with rudder fixed in trim position, to the maximum attainable with an abrupt application of a 30-pound side force on the stick, full aileron deflection, or maximum aileron boost, whichever shall first occur. The airplane shall be rolled from the initial bank to at least the same degree of bank in the opposite direction (Altitude of performing maneuver shall be altitude for greatest rolling velocity)

3.3.4.3.1.6 Pull-Out (Maximum q) - Dive and pull-out to attain 6.0 g at the maximum possible calibrated airspeed (within design limits) at a pressure altitude of approximately 3,000 feet or the lowest safe altitude, as limited by safe terrain clearance required to perform the maneuver, whichever altitude is the higher. Limit design Mach number for the test altitude or maximum Mach number attainable at the test altitude, as limited by buffeting or satisfactory stability and control, whichever Mach number is the lower, shall be attained during the dive preceding the pull-out.

3.3.4.3.1.7 Rudder and Vertical Tail Condition (Maximum Yaw) - At the calibrated airspeed corresponding to the design speed ~~for maximum maneuvering vertical tail load and with ailerons fixed~~ in trim position, displace rudder to full deflection or to limit of 180 pounds pilot effort, whichever shall first occur. After reaching steady yaw, the rudder shall be returned abruptly to neutral (Altitude of performing maneuver shall be the altitude for maximum maneuvering vertical tail load or the lowest safe altitude, as limited by safe terrain clearance required to perform the maneuver, whichever altitude is the higher).

3.3.5 Spinning Demonstration - A spinning demonstration shall be conducted in accordance with the requirements of Specification 1816.

3.3.6 Airspeed System Tests - Airspeed system tests shall be conducted in accordance with the requirements of Specification MIL-T-5072.

3.3.7 Performance Tests - Performance tests shall be conducted as required by the Contractor, with emphasis on the following tests:

Speed thrust calibration

Drag effects on speed thrust

Stalling characteristics

Take-off and landing data, including check-out of parabrake installation

Climb data

Cruise control data for Pilot's Handbook - Not more than three configurations shall be flight checked for justification of "Black" chart data.

3.3.8 Armament Tests - Armament tests shall be as specified in the contract (Reference NA 51-847, Procurement Specification for Armament Testing).

3.3.9 Pressure Cabin Tests - Pressure cabin flight tests shall be conducted in accordance with Sections D-4 and D-5 of Specification AN-T-64 at maximum range cruise power, military power, and afterburner power. 37 to 45

The tests shall be conducted to check the cabin isobaric pressure altitude of 12,500 feet from 12,500 feet to the 5.0 psi differential pressure altitude of 31,000 feet. Tests shall then be conducted at and above 31,000 feet to operational service ceiling to check the 5.0 psi differential pressure system.

Tests shall be conducted to check the cabin isobaric pressure altitude of 12,500 feet from 12,500 feet to the 2.75 psi differential pressure altitude of 21,200 feet to check the normal 2.75 psi condition and above 21,200 feet to approximately 35,000 feet to check the combat condition.

Tests shall be conducted to check control rate of cabin pressure increase to a maximum of 2 inches Hg per minute when changing from 2.75 psi differential pressure to 5.0 psi differential pressure, and for controlling the rate of decrease from 5.0 psi differential pressure to 2.75 psi differential pressure to not more than 2 inches of Hg per second nor less than 0.5 inch of Hg per second. Tests shall be conducted to check the automatic pressure vacuum relief system, main system shutoff valve, and auxiliary ram air and cabin pressure dump valve system.

3.3.10 Cabin Heating, Cooling and Ventilating Tests - Cabin heating, cooling and ventilating tests shall be conducted in accordance with the requirements of Specification AN-T-50a. 46 47

3.3.11 Anti-Icing Tests

3.3.11.1 Induction System - The heat energy supplied from the engine compressor to anti-ice the compressor inlet guide vanes incorporated in the engine, and the forward frame struts shall be measured at approximately 20,000 feet at maximum power (afterburner) military power and power for maximum range. Operation of the anti-icing manual air control and the manually controlled air inlet screen shall be checked. 48

3.3.11.2 Anti-Icing, Defrosting, Defogging of Transparent Areas - Windshield anti-icing system and defogging and defrosting system tests shall be conducted in accordance with the flight testing requirements of Specification MIL-T-5842. 49 50

3.3.12. Instrument and Eletronic Installation Tests - The following equipment shall be placed in normal operating condition and tested, including necessary test flying, and calibration where applicable, in accordance with applicable specifications listed herein: 51

Radio Set, AN/ARC-27. . . . . .MIL-A-6224 (1) 52
Radio Compass, AN/ARN-6 . . . . .R-7116 (1) 53
Radio Set, AN/APX-6 . . . . .MIL-R-6335
Gyrosyn Compass, Type J-2 . . . . .AN-C-106

3.3.13 Radio and Electronic Interference Tests - An interference compliance test shall be conducted on one test airplane in accordance with Specification MIL-I-6051. Testing of all other aircraft shall be as specified in the contract.

3.3.14 Hydraulic System Tests - Hydraulic system tests shall be conducted in accordance with Specifications MIL-H-5440 and MIL-T-5522.

3.3.15 Data and Reports - Specific final reports as required by the specifications listed in Section 2, and periodic progress reports shall be provided.

4. Deviations - Specific deviations to existing requirements as described in Appendix I, shall form a part of this specification.

APPENDIX I

DEVIATIONS

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1. Stability and Control Flight Tests Paragraph 3.3.1

Requirements: Handbook of Instructions for Aircraft Designers, Section 1.3.

"The stability and control and general handling characteristics of military aircraft must satisfy the requirements of Specification No. 1815. Compliance with these requirements must be demonstrated in three phases (calculations, wind tunnel tests and flight tests) - - - -. Finally, the third phase is during the flight test program - - - -. These flight tests must be conducted to prove that the stability and control characteristics are above the minimums set forth in Specification No. 1815. The detailed methods for determining compliance with each requirement of Specification No. 1815 for each of the three phases, are not included herein due to space limitations. However, for each of the requirements of Specification No. 1815 references are given to satisfactory methods for demonstrating compliance by calculation, wind tunnel analysis and flight test as required."

Deviation: The Contractor will conduct sufficient quantitative flight tests as required to rectify those deficiencies revealed during the course of the flight test program, and will conduct flight tests to demonstrate stability and control characteristics specified in Specification 1815-B, as amended by the airplane Model Specification, (about any axis) that are indicated to be critical from aerodynamic prototype tests, wind tunnel tests, and calculations. Specific flight tests to demonstrate compliance of the airplane with all other detail design requirements of Specification No. 1815-B shall be not mandatory. Where test methods other than those specified in the referenced publications are used, they will be described and submitted for AMC approval in the Periodic Progress Reports.

Reason for Change and Remarks: Specification No. 1815-B and the HIAD specify all of the design requirements for flying qualities of piloted airplanes, and state that compliance with these requirements must be demonstrated by flight tests to prove that the stability and control characteristics are above the minimums set forth in Specification No. 1815-B. Since these documents do not specify which of the numerous design requirements must be demonstrated by specific flight tests, the Contractor's interpretation of this requirement is summarized in the deviation for clarity. Since the entire flight program will require several hundred flight hours, the demonstration of stability and control items found to be critical during the course of such an extensive flight test program and demonstration of those items found to be critical from prototype testing, wind tunnel testing, and calculations, will adequately demonstrate the flying qualities of the airplane and satisfy the intent of Specification No. 1815-B, without demonstrating by flight tests, compliance with all of the numerous design conditions specified, particularly those items which are not indicated to be critical at any time. This procedure has been approved by the Air Force on preceding models flight tested by the Contractor, and has proven to be satisfactory.

2. Power Plant Installation - Test Schedule   Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part I, paragraph 6, page 5, Test Schedule.

". . . a report shall be submitted to the Procuring Agency prior to the acceptance of any experimental or first production airplane . . . ."

Deviation: Only the tests defined in Section A, Power Control Tests; Section C, Cooling Tests; Section E, Fuel Tank Pressure Tests - Flight; Section G, Sump Capacity and Fuel Availability Tests - Fuel Tanks; and Section G, Fuel Tank Siphoning Test, will be completed and data submitted prior to the delivery of any experimental or first production airplane. All other tests shall be conducted and reported as soon as possible, but at a later date.

Reason for Change and Remarks: The time required to conduct a complete flight test program and to complete all the specified reports is usually in excess of one year. It is impractical and unnecessary and not in the best interest of the National Defense effort to delay delivery of any airplane for the specified length of time and for the purpose stated. It is believed that the intent of the specification will be unaffected if tests other than those specified in the deviation are performed and reported on independent of airplane delivery schedules.

3. Power Plant Instrumentation   Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Section D, paragraph 9 (a), page 6, requires that all power plant instrumentation be in accordance with Table I of Appendix A.

Deviation: Instrumentation of the Contractor's choice will be utilized in lieu of using the specified instrumentation.

Reason for Change and Remarks: The instrumentation specified in Table I of Appendix A of Air Force Memorandum Report WCNEI-525-460 is not completely applicable to the F-100A aircraft. The Contractor has flight tested power plant installations for many years and has developed and standardized instrumentation systems and components that were approved by the Air Force, that are better suited and more readily adapted to the specific power plant installation. It appears that the instrumentation specified in Table I was intended for turbo-jet power plant installations of all general types. Experience gained on other aircraft has shown that using instrumentation designed for the specific purpose in lieu of using generalized instrumentation presents a clearer picture of the specific operating parameters and minimizes the total quantity of data.

4. Power Control Components — Paragraph 3.3.2

~~Requirements:~~ ~~Memorandum Report WCNEI-525-460,~~ Part II, Section A specifies cooling test requirements that form a part of the power control system tests.

Deviation: Cooling tests shall be conducted in accordance with Section C in lieu of Section A.

Reason for Change and Remarks: The cooling requirements of Section A are essentially a repetition of the cooling requirements of Section C. Power control cooling test data will be obtained during the cooling tests of Section C and duplicate tests are unwarranted.

5. Engine Accessory Components — Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section A, paragraph 2 (a), page 10, requires that all engine accessory components included in the engine model specification which are used in engine control be used during all testing.

Deviation: Operating characteristics of the engine power control system using all engine accessory components normally used in engine control will be demonstrated during the course of the test program; however, portions of the power control tests and portions of other types of tests may be conducted with certain accessory components removed or inoperative.

Reason for Change and Remarks: All accessory components cannot be used on all power control tests since it is sometimes necessary to make portions of the system inoperative, so as to demonstrate safety and emergency features of the control system, as dictated by the nature of other types of tests.

6. Power Control Test Conditions — Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section A, paragraph 2 (c), page 10, requires that no alterations, changes, adjustments or modifications of the engine and accessories be made in the period of time between engine verification tests and conclusion of the control tests.

Deviation: Where adjustments are found necessary, a detailed record will be kept and submitted as a portion of the test report.

Reason for Change and Remarks: This revised procedure will expedite the entire program, and it is believed that the intent of the requirement will be unaffected. Adjustments are sometimes required during the course of the program, particularly during initial stages of testing, so as to insure satisfactory altitude scheduling and safety of flight. If prior approval were required for all changes, the program would be delayed unnecessarily.

7. Approval of Instrumentation Prior to Tests Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section A, paragraph 7, page 13.

"Approval of instrumentation by the procuring service is required prior to the initiation of tests."

Deviation: Approval of instrumentation by the procuring service prior to the initiation of any test shall not be mandatory.

Reason for Change and Remarks: The nature of many tests requires revision of instrumentation techniques during the interim of the test program, and approval of such changes prior to conducting tests will delay the program appreciably. The procuring service will be kept informed of instrumentation techniques employed and of the test results by means of periodic progress reports.

8. Lost Motion Test Procedure Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section B, paragraph 3, page 14, requires that the lever at the engine end of the control be held rigid at an intermediate position near the center of travel and a 5, 10, and 15 pound force be applied in each direction at the center of the knob on the control lever.

Deviation: These tests shall be conducted in accordance with the 9th Edition HIAD, Section 9, Controls, paragraph 9.501, which requires a force of 150 percent of the force required to move the control.

Reason for Change and Remarks: The Contractor believes this to be a more realistic requirement. The specified requirement is incompatible with the HIAD.

9. __Submittal of Power Control and Cooling Data__ Paragraph 3.3.2

__Requirements:__ Memorandum Report WCNEI-525-460, Part II, Section C, paragraph 5, page 16, requires that power control system test data be submitted to the service supervising the test for approval prior to or simultaneously with cooling test data.

__Deviation:__ Power control and cooling test data shall be submitted as soon as practicable, but not necessarily in the order specified.

__Reason for Change and Remarks:__ In contrast to reciprocating engine installations, fuel metering characteristics of turbo-jet engine power controls have little or no effect on installation cooling. The above deviation will afford greater versatility and felxibility in the test program and the intent of the requirement will remain unaffected.

10. __Level Flight Cooling Test Procedure__ Paragraph 3.3.2

__Requirements:__ Memorandum Report WCNEI-525-460, Part II, Section C, paragraph 7, page 16, and Chart C-1, test numbers 4 through 11, page 19, require that level flight tests be carried out for a range of altitudes at 5,000 foot intervals. Runs are to be made at different power settings; for each setting a run is to be made at minimum and maximum speed. Test No. 7 requires that level flight tests be conducted at minimum speed with maximum drag conditions, i.e., external tanks, bombs torpedoes, etc.

__Deviation:__ Level flight cooling tests shall be conducted at minimum safe altitude, service ceiling and two intermediate altitudes, using minimum power required to sustain level flight, normal rated power, military power and afterburner power, for each altitude. Cooling test No. 7 shall be conducted with underwing tanks at the speed and altitude for best range in lieu of at minimum speed at 20,000 feet.

__Reason for Change and Remarks:__ The specified requirement will require an excessive amount of flight testing and yield an excessive amount of data, all of which is unnecessary to demonstrate cooling. Past experience gained testing turbo-jet power plant installations has proven the procedure specified in the above deviation to be satisfactory. If a critical cooling condition exists, it can be readily detected in altitude increments greater than 5,000 feet. Maximum drag cooling checks are necessary only under best range conditions.

11. Cooling Climb Procedures Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section C., paragraph 11, page 16, requires that a minimum of six complete readings be taken during climbs.

Deviation: The temperature recorder employed will be operated continuously in sequence during the specified climbs. Six complete readings might not be attainable.

Reason for Change and Remarks: The extremely high rate of climb of the airplane may make it impossible to obtain at least six complete readings below the service ceiling of the airplane using conventional instrumentation, such as a "Brown" recording pyrometer potentiometer or the equivalent.

12. Reports - Instrument Calibration Data Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section C, paragraphs 17 and 18, page 17, require that instrument and airspeed calibrations be included in the reports.

Deviation: Instrument and airspeed calibrations will not be included in the reports.

Reason for Change and Remarks: The data will be corrected for instrument error and the airspeed position error applied where applicable. Consequently, calibration data would serve no useful purpose if presented in the reports.

13. Air Flow Measurements Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section C, paragraph 21, page 18, requires that direct pressure measurements be made in all cases and direct differential pressure measurements be made in addition, if possible.

Deviation: In some cases, differential pressure measurements will be taken in lieu of taking direct pressure measurements.

Reason for Change and Remarks: In some applications, the differential pressure is of prime importance and the direct pressure measurements are of secondary importance or not required at all. If all pressure measurements were made directly, a separate instrument would be required for each measurement and complete coverage of all operating parameters would be unattainable per flight due to space limitations.

14. Idling Speed - Notes Applicable to Chart C-1 (Note C) Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section C, Note C, page 20, requires that the idling speed be the minimum RPM for satisfactory acceleration under all altitudes and flight conditions.

Deviation: Idling speed shall be that RPM satisfactory for normal ground idle.

Reason for Change and Remarks: The engine idle speeds on turbo-jet engines at high altitude are much higher than ground idle speeds, and consequently, the idle speed as specified in the requirement would result in an unrealistic ground cooling demonstration.

15. Cooling Climbs - Notes Applicable to Chart C-1 (Note D) Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section C, Note D, page 20, requires that for each altitude interval, a series of climbs be made using a different power setting in each case. The power settings are to cover the range from minimum power for climbing to power for maximum rate of climb.

Deviation: Cooling during climbs shall be demonstrated by conducting the following tests:

(1) A normal power continuous climb from take-off to service ceiling at best climbing speed.

(2) A military power continuous climb from take-off to service ceiling at best slimbing speed.

(3) Maximum power (afterburner) continuous climb at best climbing speed.

Reason for Change and Remarks: The Contractor is unable to completely coordinate the comments in this note with Chart C-1, since military power and afterburner power climbs are required at varying powers. Furthermore, it is felt that the broken sequence of the implied sawtooth climbs will not yield realistic cooling data because of thermal inertia characteristics of the engine-aircraft combination.

16. Maximum and Minimum Speeds - Notes Applicable to Chart C-1 (Note B) Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section C, Note B, page 20, requires that for all power settings, level flight runs be made at both maximum and minimum flying speeds.

Deviation: For all power settings, level flight runs shall be made at one airspeed.

Reason for Change and Remarks: One airspeed exists for constant power operation at constant altitude for a given airplane configuration.

17. Temperature Control - General Notes - (Note 2(a) and (b)) Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section C, Notes 2 (a) and (b), gives the conditions for setting the temperature control regulator for level flight and climb flight conditions.

Deviation: Notes 2 (a) and 2 (b) shall be not applicable.

Reason for Change and Remarks: Notes 2 (a) and 2 (b) are not applicable to the F-100A airplane. The only cooling airflow regulator used is in the oil cooling system. The setting of this regulator is determined by the lubricating oil temperature limit and is constant for all flight conditions. In order to determine the capacity of the oil heat exchanger, stabilized level flight runs will be made with several fixed oil cooler duct shutter positions.

18. Oil Tank Capacity - Lubrication System Test Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section D, Paragraph 3 (a), Page 22, requires that flight tests be made using a one-fourth filled oil tank.

Deviation: A one-fourth filled oil tank shall be considered as one-fourth the usable oil capacity of the tank plus an additional amount equivalent to the maximum amount retained by the engine and its components during operation.

Reason for Change and Remarks: The oil retained by the engine and other interconnecting components will always be available, and a realistic test must include this additional quantity of oil; otherwise, starting the test with one-fourth filled oil tank and a dry engine, the test would be conducted with considerably less than a one-fourth filled oil tank, which is believed to be an unrealistic test.

19. Lubrication and Fuel System Test Procedure Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section D, paragraph 3 (a), page 22, and Part II, Section E, paragraph 7, page 27.

". . . flight tests shall be made at all flight attitudes of which the aircraft is structurally and aerodynamically capable. These should include slip, climb, and dive attitudes required in . . . and in Table II, Appendix B."

Deviation: Flight tests shall be conducted at all safe flight attitudes, including slip, climb, and steep dive attitudes, as limited by satisfactory stability and control, buffeting, safe structural limits or safe terrain clearance, in lieu of the attitudes stated in Table II, Appendix B.

Reason for Change and Remarks: The climb and dive attitudes in Table II, Appendix B are excessive, and it would be unrealistic to hold the specified attitudes for the specified one minute period.

20. Inverted Flight - Engine Oil System Tests Paragraph 3.3.2

Requirements Memorandum Report WCNEI-525-460, Part II, Section D, paragraph 3 (d), page 22, requires that the airplane be flown inverted for one minute with a one-fourth filled oil tank.

Deviation: The airplane shall be flown inverted for a maximum period of 10 seconds at an altitude not lower than 35,000 feet.

Reason for Change and Remarks: The airplane is not designed to fly inverted for one minute. The maximum duration of inverted flight at 35,000 feet is 10 seconds. Below this altitude, the maximum duration of inverted flight is governed by the fuel system, which is designed for a maximum duration of 5 seconds at sea level and 10 seconds at 35,000 feet. As a safety precaution, the Contractor desires to perform the test at 35,000 feet or higher. The test conditions stated in the deviation represent the maximum design conditions for 35,000 feet.

21. Purging System Flight Tests Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section E, paragraphs 9, 10, 11 and 12, pages 27 and 28, and Chart E-2, page 31, outline the tests required for purging systems.

Deviation: Purging system tests shall be conducted to check nitrogen gas purging of the fuel cell interior vapor space in accordance with Section 4.5 of Specification MIL-P-5902, in lieu of Memorandum Report WCNEI-525-460.

Reason for Change and Remarks: Purging system tests are specified in Air Force Memorandum Report WCNEI-525-460 and Specification MIL-P-5902; therefore, duplicate test requirements exist which are incompatible. HIAD, Section 14.420 makes specific reference to Specification MIL-P-5902, which is specifically a purging specification, and consequently, the Contractor proposes to perform the tests in accordance with Specification MIL-P-5902.

22. Applicability of Specifications for Testing Droppable Under Wing Tanks Paragraph 3.3.2

Requirements: Testing requirements for droppable under wing tanks are specified in Specifications 1815-B, MIL-T-7378, 34040 and WCNEI-525-460.

Deviation: The testing requirements of Specifications MIL-T-7378 and 1815-B shall apply to the extent specified herein (Reference paragraph 3.3.3). The testing requirements of 34040 and WCNEI-525-460 shall not apply to the external tank tests.

Reason for Change and Remarks: Many repetitious and conflicting requirements are specified in the above specifications, which are all mandatory requirements of the HIAD. For example, Specification 34040 requires that empty tank and full tank drop tests be conducted at maximum cruising power and maximum allowable speed; Specification MIL-T-7378 specifies that the speeds be 1.5 times stall speed at sea level and speed for military power at design attitude; Specification WCNEI-525-460 omits reference to full tank drops and specifies that empty tank drops be conducted at maximum cruising speed. In addition, Specification MIL-T-7378 clearly states a set of test conditions but also makes reference to Specification 34040, which is incompatible. Specification WCNEI-525-460, paragraphs 17, 18, 19 and 20 outline a test procedure to determine the effects of jettisonable fuel tanks upon the flying characteristics of the airplane, which are not in complete agreement with the basic tank ~~specification MIL-T-7378~~ and the basic stability and control specification 1815-B, and are of a repetitious nature.

It is obvious that a [illegible]ication of the test requirements is necessary. The Contractor believes that the requirements of Specifications MIL-T-7378 and 1815-B are more realistic and more stringent than the requirements of the other specifications noted in the requirement. The program that the Contractor proposes to conduct is specified in paragraph 3.3.3 herein, for clarity.

23. Sump Capacity and Fuel Availability Tests Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section G, paragraph 3 (d), page 33.

"The test procedure described in sub-paragraphs, (b) and (c) above, shall be repeated for each of the flight attitudes specified in the sump capacity and fuel availability chart, Chart G-1."

Deviation: The specified tests shall be conducted in level flight, 10 degree and 20 degree climb attitudes, and in the normal ground attitude, in lieu of conducting the tests at all of the attitudes specified in Chart G-1.

Reason for Change and Remarks: Since no internal fuel is carried in the wings, many of the tests specified in Chart G-1 are not applicable to this airplane. The tests specified in the deviation will demonstrate the fuel availability and drainage capacity of this specific fuel system.

24. Power Plant and Accessory Interchangeability Tests Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-460, Part II, Section H, paragraph 2 (b), page 39 and paragraph 10 (b), page 41.

"No special jigs or aligning devices will be used during the power plant change, other than those furnished with each engine."

Deviation: The use of one aft fuselage section handling dolly shall be permitted.

Reason for Change and Remarks: A handling dolly is required to permit satisfactory removal of the aft fuselage section. Removal of the aft fuselage section is required to afford an engine change and to gain access to the afterburner and the variable exhaust nozzle.

25. Engine Interchangeability Test — Paragraph 3.3.2

Requirements: Memorandum Report WCNEI-525-400, Part II, Section H, paragraph 1, page 39 and paragraph 5, page 40, require that tests be made to determine the amount of time necessary to make a complete engine change on each power plant installation.

Deviation: The tests specified in paragraph 5, page 40, shall be not required.

Reason for Change and Remarks: The power plant installation of the airplane is such that there will be no difference between Power Plant Interchangeability Tests defined in paragraph 1, page 39, and the Engine Interchangeability Tests defined in paragraph 5, page 40.

26. Overheat Detector System Tests — Paragraph 3.3.2

Requirements: The Handbook of Instructions for Aircraft Designers, Ninth Edition, paragraph 11.22, requires that an overheat detector system be installed (and tested) in accordance with Specification No. 41409.

Deviation: Specification No. 41409 shall be not applicable. Tests shall be conducted to determine optimum settings of the detectors.

Reason for Change and Remarks: The procedure specified in Specification No. 41409 will not permit determination of optimum settings of detectors for the particular detector configuration employed. The Contractor has conducted tests of a similar nature using the procedure recommended by the Vendor and satisfactory results were obtained and approved by the AMC.

27. Purging System - Test Airplane and Chronological Order of Conducting Tests — Paragraph 3.3.2

Requirements: Specification MIL-P-5902, paragraphs 4.5.2.3.1 and 4.5.2.3.2, require that tests be conducted on the first model aircraft and that the ground tests be made prior to the first flight. Paragraph 4.5.2.1 requires that ground tests be conducted prior to any flight tests.

Deviation: Purging system tests shall be ~~performed on a test airplane selected by the Contractor, not~~ necessarily the first airplane.

It shall be unnecessary to conduct purging system tests prior to first flight and unnecessary for purging tests to precede other flight tests of the contract. The chronological order in which tests are performed, and the airplane used for test purposes, shall be at the discretion of the Contractor and in accordance with Bailment Instructions for the test airplane used.

Reason for Change and Remarks: The chronological order in which tests are to be conducted is indeterminate. The entire program will require several hundred flight hours in addition to ground tests, and if the Contractor is required to conduct tests in a specified chronological order, program delays will most surely result that could otherwise be avoided. The Contractor must schedule tests so as to parallel availability of reworked parts, availability of test aircraft, and to follow up on malfunctions and fixes in the order in which they occur with due consideration to order of importance and safety requirements. In addition, it is not mandatory, for test purposes, that the purging system be operated for most tests. Past experience has shown that such tests as cooling, power control, afterburner operation, etc., are always performed prior to purging system tests as these tests are more directly related to flight safety.

It is believed that the intent of the requirement will be unaffected if the purging system tests are conducted on an airplane other than the first. The first airplane might not be available for purging tests.

28. Purging System - Gunfire Resistance Test Paragraph 3.3.2

Requirements: Specification MIL-P-5902, paragraph 4.5.4, requires that a gunfire resistance test be conducted on a full scale tank and surrounding compartment complete with all the equipment and accessories used in the aircraft installation necessary for purging the fuel tanks and compartments.

Deviation: The specified test shall be not required.

~~Reason for Change and Remarks: Sufficient data have been~~ obtained from previous tests of the F-86D airplane (Reference Report No. NA 51-1111). The specified tests, for the most part, would be a repetition of the F-86D fuel cell gunfire resistance test because the fuel cell is removed from the airplane and consequently the differences in airplane characteristics will bear no relationship to the test. The tank employed for the F-86D tests is similar to the tank employed in the F-100A airplane.

29. Purging System Data - Recording Rate Paragraph 3.3.2

Requirements: Specification MIL-P-5902, paragraph 4.5.2.2.1, sub-paragraphs (1) and (2), require that data be recorded every 5,000 feet.

Deviation: Data shall be recorded every 5,000 feet or at the maximum rate of the instrumentation employed, whichever rate is slower.

Reason for Change and Remarks: Due to the extremely high rate of climb and rate of descent of the test aircraft it may not be feasible to obtain readings every 5,000 feet. An adequate number of readings will be obtained, consistent with the instrumentation employed, and consistent with the climb and dive characteristics of the airplane.

30. Sound Level Measurements Paragraph 3.3.2

Requirements: Handbook of Instructions for Aircraft Designers, ninth edition, revised January 1951, paragraph 4.61.

"To insure that specified levels are met, noise measurements shall be made in flight at the head levels of personnel stations by means of apparatus meeting the requirements of Specification MIL-S-3151. . . . unless otherwise specified, the noise levels shall not exceed 118 db. over-all noise and the levels in the frequency bands 300 to 600 cps, 600 to 1200 cps, 1200 to 2400 cps, 2400 to 4800 cps and above 4800 cps shall not exceed 103, 93, 84, 81, and 78 db. respectively."

Deviation: Over-all sound level measurements shall be made in flight at the head level of the pilot by means of a H. Hosmer Scott Type 410-A sound level meter, or the equivalent. Sound level measurements in the specified frequency-bands will not be conducted.

Reason for Change and Remarks: Frequency-band type of sound level measuring equipment is not readily available, and cannot be readily installed in fighter type aircraft. The Contractor employed a H. Hosmer Scott Type 410-A sound level meter for measuring over-all sound level in other jet propelled fighter type aircraft and satisfactory results were obtained.

31. Underwing Tank Drop Test Procedure Paragraph 3.3.3

Requirements: Specification MIL-T-7378, paragraph 4.3.2.3.4.

"Tank drop tests shall be conducted on the aircraft in question with full and empty tanks . . . . Drop tests of external fuel tanks shall conform to Specification No. 34040."

Deviation: One tank will be dropped for each condition in lieu of dropping a pair of tanks for each condition.

Reason for Change and Remarks: Specification No. 34040 requires that a complete load of tanks be dropped using simultaneous release. The requirement is not clearly specified in Specification MIL-T-7378. The underwing tank installation is symmetrical, and consequently it is believed that only one tank need be dropped for each condition. This procedure has been approved by the Air Force on similar installations, and the tests were satisfactory. In addition, the tests specified in the Deviation will require the complete destruction of 4 drop tanks during 2 flights, whereas the tests specified in the Requirements will require the complete destruction of 8 drop tanks during 4 flights. It is believed that the above deviation will evolve a more economic and expeditious program without effecting the intent of the requirement.

32. Spinning Demonstration Loading Conditions Paragraph 3.3.5

Requirements: Specification 1816, "Spinning Requirements for Airplanes", paragraph D-3a, requires that three turn power-off spins be made both right and left, using straight stall entry (flaps and gear up) for each of the following loading conditions:

D-2a (1) (a). Most aft center of gravity.

D-2a (1) (b). Full fuselage load, all expendable items out of wing, allowing sufficient fuel and oil at take-off for a one hour spin test flight.

D-2a (1) (c) Full wing load all expendable items out of fuselage allowing sufficient fuel and oil at take-off for a one hour spin test flight.

Deviation: The loading conditions for the spinning demonstration shall be as follows:

D-2a (1) (a) Most aft cg (gear up) - Clean condition design gross weight at take-off minus oxygen, minus gun port plugs, minus ammunition (ammunition links retained), 107 gallons aft fuel expended and 212 gallons forward fuel expended (flight weight of approximately 21,800 pounds and a flight cg location of approximately 34.8 per cent mac).

D-2a (1) (b) Clean condition design gross weight at take-off minus 107 gallons aft fuel or minus fuel required to climb to the test altitude, whichever weight is the lighter (Flight weight of approximately 23,850 pounds and flight cg location of approximately 29.5 percent mac).

D-2a (1) (c) Not applicable (same as D-2a (1) (a)).

Reason for Change and Remarks: The specified loading conditions are not completely applicable to this airplane; all internal fuel is carried in the fuselage and no expendable items are carried in the wing, except for alternate loading conditions, which are not recognized for purposes of formal demonstration. The conditions D-2a (1)(a) and D-2a (1)(c) of the specification are, in effect, identical and are representative of the lightest fuselage loading attainable in flight, and are also representative of the most aft cg attainable in flight, allowing sufficient reserve fuel to perform the spinning test. The wing loading remains unchanged.

The condition D-2a (1) (b) of the Specification requires a full fuselage load; since all fuel is carried in the fuselage, the test must be performed with a full fuselage load minus the amount of fuselage fuel required to climb to the test altitude. If 700 pounds of fuselage fuel were consumed prior to entering the spin, the cg would shift forward approximately 2 percent mac of the specified condition, resulting in the most forward cg attainable in combat, which is believed to be a realistic test point. The fuselage inertia (I_y), wing inertia (I_x), and parameter $\frac{I_x - I_y}{m b^2}$ remain essentially unchanged with respect to the specified condition. In addition, the tail damping arm change resulting from a 2 percent cg shift is small and the spinning characteristics should be unaffected. It is believed, therefore, that the intent of the specification will be unaffected by this deviation.

33. Spinning Demonstration - Anti-Spin Device Paragraph 3.3.2

Requirements: Specification No. 1816, "Spinning Requirements for Airplanes", paragraphs F-1 and F-2a, require that spin chutes be installed and design data on the installation be furnished.

Deviation: Anti-spin rockets may be used in lieu of anti-spin chutes, and the equivalent data will be provided.

Reason for Change and Remarks: Anti-spin chutes have proven unreliable in the past due primarily to chute failures attributable to high opening shock loads. In addition, excessive structural reinforcements are required for such installations. Data pertinent to the rocket installation will be provided which will be equivalent to the anti-spin chute data requirements of paragraph F-2a.

34. Airspeed and Altimeter System - Test Schedule Paragraph 3.3.6

Requirements: Specification MIL-I-5072, paragraph 4.3.2.1, requires that the first pitot static tube installation be subjected to tests.

Deviation: The specified tests may be conducted on any of the flight test airplanes, not necessarily the first.

Reason for Change and Remarks: To afford greater flexibility in the overall test program, it might be advantageous to test the installation in a flight test airplane other than the first.

35. Airspeed and Altimeter System - Prior Approval of Test Methods and Instrumentation — Paragraph 3.3.5

Requirements: Specification MIL-I-5072, paragraph 4.3.3.4.2, requires that an outline of the test method and instrumentation to be used be submitted to the Procuring Service and approval obtained prior to conducting the tests.

Deviation: Prior approval of the method of testing and instrumentation to be used shall be non-mandatory.

Reason for Change and Remarks: The nature of many tests frequently requires revision of instrumentation techniques during the interim of the test program, and approval of such changes prior to conducting tests will delay the program appreciably. The AMC will be kept informed of instrumentation techniques employed and of the test results by means of periodic progress reports.

36. Airspeed and Altitude Calibration-Tolerances — Paragraph 3.3.6

Requirements: Specification MIL-I-5072 paragraph 4.3.3.4.3. specifies the permissible airspeed and altimeter allowable errors.

Deviation: The requirements of paragraph 4.3.3.4.3 will not necessarily be met. An attempt will be made to meet an altimeter error at sea level consistent with the airspeed requirements, assuming all system error attributable to static defect.

Reason for Change and Remarks: The altimeter tolerance values in Table I are incompatible with the specified airspeed tolerance values.

37. Structural Testing of Static Test Article Paragraph 3.3.9

Requirements: Specification AN-T-64, Section D-2 covers requirements for structural testing of the static test article.

Deviation: Testing of the static test article shall not be a requirement of this specification.

Reason for Change and Remarks: Requirements for the static test article are covered by separate specification (Reference Report No. NA-51-833). Testing of the static test article is beyond the scope of this flight test specification.

38. Cabin Pressure - Leakage Tests Paragraph 3.3.9

Requirements: Specification AN-T-64, paragraph D-2b, states that leakage tests shall be conducted before and after fuselage static tests.

Deviation: Leakage tests shall be accomplished before and after flight tests.

Reason for Change and Remarks: Leakage tests conducted on the static test article after limit pressure has been exceeded are considered to bear little or no relation to the leakage which will occur in the flight article. The airframe equipment configuration and methods of sealing are usually entirely different between the flight and static test articles. The Contractor considers that the results of leakage tests are of significance only if conducted on the flight article.

39. Cabin Pressure Emergency Sealing of Leaks Paragraph 3.3.9

Requirements: Specification AN-T-64, paragraph D-2c, requires testing of provisions for emergency sealing of leaks.

Deviation: Paragraph D-2c - Not applicable.

Reason for Change and Remarks: There are no provisions for emergency sealing of leaks on this aircraft.

40. Cabin Pressure - Structural Tests Paragraph 3.3.9

Requirements: Specification AN-T-64, paragraph D-3a (1), requires the pressure cabin to be subjected to a test pressure differential expressed as a percentage in excess of the limit differential corresponding to the critical flight altitude of the aircraft.

Deviation: The specified tests will not be conducted on the flight article.

Reason for Change and Remarks: Tests of this nature can be performed on the static test article. The requirements for the static test article are covered by separate specification (Reference Report No. NA-51-833).

41. Ground Leakage Tests Paragraph 3.3.9

Requirements: Specification AN-T-64, paragraph D-3a (2), states that ground testing for leakage of the flight article is to be accomplished as specified in Section D.

Deviation: Leakage tests shall be accomplished before and after flight tests at normal design cabin pressure differential.

Reason for Change and Remarks: The requirements of Section D pertain to testing the static test article up to either the limit (or design yield) load, design ultimate (or failing) load for critical conditions of maneuver or gust flight loads and differential pressure loads acting alone and in combination, including the effect of sudden disintegration of canopies as from gunfire or from any other cause. Paragraph D-2b, Leakage Test, requires that tests be conducted maintaining a constant ultimate pressure cabin differential. It is obvious that these tests should not be demonstrated on the flight article.

42. Cabin Pressure Regulator Tests Paragraph 3.3.9

Requirements: Specification AN-T-64, paragraph D-3b (1), requires determination of cabin pressure as controlled by the cabin pressure relief valve with maximum airflow supplied to the cabin.

Deviation: A simulated pressure cabin may be used for the specified tests.

Reason for Change and Remarks: Cabin pressure as controlled by the emergency cabin pressure relief valve can be determined by laboratory tests.

43. Pressure Cabin Test Altitude and Power Settings Paragraph 3.3.9

Requirements: Specification AN-T-64, paragraph D-4b (1).

"Flight tests shall be carried out with the lowest possible RPM and with military power at a selected altitude between sea level and 10,000 feet, and at each of the following altitudes: 10,000 feet, 25,000 feet, 35,000 feet and service ceiling."

Deviation: The flight tests shall be conducted at maximum range cruise power, at military power and at afterburner power. Tests shall be conducted to check the cabin isobaric pressure altitude of 12,500 feet from 12,500 feet to the 5.0 psi differential pressure altitude of 31,000 feet. Tests shall then be conducted at and above 31,000 feet to operational service ceiling to check the 5.0 psi differential pressure system. Tests shall be conducted to check the cabin isobaric pressure altitude of 12,500 feet from 12,500 feet to the 2.75 psi differential pressure altitude of 21,200 feet to check the normal 2.75 psi condition, and above 21,200 feet to approximately 35,000 feet, to check the combat condition.

Reason for Change and Remarks: An altitude of 12,500 feet is specified in lieu of 10,000 feet as the lowest altitude at which pressurization occurs is 12,500 feet. The power settings and pressure schedules specified in Specification AN-T-64 are not completely applicable to this airplane; consequently, the test procedure has been revised so as to afford an evaluation of all significant features of the system employed, including the dual range pressure schedules and the afterburner power condition.

44. Cabin Pressure - Rate of Change — Paragraph 3.3.9

Requirements: Specification AN-T-64, paragraph D-4b (3), requires that the airplane be operated in a normal rated power climb from sea level to service ceiling of the airplane at best climbing speed.

Deviation: The airplane shall be operated in an afterburner climb from take-off to afterburner operational service ceiling of the airplane at best climbing speed, in lieu of the specified test.

Reason for Change and Remarks: The Contractor feels that this is a more stringent test and will demonstrate operation of the pressurization system at the maximum practical altitude of the airplane.

45. Cockpit Depressurization Tests — Paragraph 3.3.9

Requirements: Specification AN-T-64, paragraph D-4b (5), requires that during the specified test the force and time required to open the various exit doors be measured and recorded.

Deviation: The force and time required to jettison the canopy during the specified tests shall not be measured and recorded.

Reason for Change and Remarks: For the purpose of the specified tests, the canopy is not considered as an exit door. Emergency egress of the pilot is accomplished by means of the canopy and seat ejection, which are tested in accordance with other requirements specified herein.

46. Cockpit Heating and Ventilating Test - Time Required for Temperature Stabilization — Paragraph 3.3.10

Requirements: Specification AN-T-50a, paragraphs D-4a (a), D-4a (b), D-5a (a) and D-5a (b), specify the time required for temperature stabilization for various test requirements.

Deviation: The stabilization period shall be consistent with the operating characteristics of the test airplane and the ambient conditions existing at the time the test is conducted, or fifteen minutes, whichever period is the shorter.

Reason for Change and Remarks: During tests of a similar nature conducted on other aircraft, stabilization was reached in less than the specified time. The intent of the specified requirement will be satisfied and flight time and engine time will be utilized more efficiently.

47. Cockpit Heating and Ventilating Tests Altitude — Paragraph 3.3.10

Requirements: Specification AN-T-50a, paragraphs D-4a and D-5a, require that the airplane be flown at approximately 1,000 feet above the ground but not in excess of 2,500 feet above sea level.

Deviation: The airplane shall be flown at the minimum safe altitude consistent with the characteristics of the test airplane and test area used.

Reason for Change and Remarks: Tests of this nature will likely be conducted at Edwards Air Force Base, where the ground elevation is approximately 2,300 feet above sea level and is surrounded by mountains.

48. Anti-Icing System Tests - Paragraph 3.3.11.1

Requirements: Handbook of Instructions for Aircraft Designers, Ninth Edition, Revised January 1951, paragraphs 11.30 and 16.623, specify the design requirements and imply that flight tests be conducted in accordance with Specification 40395-C.

Deviation: Specification No. 40395-C shall be not applicable. The heat energy supplied from the engine compressor to anti-ice the compressor inlet guide vanes incorporated in the engine, and the forward frame struts shall be measured at approximately 20,000 feet at maximum power (afterburner), military power and power for maximum range. Operation of the anti-icing manual air control and the manually controlled air inlet screen shall be checked.

Reason for Change and Remarks: Specification 40395-C is intended to cover complete airplane systems and complex installations including entire wing, empennage and other major portions of the airplane. Although the hot air anti-icing of the compressor inlet guide vanes and forward frame struts are of major importance, the simplicity of this anti-icing installation does not warrant the extensive testing and instrumentation required by Specifications 40395-C and AN-T-55.

49. Windshield Anti-Icing Paragraph 3.3.11.2

Requirements: Specification MIL-T-5842, paragraph 4.3.2, requires that laboratory tests be conducted to demonstrate that the heat flow requirements of paragraph 3.2.2.2 can be transferred through the transparent area.

Deviation: No tests will be conducted to measure the heat transferred through the transparent area. Flight tests will be conducted to measure the heat being supplied and the temperature rise of the external glass surface above the ambient temperature.

Reason for Change and Remarks: The anti-icing system is designed to direct hot air into the boundary layer over the outside surface through manifold openings located at the forward base of the windshield. Therefore, the heat transfer through the glass bears little relationship to the effectiveness of this windshield anti-icing system, and no tests of this nature are required.

50. Prior Approval of Anti-Icing and Defrosting Program — Paragraph 3.3.11.2

Requirements: Specification MIL-T-5842, paragraph 4.3.1.

"A report covering the proposed laboratory and flight tests required to prove the system design shall be submitted to the procuring agency for comment and approval prior to the conducting of the final laboratory or flight tests required to prove the system performance."

Deviation: Approval of this Procurement Specification shall constitute authority to conduct the specified tests. A separate report will not be submitted prior to conducting the tests.

Reason for Change and Remarks: The nature of the specified tests precludes the practicability of formulating program details beyond the extent specified herein. Program details and instrumentation requirements beyond those specified herein will be formulated during the course of the program and will be based upon analysis of the preceding tests. The results of these tests will be submitted to AMC for comments by means of Periodic Progress Reports. If approval is required for each test prior to performing the test, the program will be delayed appreciably.

51. Test Procedure for Airborne Electronic Equipment — Paragraph 3.3.12

Requirements: Handbook of Instructions for Aircraft Designers, Ninth Edition, Revised January 1951, paragraph 20.11, requires that tests be conducted in accordance with Specification AN-T-65.

Deviation: Specification AN-T-65 shall be not applicable.

Reason for Change and Remarks: Specification AN-T-65 covers test procedures for airborne electronic equipment including communication, radio, navigation, radio noise effects, antennae, radar, etc., etc. Since the writing of Specification AN-T-65 the Air Force has issued numerous specifications covering all these requirements separately and in greater detail. Many of these specifications form a part of this specification (NA 51-858) and conflicting requirements exist. Tests conducted in accordance with AN-T-65 would, therefore, be of a repetitious nature, and in some cases would be incompatible with type specification requirements.

52. Antennae Test Reports — Paragraph 3.3.12

Requirements: Specification No. MIL-A-6224, paragraph 3.3.4, requires that reports be prepared in accordance with Specification 40146.

Deviation: The specified reports will not be prepared in accordance with Specification 40146. Reports will be prepared in accordance with good engineering practice and will fully describe the tests conducted and clearly present the technical data obtained.

Reason for Change and Remarks: Specification 40146 sets forth many requirements which the Contractor believes are of minor importance and contribute little to the prime objective of these antenna tests. The specification requires such details as the names and technical qualifications of persons conducting the tests, the Contractor's qualifications including a list of patents held by the Contractor on related work, techniques to be used in making reproductions of the reports, report numbering system, contents and form of each paragraph, etc., etc. The Contractor does not consider it feasible to include personnel qualifications, patent rights and such data in reports of this nature.

53. Procedure for Testing UHF Airborne Communications Equipment — Paragraph 3.3.12

Requirements: Specification No. MIL-A-6224, paragraph 4.4.8.1, requires that the flight plan shown in Figure 1 be executed once for each of 3 assigned frequencies with the installation being tested transmitting.

Deviation: The flight plan of Figure 1 shall be executed once, switching through the three assigned frequencies during the one run, in lieu of repeating the run for each assigned frequency.

Reason for Change and Remarks: The specified flight pattern entails flying through four legs, each leg being 50 miles long. It is believed that a minimum of 600 miles of flying for this test is excessive, and that the one 200 mile test will enable an evaluation of the antenna to be made for the three assigned frequencies.

PROCUREMENT SPECIFICATION AMENDMENT NO. 1

North American Aviation, Inc.
Los Angeles 45, California

Date: 3 April 1953

Specification No.: NA 51-585, Revised 1 May, 1952

Specification Title: "Procurement Specification for Flight Testing an Air Superiority Fighter Airplane - Day. AF Model F-100A (NAA Model NA-192)"

Airplane Model: F-100A NAA Model: NA-192

Contract No.: AF 33(600)-6545

Title of Change: Changes to Flight Test Program

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Page 1 - Table of Contents

Add the following:

Page 5, Section 2 - Applicable Specifications and Other Publications

Add:

"Air Force Specification No. 41409, entitled 'Detector; Overheat, Thermal Switch Unit, Installation of, 'Dated 23 August 1948"

Page 5, Section 3.1.1 - Ground Tests

After the fourth sentence add a new sentence as follows:

"Operation of the overheat detector shall be checked."

Page 6, Section 3.1.3.2 - Functional Tests

Add:

"Emergency operation of the landing gear shall be checked."

Page 8, Section 3.3.2 - Power Plant Installation Tests (Overheat Detector)

Delete:

"Overheat detector system tests shall be conducted in accordance with the procedure recommended by the Contractor and the vendor of the detector equipment."

Substitute:

"The flight phase of the overheat detection system shall be tested in accordance with Specification No. 41409."

Page 8, Section 3.3.2 - Power Plant Installation Tests (Sound Level Tests)

Delete:

"Over-all sound level measurements shall be made in flight at the head level of the pilot."

Substitute:

"Over-all sound level measurements shall be made in flight at the head-level of the pilot at 85 percent and 100 percent engine RPM."

Page 9, Section 3.3.4 - Structural Integrity Demonstration

Add:

"All references to specific gross weights and center of gravity locations are subject to change so that they correspond to the actual values for the airplane as it will be flown in service. The load factors and other test conditions used for the structural integrity demonstration shall not exceed design limits as specified in the airplane Model Specification."

Page 9, Section 3.3.4.1.1 - Forward cg Condition:

Delete the first sentence:

"The following maneuvers (3.3.4.1.1.1 through 3.3.4.1.1.4) shall be performed with the airplane in the clean condition (without external stores), at a flight weight of approximately 23,000 (*) pounds and a flight cg location of approximately 29.5 percent mac."

Substitute in lieu thereof the following:

"The following maneuvers (3.3.4.1.1.1 through 3.3.4.1.1.6) shall be performed with the airplane in the clean condition (without external stores), at a flight weight of approximately 23,996 (*) pounds and a flight cg location of approximately 29.5 percent mac."

Page 9, Section 3.3.4.1.1.1 - Limit n Pull-Out at Maximum Mach Number

Delete from the first sentence the following words:

"Air Material Command's."

Substitute the following:

"Wright Air Development Center's"

Page 10, Section 3.3.4.1.1.2 - Pull-Out (Maximum n)

Add the word "abruptly" between the words "and" and "pull-out" in the first sentence.

Page 10, Section 3.3.4.1.1.3 - Rolling Pull-Out (Maximum Wing Torsion)

Change "30-pound" to "60-pound" and delete "with rudder fixed in trim position."

Page 10, Section 3.3.4.1.1.4 - Push-Down

At the end of the sentence add "and abruptly check the maneuver (return to 1.0 g)."

Page 10, Section 3.3.1.1 - Forward cg Condition

Add the following new sections:

"3.3.4.1.1.5 Pull-Out at 12,000 Feet - Dive and abruptly pull-out to obtain 7.33 g at the maximum Mach number (within design limits) at approximately 12,000 feet pressure altitude (or lowest safe altitude, whichever altitude is higher).

3.3.4.1.1.6 Pull-Out (High Angle of Attack) - Abruptly pull-out to obtain 7.33 g at the minimum airspeed at which it is possible to attain the specified load factor (altitude of performing pull-out optional)."

Page 10, Section 3.3.4.1.2.1 - Pull-Out (High Angle of Attack)

Insert the word "Abruptly" as the first word of the sentence.

Page 11, Section 3.3.4.1.2.2 - Rolling Pull-Out (Maximum pb/2V)

Change "30-pound" to "60-pound".

Page 11, Section 3.3.4.1.2.3 - Speed Brake Operation

Add:

"If extension of the speed brake results in a negative pitching moment, this maneuver will be required at a forward center of gravity in lieu of aft center of gravity."

Page 11, Section 3.3.4.2 - Airplane with Empty 275 Gallon External Wing Tanks

Change "approximately 24,546 pounds" to approximately 25,000 pounds."

Page 11, Section 3.3.4.2.1.1 - Limit g Pull-Out at Maximum Mach number

Delete from the first sentence the following words:

"Air Materiel Command's"

Substitute the following:

"Wright Air Development Center's"

Page 12, Section 3.3.4.2.1.3 - Rolling Pull-Out (Maximum Wing Torsion)

Delete the phrase "with rudder fixed in trim position" and change "30-pound" to "60-pound".

Page 12, Section 3.3.4.3.1.4 - Push-Down

At the end of the sentence add "and abruptly check the maneuver (return to 1.0 g)."

Page 13, Section 3.3.4.2.2.2 - Rolling Pull-Out (Maximum pb/2V)

Change "30-pound" to "60-pound".

Page 13, Section 3.3.4.3.1.1 - Limit g Pull-Out at Maximum Mach Number

Delete from the first sentence the following words:

"Air Material Command's"

Substitute the following:

"Wright Air Development Center's"

Page 14, Section 3.3.4.3.1.3 - Rolling Pull-Out Maximum Wing Torsion

Delete the phrase "with rudder fixed in trim position" and change "30-pound" to "60-pound".

Page 14, Section 3.3.4.3.1.4 - Push-Down

At the end of the sentence add "and abruptly check the maneuver (return to 1.0 g)."

Page 14, Section 3.3.4.3.1.5 - Rolling Pull-Out (Maximum Rolling Velocity)

Delete the phrase "with rudder fixed in trim position" and change "30-pound" to "60-pound".

Add in parenthesis at the end of the section "or lowest safe altitude, whichever altitude is higher."

Page 15, Section 3.3.7 - Performance Tests

Change "parabrake" to "drag chute."

Appendix I - Deviation Index

Delete the following deviations from the index:

"No. 19 Lubrication and Fuel System Test Procedure
No. 26 Overheat Detector System Tests."

Page 30, Deviation No. 19 - Lubrication and Fuel System Test Procedure.

Delete deviation No. 19.

Page 33, Deviation No. 26 - Overheat Detector System Tests

Delete deviation No. 26.

Page 35, Deviation No. 30 - Sound Level Measurements

Under "Deviation" delete the following:

"Over-all sound level measurements shall be made in flight at the head level of the pilot by means of H. Hosmer Scott Type 410-A sound level meter, or the equivalent."

Substitute in lieu thereof the following:

"Over-all sound level measurements shall be made at the head level of the pilot at 85 percent and 100 percent engine RPM by means of a H. Hosmer Scott Type 410-A sound level meter, or the equivalent."

Page 39, Deviation No. 36 - Airspeed and Altitude Calibration - Tolerances

Under "Deviation" delete the following:

"The requirements of paragraph 4.3.3.4.3 will not necessarily be met. An attempt will be made to meet an altimeter error at sea level consistent with the airspeed requirements, assuming all system error attributable to static defect."

Substitute the following in lieu thereof:

"Altimeter tolerances compatible to those for the specified airspeed tolerances shall be met assuming all system error to be attributable to static defect. These compatible values of altimeter tolerance range from approximately 38 feet to 70 feet per 100 knots I.A.S. for level flight speeds, and to approximately 86 feet per 100 knots I.A.S. for limit dive speed."

Written by Engineering Flight Test: MA/mn

PROCUREMENT SPECIFICATION AMENDMENT NO. 2

North American Aviation, Inc.
Los Angeles 45, California

Date: 2 Jun

Specification No.: NA51-858 Revised: 1 May 1952

Specification Title: "Procurement Specification for Flight Testing an Air Superiority Fighter Airplane-Day, AF Model F-100A (NAA Model NA-192)".

Airplane Model: F-100A NAA Model: NA-192

Contract No.: AF 33(600)-6545

Title of Change: Structural Integrity Demonstration

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Delete the structural integrity demonstration in its entirety as specified in NA51-858, revised 1 May 1952 and the changes to the structural demonstration as specified in Amendment No. 1, dated 3 April 1953 and substitute in lieu thereof the following revised structural integrity demonstration:

3.3.4 Structural Integrity Demonstration - A structural integrity demonstration consisting of the tests specified herein (Tables I and II) shall be conducted to demonstrate critical analysis conditions and verify design. More than one maneuver may be performed during the same flight where the fuel consumed would produce no appreciable departure from the intended test condition. The limit load factor, maximum q, limit rolling velocity and other test conditions for the demonstration shall not exceed design limits as specified in the airplane Model Specification.

3.3.4.1 Clean Airplane (Without External Stores) - The maneuvers specified in Table I shall be performed with the airplane in the clean condition at a flight weight of approximately 24,000 pounds. Unless otherwise specified the speed brake shall be closed.

TABLE I CLEAN CONDITION TESTS

Test No.	Maneuver	C.g.	Approximate Test Condition: Load Factor g	Mach No.	Airspeed EAS Knots	Altitude Feet	Remarks
1	Sym. Pull-up	Fwd.	7.33	1.10		5,000	Critical Analysis Condition for Wing & Tail.
2	Sym. Pull-up	Fwd.	7.33		Max Q 700	5,000	Demonstration point, Critical for wing.
3	Sym. Pull-up	Fwd.	7.33		Min.	10,000	Demonstration point, Critical for wing.
4	Sym. Pull-up	Aft.	7.33		Min.	10,000	Demonstration point, Critical for tail.
5	Sym. Pull-up	Fwd.	7.33	.80		5,000	Intermediate Critical for wing.
6	Sym. Pull-up	Fwd.	7.33	.95		5,000	Intermediate Critical for wing.
7	Sym. Pull-up	Fwd.	7.33	1.20		20,000	Critical Analysis Condition for wing.
8	Sym. Pull-up	Fwd.	7.33	Max.		23,700	Demonstration point, Critical for wing.
9	Sym. Pull-up	Fwd.	7.33		Min.	23,700	Demonstration point, Critical for wing.
10	Sym. Pull-up	Fwd.	7.33	1.00		23,700	Intermediate Critical for wing.
11	Sym. Pull-up	Fwd.	7.33	1.40		23,700	Intermediate Critical for wing.
12	Push-down	Fwd.	-3.00		Max. Level Flt.	10,000	Demonstration point, Critical for wing. This maneuver to be performed with speed brake open
13	Rolling Pull-Out (See Note (a))	Fwd.	4.88	1.05		10,000	Critical Analysis Condition for wing and tail. (See Note (a)

TABLE I (CONTINUED) CLEAN CONDITION TESTS

Test No.	Maneuver	c.g.	Approximate Test Condition: Load Factor g	Airspeed: Mach No.	Airspeed: EAS Knots	Altitude Feet	Remarks
14	Rolling Pull-Out (See Note (a))	Fwd.	4.88	1.69 or Max. Obtainable		23,700	Critical Analysis Condition for aft fuselage
15	Sym. Pull-up	Fwd.	7.33	1.05		10,000	Critical Analysis Condition for tail
16.	Yaw (See Note (b))	Aft	1.00	.80		5,000	Demonstration point, Critical for Vert. Tail. 180 pounds Dem.
17	Yaw AF (See Note (c))	Aft	1.00		250	5,000	Demonstration point, Critical for Vert. Tail. 300 pounds Dem.
18	Speed Brake Opening	Aft	1.00	1.55	700	20,000	Demonstration point. Critical for Speed Brake

NOTES FOR TABLES I AND II

(a) Rolling pull-out - Perform a rolling pull-out to the right from a steady left turn established at the specified load factor and airspeed. The specified load factor shall be maintained while the rate of roll is built-up, with rudder fixed in trim position, to the maximum attainable with an abrupt application of a 60-pound side force on the stick, full aileron deflection, or maximum aileron boost, whichever shall first occur. The airplane shall be rolled from the initial bank to at least the same degree of bank in the opposite direction.

(b) Yaw Maneuver (Gear Up) - With the airplane in straight level flight abruptly kick rudder with an 180-pound pedal force, or full deflection, whichever shall first occur, and hold until steady sideslip is obtained, then abruptly return rudder to neutral.

(c) Yaw Maneuver (Landing Approach - Gear Down) - With the airplane in straight level flight gear down, speed brake open, displace rudder with a 300-pound pedal force, or full deflection, whichever shall first occur, and return rudder to neutral from steady sideslip. (Design Condition)

(d) Rolling Push-down - Push down to attain the specified load factor and roll left with a 60-pound lateral stick force, full deflection, or maximum boost, whichever shall first occur, and attain maximum rolling velocity (approximately 40 - 60 degrees roll angle).

(e) The critical analysis for this rolling pull-out maneuver is at 5,000 feet. The maneuver shall be performed at 10,000 feet for safety. The load difference at 10,000 feet will be negligible .

3.3.4.2 275 Gallon External Wing Tank Condition - The following maneuvers shall be performed with 275 gallon tanks installed. Tanks shall be full at take-off. Maneuvers shall be performed as soon as possible after take-off consistent with the test conditions, using normal fuel sequencing. More than one maneuver may be performed during same flight if performed with minimum delay.

TABLE II TANKS ON CONDITION

			Approximate Test Condition				
Test No.	Maneuver	c.g.	Load Factor g	Mach No.	Airspeed EAS Knots	Altitude Feet	Remarks
1	Sym. Pull-up	Fwd.	6.0	Max.		27,500	Demonstration point Critical for wing.
2	Sym. Pull-up	Fwd.	6.0		Max.q 700	5,000	Demonstration point Critical for wing.
3	Sym. Pull-up	Fwd.	6.0		Min.	20,000	Demonstration point Critical for wing.
4	Push-down	Fwd.	-3.0		Max. Level Flt. Speed	10,000	Critical Analysis for wing and fuselage. Maneuver to be performed with brake open.
5	Rolling Pull-Out (See Note (a))	Fwd.	4.0	1.05		10,000	Critical Analysis for tail. (See Note (e))
6	Rolling Pull-Out (See Note (a)	Fwd.	4.0	.90		10,000	Demonstration point for Max. rolling velocity.
7	Rolling Pull-Out (See Note (a))	Fwd.	4.0	Max.		27,500	Tail Condition
8	Rolling Push-down (See Note (d))	Fwd.	-1.0	.95		10,000	Critical Analysis - Tail Perform with speed brake open
9	Yaw (See Note (b))	Fwd.	1.0	.80		5,000	Critical for Vert. Tail and Tanks. 180 pounds Dem.
10	Yaw (See Note (c))	Fwd.	1.0		250	5,000	Critical for Vert. Tail and Tanks. 300 pounds Dem.

SK 10-12-4

Maj Fromm/al/6273

3 DEC 1954

MEMORANDUM FOR THE INSPECTOR GENERAL, USAF, WASHINGTON 25, D. C.

SUBJECT: Case Report, Special, Air Force Plant Representative's Office, North American Aviation, Inc., Los Angeles, California - Improper Aircraft Accident Investigation Procedures

1. During the special investigation of a recent accident involving an F-100 aircraft near Palmdale, California, it was determined that the investigation by local Air Force personnel was not being conducted in accordance with AFR 62-14. Accordingly, an investigation under the provisions of AFR 123-1 was conducted, and a Case Report was prepared for forwarding to the major command concerned.

2. Attached for your information are copies of the Case Report with contemplated corrective action included. The report of special investigation of the accident was previously forwarded your office on 23 November 1954.

1 Incl
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C/R, Special,
w/3 Inds
(in trip)
(Orig in M-R.)

VICTOR E. BERTRANDIAS
Major General, U. S. Air Force
Deputy Inspector General

cc: D/FSR

OFFICE SYMBOL	1. AFCDT-B	2. AFCDT-11	3. AFCDT-R	4. AFCDT	5.
GRADE AND SURNAME OF COORDINATING OFFICERS	Col Urbach	Col [illegible]	Col Richards	General Bertrandias	
	Maj Fromm				

[illegible] REVIEW:

EMAMA - Dec 53 [illegible]

Hq USAF Ltr 4 Nov 54 "Case Rept, Spec, AFPR Office, North American Avia, Inc, Los Angeles, Calif - Improper Acft Acdt Inves Procedures"

3d Ind

HQ AIR MATERIEL COMMAND, Wright-Patterson Air Force Base, Ohio NOV 26 1954

TO: Office of the Inspector General, USAF Norton AF Base, California

1. This headquarters concurs with action taken by Commander, Sacramento Air Materiel Area.

2. In addition, this headquarters is preparing an implementing AMC regulation to more clearly define and delineate the responsibilities of the Air Materiel Areas for investigating and reporting aircraft accidents/incidents involving aircraft under their jurisdictional control.

FOR THE COMMANDER:

A. V. P. ANDERSON
Brigadier General, USAF
Director, Personnel and
Support Operations

FOR OFFICIAL USE ONLY
(AFR 190-16)

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON

Office of The Inspector General, USAF
Norton Air Force Base
San Bernardino, California

4 NOV 1954

SUBJECT: Case Report, Special, Air Force Plant Representative's Office, North American Aviation, Inc., Los Angeles, California - Improper Aircraft Accident Investigation Procedures

THRU: Commander
Air Materiel Command
ATTN: MCATF
Wright-Patterson Air Force Base
Ohio

TO: Deputy Inspector General
Office of The Inspector General, USAF
Norton Air Force Base, California

I. INVESTIGATION

1. This report was prepared by Colonel E. P. Rose, representative of the Director of Flight Safety Research, Office of The Inspector General, USAF, in connection with the investigation of aircraft accident investigating procedures at the Air Force Plant Representative's (AFPR) Office, North American Aviation, Inc. (NAA), Los Angeles, California, during the period 18 - 26 October 1954.

II. IRREGULARITY

2. The investigation of aircraft accident involving F-100, Serial Nr. 52-[illegible], which crashed near Palmdale, California, on 12 October 1954, was not conducted in accordance with Air Force Regulation (AFR) [illegible] dated [illegible] June 1954 and Air Force Manual (AFM) 62-5 dated May 1953. Non-conformance with the aforementioned directives is as follows:

a. A thorough on-the-scene investigation was not conducted by Air Force personnel. Responsible accident investigating officers and members of the accident investigating board did not visit the impact area. This phase of the investigation was accomplished by NAA personnel under the leadership of Mr. J. F. O'Brien, General Supervisor of NAA activities at Palmdale Airport. The accident occurred at 1100 PST, 12 October 1954, and on-the-scene investigation terminated 15 October 1954.

(1) The aircraft crashed while undergoing structural integrity flight testing and therefore termed an incident in accordance with paragraph 6, AFR 62-14. Paragraph 28 of AFR 62-14 requires a thorough investigation of such incidents by an accident investigation board.

(2) AFM 62-5, Chapter 7, Section IV, instructs accident investigating officers to "get to the scene of the accident as soon as possible before evidence is disturbed."

(3) AFM 62-5, Chapter 1, states, "Nothing is more fundamental to accident prevention than the work of investigators at the scene of the accident and the report of accident investigating boards.

(4) AFM 62-5, Chapter 3, Section II, states that "It is essential that the investigation be started immediately following the accident before evidence is altered."

(5) AFM 62-5, Chapter 3, Section I, states "Upon arrival at the scene of the accident, investigating officers should find out immediately who is in charge. Unless competent personnel are in charge, the senior investigating officer should take over personally."

3. Air Materiel Command (AMC) was directly responsible for an adequate Air Force investigation, as stipulated in paragraph 21 of AFR 62-14, as the aircraft was bailed to NAA from AMC and was operated by a civilian pilot. There are no directives within AMC delegating investigative responsibilities of such occurrences; therefore, interested and neighboring agencies were confronted with the problem of who would conduct the investigation. The following events took place following the crash:

a. The Air Force Project Officer at Palmdale Airport departed for the scene of the crash and assumed charge because the aircraft had departed Palmdale Airport. He remained at the scene an estimated three hours.

Ltr to DIG, subj: Case Rept, Special, AFPR Office, NAA, Inc., Los Angeles, Calif. - Improper Acft Acdt Inves Procedures (Cont)

b. Edwards Air Force Base, the nearest Air Force Base, dispatched an accident investigator. This officer was relieved, on the scene, by the Palmdale Air Force Project Officer.

c. Due to the peculiar circumstances concerning this accident, the AFPR, NAA, telephoned his superior headquarters, Sacramento Air Materiel Area (SMAMA) and requested a decision as to what activity would conduct the investigation. The AFPR received a return call from SMAMA at approximately 1400 PST with instructions that his activity would conduct the investigation. This information was transmitted to the Palmdale Air Force Project Officer, thus relieving him of further responsibility.

d. No member of the AFPR Office, NAA, examined the wreckage until after it was transferred by NAA personnel from the impact scene to the Los Angeles plant of NAA.

4. The procedure of permitting a contractor to investigate without direct Air Force supervision was previously demonstrated by the same AFPR's Office in December 1953. The investigation of F-86F, Serial Nr. 52-51281, which crashed at Los Angeles International Airport on 13 December 1953 was conducted almost entirely under the direction of NAA personnel.

5. The aforementioned procedures are not in consonance with the letter and intent of AFR 62-14 and AFM 62-5 and emphasize the necessity for the Air Force to assume the initiative in the investigation of all Air Force accidents.

6. The participation of industry representatives in Air Force investigations is authorized, encouraged and of great value; however, Air Force aircraft accidents must be conducted under the direction and control of Air Force personnel to insure the complete objectivity of the investigation. The objectivity of investigations conducted under the direction of the manufacturers' personnel is subject to compromise. It is recognized that the limited number of personnel assigned to the Office of the AFPRs, and the nature of their functions, presents a problem in assembling the operational and technical experience necessary to properly investigate an accident. For this reason, it is considered advisable to establish policies and procedures which require the AFPRs to request assistance from the maintenance engineering [illegible] of the aircraft involved in the accident or from other sources of the [illegible], in order to insure that a proper investigation is conducted [illegible] Air Force aircraft accidents occurring at the manufacturers' plant.

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Ltr to DIG, subj: Case Rept, Special, AFPR Office, NAA, Inc., Los Angeles, Calif. - Improper Acft Acdt Inves Procedures (Cont)

III. RECOMMENDATIONS

7. ~~It is recommended that AMC take action to insure that~~ Air Force aircraft accident investigations under the jurisdiction of AMC are at all times conducted by Air Force personnel and in accordance with applicable Air Force directives.

IV. INSTRUCTIONS

8. This report will be reviewed and indorsed as prescribed in paragraph 20b(7), AFR 123-0, dated 13 January 1953.

VICTOR E. BERTRANDIAS
Major General, U S Air Force
Deputy Inspector General

Hq USAF Ltr 4 Nov 54 "Case Rpt, Spec, AFPR Office, North American Aviation, Inc, Los Angeles, Calif - Improper Acft Acdt Inves Procedures"

1st Ind

HQ AIR MATERIEL COMMAND, Wright-Patterson Air Force Base, Ohio NOV 12 1954

TO: Commander, Sacramento Air Materiel Area, McClellan Air Force Base, California

1. Forwarded for your information and appropriate corrective action.

2. The report will be reviewed and indorsed through this headquarters to the Deputy, Inspector General according to the provisions of Part IV, Paragraph 8, basic communication.

BY ORDER OF THE COMMANDER:

G.V. Minnis

G. V. MINNIS
Colonel, USAF
Deputy Director, Personnel
& Support Operations

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(AFR 190-16)

Hq USAF Ltr 4 Nov 54 "Case Rept, Spec, AFPR Office, North American Aviation, Inc, Los Angeles, Calif - Improper Acft Acdt Inves Procedures"

(4 Nov 54) 2d Ind

~~HQ SACRAMENTO AIR MATERIEL AREA, McClellan AFB, McClellan, Calif 1 [illegible]~~

TO: Commander, Air Materiel Command, ATTN: MCATF, Wright-Patterson Air Force Base, Ohio

1. This Headquarters conducted an investigation during the period 19 - 21 October 1954 into the methods and procedures followed by the AFPR at the North American Aviation Corporation relative to the aircraft accident referred to in basic case report. It was determined during this investigation that closer supervisory control over field activities involved in flying operations is required. Accordingly, this Command is presently actively engaged in inspecting such activities to determine the extent and character of staff surveillance which will insure the adequacy of accident prevention, safety criteria, and investigation and reporting of incidents/accidents in all field activities under the jurisdiction of this Headquarters.

2. Consideration is being given to the establishment of a Hq SMAMA aircraft investigating board to investigate accidents of a sensitive nature involving aircraft under the jurisdiction of this Command. This board, when directed by the Commander, would proceed at once to the scene of the accident and conduct the investigation in accordance with the provisions of AFR 62-14.

3. An alternate plan being considered is the appointment of a small group of qualified personnel who would act as advisors to aircraft accident investigating boards presently on orders and under the supervision of this Command. Personnel acting in this capacity would be placed on orders as voting members of accident boards presently established.

4. When either one or both of the above procedures are established, responsible personnel will be thoroughly indoctrinated, and the procedure published as a SMAMA regulation.

[illegible]

FOR [illegible]

[illegible]

Major General, USAF

Commander

NORTH AMERICAN AVIATION INC

NORTH AMERICAN AVIATION, INC

F-100A, USAF #525764, CRASH
OF NEAR PALMDALE, CALIF.,
APPROX. 11:0[illegible] AM 10/12/54;
PILOT: GEORGE S. WELCH

[redacted]
NORTH AMERICAN AVIATION, INC.

Plant Protection Department

Date: October 19, 1954 | File No: 78-3-2

Report On:	Character: CRASH
~~F-100A, USAF #525764, CRASH OF NEAR~~ PALMDALE, CALIFORNIA, APPROXIMATELY 11:02 A.M. 10/12/54; PILOT: GEORGE S. WELCH	Report by: A. G. COFFMAN
	Period: 10/12 thru 10/19, 1954

SUMMARY

F-100A, USAF #525764, piloted by GEORGE S. WELCH, NAA Senior Engineering Test Pilot, crashed approximately nine miles north-northeast of Palmdale Airport at approximately 11:02 A.M. 10/12/54. Aircraft came apart in the air and was a total loss. Pilot was fatally injured during the breakup of the plane or ejection, but descended by parachute. Ground property damage minor. Witnesses state in general that plane appeared to explode in air. Nearest known witnesses to accident were the occupants of a B-47, who were flying at approximately 25,000 feet some three miles distant. Statements of all witnesses set forth. Area searched in detail and all major parts of plane recovered. Wreckage removed to Los Angeles plant for further analysis. At preliminary meeting held 10/15/54 medical testimony received indicated that pilot suffered damage to body in possibly two separate instances, the second instance causing a severe crushing of the chest that eventually caused his death. Plane bailed to NAA June 1, 1954 for power plant and other development tests. Instant flight was #48 and was a structural demonstration flight.

- PENDING - CLASSIFICATION CHANGED [illegible]
TO ______
BY AUTHORITY OF AFR 205-1 [illegible]
BY J. Lovely DATE 1-4-61

Approved:	Copies to:	
A R Miller	Air Force (10)	J. S. Smithson
	R. H. Rice	L. R. Taylor
	R. H. Kemp	E. D. Starkweather
	G. R. Mollinger	Insurance (2)
	W. A. Spivak	Contract Administ.on
	J. W. Young	File (2)
Plant Protection Office		

[redacted]

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DETAILS

This investigation is predicated upon a report that F-100A, USAF #525 64, piloted by GEORGE S. WELCH, Senior NAA Engineering Test Pilot, had crashed near Palmdale at approximately 11:02 A.M., October 12, 1954. Emergency action was immediately taken at Palmdale and additional assistance was dispatched from Los Angeles.

It was ascertained that WELCH took off from Palmdale Airport at approximately 10:46 A.M. on a test flight over the Rosamond Dry Lake area northeast of Palmdale, California. At approximately 11:00 A.M., WELCH radioed that he was over Rosamond Dry Lake at 47,000 ft. altitude and ready for the test. At 11:02 A.M. a B-47 flying nearby at 25,000 ft. reported to Palmdale tower that the plane had exploded and parachutes were observed. The aircraft was a total loss and was scattered over an area 1-1/2 miles by one mile in size, nine miles north-northeast of Palmdale Airport. (See attached chart). The crash area is uncultivated desert land; hence, property damage was nil. WELCH parachuted to earth, landing in an alfalfa field some two miles to the east at Avenue D-8 and 60th Street East. Witnesses stated he was alive when placed aboard a helicopter from Edwards Air Force Base at 11:25 A.M. but died enroute as he was pronounced dead on arrival at EAFB hospital.

Colonel H. C. KNAPP, Commander 6510 USAF Hospital, EAFB, California, advised that WELCH received several deep lacerations, particularly on the right lateral thigh and left anterior patella. The knee cap tissues surrounding these lacerations were filled with air. Colonel KNAPP stated that it requires approximately 500 miles per hour wind or air to produce these conditions, thus it was concluded by COLONEL KNAPP that the lacerations were sustained before the pilot was free of the parts of the aircraft since the air in the tissues in the knee cap was due to wind blast.

LIEUT. NORMAN PANTING, Flight Surgeon at EAFB, advised he had examined WELCH on 10/12/54. He stated that the injuries were multiple, severe, and fatal. LIEUT. PANTING added that the entire flying suit of WELCH, an ordinary tan cotton flying suit of light weight material, was partially saturated with JP-4 fuel, particularly in the sitting surfaces about the thighs and legs. He added that there were no burns on the body or the flying suit. LIEUT. PANTING stated that he believed that WELCH was struck over the left upper chest, lower neck and upper back by some object. There were no scratches on his back. At the time WELCH was taken to the hospital his hands were bare, there was no helmet, no G-suit and no emergency bail-out (oxygen) bottle.

The official medical report of COL. HOWARD C. KNAPP, Commander, EAFB Hospital, set forth the following observations:

Comminuted fracture, right fifth finger
Comminuted fracture, right ulna, upper third
Dislocation right radius
Proximal fractures left posterior ribs one to eight
Fracture right scapula
Fracture left scapula
Fracture left clavicle, severe

AIR FORCE APPROVED
T. [illegible] 1-11-61

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Fracture ribs, anterior one and two, right
Dislocation of right humeral head
Severe abrasions, left side of neck, chin, and left forearm
Several small shiny metallic fragments in the skin of the left arm and forearm, right lower abdominal wall, and right anterior thigh
Lacerations right thigh, lateral, and left patella, anterior, with air incarcerated in the tissue about these two lacerations

WELCH's body was removed from EAFB to the Hardin-Flanagan Mortuary, Inglewood, California, October 13, 1954. His body was examined 10/14/54 by Dr. C. F. LOMBARD, Aviation Physiologist, Dr. C. L. LLOYD, NAA Medical Director, and COL. JOHN P. STAPP, Lieut. Col., USAF (MC), Chief of the Aero-Medical Field Laboratory, Holloman AF Base, New Mexico. A detailed autopsy was performed October 15, 1954 by Lieut. Col. STAPP and Dr. LLOYD, the findings of which will be reported in a subsequent report.

All available known witnesses were interviewed and a door-to-door canvass of the entire residential area surrounding the crash scene was made. This canvass covered the area from Tenth Street to 90th Street and from Avenue G north to the Kern County line, an area approximately nine miles by 6-1/2 miles in size. (Statements of all witnesses are attached).

Witnesses differed extensively as to the sequence of events in view of the high altitude and the distance from the plane. However, the majority of those who observed or heard the plane reported that several explosions were heard, and fire enveloped the plane after the explosion and numerous parts fell from the plane as it plummeted toward the ground.

Several aircraft were in the area at the time, the closest plane being a B-47 from Castle Air Force Base, Merced, California. The pilot and pilot-instructor of the plane were interviewed 10/14/54 and offered the following information:

MAJOR GUY W. HOAGLAND, U.S. Air Force, Serial No. AO 790560, advised on 10/14/54 that he is a pilot-instructor on B-47 aircraft. He is with the 93rd Bomb Wing of the 330th Bomber Squadron assigned to Castle Air Force Base, Merced, California. He has been at Castle for five months and is being transferred effective October 14, 1954 to Lincoln Air Force Base, Lincoln, Nebraska. He has slightly in excess of 8,000 hours flying time, slightly more than 800 of which is in B-47 aircraft as an instructor. He was interviewed at his home in Modesto, California.

MAJOR HOAGLAND stated he was in a B-47 on Tuesday, October 12, 1954, in company with CAPT. WENDELL BUCK. With them in this B-47 were two other individuals. CAPT. SIEHART was in the ship as observer. The other individual was T/SGT. PFISTER, the crew chief. SIEHART and PFISTER were in the nose of the aircraft and at no time did they see or were they aware of the F-100 or its difficulties. HOAGLAND stated that this was a routine bombing mission. They had been over the Salton Sea and were returning because of gear trouble. Their gear would not retract and as a result they had jettisoned their practice bombs. Their altitude was 25,000 feet over Palmdale. They had observed the F-100 to their right for approximately five minutes prior to its difficulty. The estimated altitude of the F-100 was 45,000 feet. It was first observed by HOAGLAND

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after following the contrail. They observed the contrail of the F-100 in a direct line. The compass heading of the B-47 was 330 degrees at the time he observed the F-100. The F-100 was on an estimated course of 270 degrees, indicating that the F-100 (which had not been identified as an F-100 at this time) was to the right of the B-47 and, of course, above. His first sight of the F-100 above and to his right was at an estimated distance of approximately 3-1/2 miles. The F-100 continued on its course, which was straight and direct, not erratic in any way, the vapor trails were continuous and constant, not intermittent, and HOAGLAND estimated the speed of the F-100 at this time as between 650 and 750 knots. The B-47 was cruising at an indicated air speed of 425 knots.

When the F-100 was observed at a distance of approximately 3-1/2 to five miles ahead and to the right of the B-47, the F-100 made a wingover to the right which was the beginning of his dive. HOAGLAND commented that this appeared to him to be quite an abrupt wingover. He stated that he estimated this wingover and turn to be made in less than one-half mile. HOAGLAND then contrasted that with the ten miles required for the B-47 to make a turn. The next thing he recalled was having seen it starting into a dive. He stated, however, that at no time did the aircraft appear to be out of control. He gave its diving attitude as one of approximately 70 to 80 degrees for the first 10,000 feet of penetration. He stated he had not as yet identified the aircraft, other than to discuss it with his fellow pilot and they agreed it was a Delta Wing. He had to move his head rapidly to follow the aircraft from the start of its dive until its explosion.

At the start of its dive the angle of the ship never changed at all. It was in his vision without any obstruction because of his clear canopy in the B-47. From the start of the dive until the explosion the contrail from the F-100 continued for approximately 10,000 feet, which would take it to approximately 30,000 feet. In connection with the contrail, it did not give an intermittent appearance but was a steady slackening, which is normal, according to HOAGLAND. Once it stopped it did not again begin. The aircraft in its 70 to 80 degree dive started from 45,000 ft., passed the altitude of the B-47 which was at 25,000 feet and on to, according to HOAGLAND, approximately 14,000 to 15,000 feet, at which time it exploded. HOAGLAND used the term "ball of fire".

Again he stated there was no interruption in its path of travel. He was positive there was no fire apparent to him prior to the explosion. As the F-100 began its dive, HOAGLAND said he was looking into and partially through the canopy and at this time was approximately one to one and a half miles away from the F-100 which was still on the right side of the B-47. At the instant of explosion, HOAGLAND, who again stated he had been watching the aircraft ever since he had observed its contrail, said there appeared a circular orange color, intensely bright, surrounding at its outer perimeter by a black appearing smoke, which he attributed to the combustion of the jet fuel. He said that this ball of fire remained for between six and seven seconds, at which time as it began to diminish he observed what he considered to be a wing of the aircraft tumbling over and over in the air. He stated that was the largest portion he could see. It was his opinion from the direction in which the wing was blown from the center ball of fire that the compressor had exploded and it was his theory that a compressor blade had struck a fuel tank.

TO ...

BY ... APR 2051 ...

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HOAGLAND stated that the explosion occurred toward the rear of the B-47 on the right hand side and at approximately 14,000 to 15,000 feet, which was approximately 10,000 feet below the altitude of the B-47, which was still at 25,000 feet. He estimated that the explosion occurred approximately 3 to 3-1/2 miles to the rear and to the right of the B-47. He stated then that he observed two chutes open. He was certain there were two chutes, one was white in color and the second was orange in color. He theorized that one was carrying the pilot down, that the second was an equipment chute. He stated he assumed the second was a drag chute. He added at this time that he was certain that the pilot of the F-100 did not eject himself but was rather blown from the exploded plane. He stated he did not see the canopy blow off at all, but agrees it could have come off since it is clear material and he might not have seen it. ~~He stated, however, that the aircraft was in its same degree of dive at~~ the instant of explosion as it had been at the start of the dive and at no time did it give an appearance or impression of being out of control. HOAGLAND stated the aircraft gave no impression of anything out of order until the instant of explosion.

At the instant of explosion he called Palmdale radio while still observing the explosion and notified them. He then called Edwards Air Force Base by radio and notified them. He then called back to Palmdale and asked if they could see the debris and the chutes. He was informed by Palmdale radio that they had the falling chutes in sight.

MAJOR HOAGLAND stated further that in his opinion there was no structural failure. He saw no violent maneuver. After calling Palmdale radio, he made a right hand turn and circled to the right. This was not his normal plan but he did so to keep the aircraft in sight with the idea in mind of assisting the pilot if such were possible, but because of an extremely low fuel supply in his B-47 he feared dropping down to a lower altitude for a better view.

HOAGLAND estimated the speed of the F-100 as it passed from right above to right below him between 1800 to 2000 knots, incredible as it may seem.

CAPTAIN WENDELL R. BUCK, U.S. Air Force, Serial No. AO 818585, advised on 10/14/54 he is currently assigned to the 93rd Bomber Wing of the 330th Bomber Squadron. He has been at Castle Air Force Base for five years, has over 4,000 hours flying time, slightly in excess of 550 hours in B-47. He was interviewed at Castle Air Force Base in Merced, California. CAPT. BUCK advised he was piloting a B-47 on Tuesday, October 12, 1954. He stated they had been over the Salton Sea on a routine bombing mission and had jettisoned bombs because of a gear which would not retract. As a result they drained off more of fuel supply than they should have. The B-47 ordinarily flies at 35,000 to 40,000 feet, however, on Tuesday, October 12, because of gear difficulty, they did not want to use additional fuel to climb to this altitude so they were at 25,000 feet. BUCK furnished the same information as HOAGLAND as to their first encounter with the F-100.

BUCK explained that at first he discussed the aircraft with HOAGLAND and they agreed it was a Delta Wing; however, a few seconds prior to the beginning of the dive, BUCK stated he, after seeing its wings, decided it must be an F-100.

CLASSIFICATION CANCELLED
TO [illegible]
[illegible] AFR [illegible]

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BUCK commented on the long, heavy contrail, describing it as straight, very direct. He stated that it was first seen off to the right, at approximately 3 o'clock high, using 12-hour clock dial to indicate position. He said the B-47 indicated speed was 425 K; however, his true air speed at that time was 300 K. BUCK estimated the speed of the F-100 as between 600 and 700 K in level flight prior to its dive and gave the same relative positions as had HOAGLAND, except that he considered the F-100 to be at least at 50,000 ft. altitude.

BUCK commented on the seeming abruptness of the beginning of the turn; however, he described the maneuver at the beginning of the dive slightly differently than did HOAGLAND. BUCK described the movement of leaving level flight as an abrupt peel-off. He stated that at this time and point he believed that the pilot of the F-100 turned so abruptly he may have rolled on his back and then dropped out into the dive. He stated, however, at no time did the aircraft appear to be in trouble or out of control. He gave the degree of dive as 65 to 75 as contrasted to that of HOAGLAND of 70 to 80.

BUCK stated the contrails were thick and heavy, even after the abrupt maneuver, dropping onto a dive and he estimated they continued down for approximately 10,000 feet. The contrail dribbled out from a strong heavy contrail to nothing, in the normal way. He said that they diminished completely before the F-100 arrived at the same altitude at that which the B-47 was flying. CAPTAIN BUCK stated he discerned a slight gathering of smoke coming from the tail, which he attributed to the surprising burst of speed with which the aircraft started toward the earth in its dive. He described this smoke as that which he normally sees come from the tail of a jet aircraft. BUCK stated he was familiar with some of the characteristics of the afterburner of the F-100 and believes that if the F-100 had been in afterburner he might not have been able to observe the resulting flash from the tail while the aircraft was to the right of the B-47 and at an estimated 50,000 feet as opposed to his altitude of 25,000 feet. He attributed this smoke from the tail to the pilot's adding of power. He said he would assume from the rapidity of pick-up of the dive that the aircraft was 100% of power.

BUCK stated that at the time the aircraft passed the B-47 at the elevation of 25,000 feet he estimated it to be within 1-1/2 to two miles away from the B-47. BUCK estimated the altitude of the F-100 at the time of the explosion as between 15,000 and 20,000 feet. He stated it was definitely below the altitude of the B-47 and to the right rear. BUCK then stated he had no feeling that there was anything out of order as its dive remained constant and yet under control. He stated he was looking into and partially through the cockpit of the F-100 as its dive was back towards the B-47 and can say with certainty there was no flame apparent to his eye, although the distance was as stated between 1-1/2 and two miles from the B-47.

At the instant of explosion, BUCK stated, he saw a "ball of fire". He stated he felt no concussion nor was he able to hear the explosion. BUCK described the ball of fire as large, circular, intensely bright, with a mingling of colors of red, yellow and orange. He further stated that to him there appeared to be heavy black smoke around the outer edge

[redacted]

of the explosion as it remained in the air. He stated that after the explosion he observed a rectangular portion falling. He did not describe it as tumbling as did HOAGLAND, and stated that other than the rectangular piece which he observed, the remainder of the aircraft with the exception of the chutes seemed to disintegrate as a result of the blast.

BUCK further stated that he was positive there were two chutes. Both seemed to appear at the same time below the ball of fire and both remained open. One was orange in color and the other white. Both appeared to BUCK to have something dangling from them, keeping them filled with air. At no time did they appear slack as if there was no weight bringing them toward the earth.

BUCK said they then called Palmdale radio, then Edwards Air Force radio. They were at that time on frequency 255.4 UHF. They constantly monitored the emergency frequency before, during and after the explosion and there was no traffic on that frequency.

It was at this time that CAPT. BUCK explained that he would like to contradict the story in the newspaper read by him which stated that the explosion occurred as the pilot attempted to pull out of a dive. BUCK stated emphatically the aircraft did not attempt to pull out of the dive but remained in the same angle or degree of dive at the time of explosion as it had at the start of its dive. BUCK said its acceleration was extremely raised, so much so that they remarked about it, and he estimated the speed of the F-100 as it passed from upper right to lower right as between 1500 and 2000 K.

BUCK stated definitely that in his opinion the pilot did not eject nor was the canopy ejected. He feels from actually having been as close as he was and looking at the aircraft and canopy that the pilot was blown from the aircraft and did not leave the aircraft as a result of any ejection.

The statements of MAJOR HOAGLAND and CAPTAIN BUCK were obtained by W. J. SEIBERG, NAA Fresno Plant Protection Representative, who pointed out that the descriptions and choice of words such as explosion, disintegrate, ball of fire, etc., were strictly those of BUCK and HOAGLAND. SEIBERG pointed out that both occupants of the B-47 were emphatic that there was no fire prior to the explosion and that, with the exception of one wing, the plane seemed to disintegrate following the explosion. CAPTAIN BUCK emphasized that the F-100 continued to accelerate at an alarming rate during the dive and for that reason he estimated the plane's speed as 1500 to 2000 knots.

An immediate search of the entire area was made by ground forces and by helicopter from October 12 to October 15, which resulted in the locating of almost every part of the aircraft. These parts were removed from the Palmdale area to the Los Angeles Plant October 15 for further study. A detailed chart of the location of the wreckage and photographs of the same were made and will be attached.

A preliminary Crash Committee meeting was held at NAA 10/15/54, primarily to hear the testimony of DRS. LOMBARD AND LIEUT. COL. STAPP, particularly since LIEUT. COL. STAPP was scheduled to leave the area over the week end. Attending this meeting were:

NAA Personnel

A. R. Miller	Plant Protection
A. G. Coffman	" "
W. G. Wilson	" "
R. H. Fisher	" "
W. H. Nelson	Manufacturing
Fred Earl	Quality Control
John C. Bryan	Inspection Flight Test
A. F. Weissenberger	Engineering
R. M. Kemp	"
G. R. Mellinger	"
D. R. Rogerson	"
R. Pribil	"
R. L. Schleicher	"
A. LoPresti	"
J. Hegenwald	"
H. A. Storms	"
B. G. Peterson	"
Dr. C. L. Lloyd	Medical Department
Dr. C. F. Lombard	Consultant on Aviation Physiology

CLASSIFICATION CANCELLED [redacted]
TO ____________
BY AUTHORITY OF AFR-205-1 PARA 37e
BY I. Lowery DATE 1-4-61.

Air Force

Lieut. Col. A. T. House, Jr.	AFPR Office - NAA
Maj. T. S. Coberly	" " "
Maj. W. A. Wendt	" " "
Maj. R. H. Turnquist	" " "
Capt. A. T. Stemmerman	" " "
Col. Paul P. Douglas	1002IG - Norton AF Base
Lieut. Col. John P. Stapp	Chief, Aero Medical Field Lab., Holloman AF Base
Maj. G. C. MacDonald	WADC
Capt. C. T. Terry	Long Beach AF Base

DR. LOMBARD first advised that he had examined WELCH's body October 14, 1954, and from his examination believed that the pilot probably suffered from two different blasts or sequence of injuries. DR. LOMBARD pointed out that he felt that the initial blast, which did not include fire, came from the vicinity of the pilot's right side, inasmuch as there is initial damage to the pilot's right hand and right arm, and the damage to the arm being sufficiently severe to break the right forearm, rendering it useless. The blast also forced some object through the right side of the pilot's visor, inasmuch as there was a hole approximately 1/2" x 3/4" just to the right of the right eye and the object causing this hole probably caused the contusion on the right temple. The blast also shattered the left side of the pilot's visor. An examination of the pilot's face by DR. LOMBARD revealed that the left side of the pilot's head was severely bruised but the part protected by the undamaged visor was not so bruised.

DR. LOMBARD pointed out that since the edges of the visor had been due to fire or extreme heat, it is obvious that the damage to the occurred while the helmet was on the pilot's head and prior to exposure fire or extreme heat. DR. LOMBARD concluded that the aforementioned injuries could reasonably have been caused while the pilot was still in the cockpit.

LIEUT. COL. STAPP then stated that he had examined WELCH's body on 10/14/54 and performed an autopsy on 10/15/54 and found that the pilot had obviously suffered fatal injuries due to a collision at high velocity with a solid object. COL. STAPP stated that the neck was not broken nor was there a fracture of the skull, but that the fractures of both shoulder blades and the collar bones were caused by a downward blow which was very possibly ~~centered over the breast bone inasmuch as the collar bone or clavicle broke~~ downward. The broken ribs and broken clavicles caused multiple punctures of the lungs. COL. STAPP found that the left lung had collapsed but the right lung had not completely collapsed. COL. STAPP added that although there could have been blast effect, the aforementioned injuries could not have been caused by blast alone. COL. STAPP pointed out that in addition to the serious crushing of the upper chest, eight ribs were broken adjacent to the spinal column. He pointed out that research in this type of injury has caused him to conclude that this type of injury could only have been suffered while the pilot was seated in the ejection seat, inasmuch as it was necessary for a solid object to support the back to receive this type of injury. Although there may be discrepancies between medical opinion and engineering data, it was concluded by medical personnel present that WELCH suffered from an initial blast, probably while still in the cockpit and that the severe crushing of the chest and shoulders which caused his death occurred subsequently, either while ejecting from the plane or while in the vicinity of the plane but prior to the time the ejection seat was pulled from his body following ejection.

Detailed reports submitted by DRS. LOMBARD and COL. STAPP will be set forth in subsequent reports.

Following the testimony of DR. LOMBARD and COL. STAPP, it was agreed that Engineering and Mechanical personnel would immediately proceed on an analysis and detailed study of the wreckage and that the next meeting of the crash committee would be held Wednesday, 10/20/54 at 2:00 P.M., unless delayed to a later date due to the need for additional time for technical studies.

F-100A #525764 was bailed to NAA June 1, 1954, for power plant tests and for such other tests considered necessary in the development of the F-100 series. The instant flight was test flight #40. The purpose of the flight was a structural demonstration test, one of the many provided for by the bailment agreement.

- PENDING -

AGC:jh

BY AUTHORITY OF AFR 205-1 PARA 39A
BY T. Towey DATE 1-4-61