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31 Aug 64
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MGDR - TPE

8/21/64

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WC-64-2762

B-908 Aircraft Accident

Enclosed are copies of the Structures, Tachometer and Manifold Pressure Gage reports which were today given to us by Mr. John Pahl of the CAB. These are the best copies he could provide, and you will note that the reproductions of the photographs which are shown as exhibits to the Structures report leave much to be desired.

We received these reports late today and have not had an opportunity to read them. However, I wanted to get them to you as soon as possible. We have made copies and will read them later.

I was advised by Mr. Pahl that two copies were given to the State Department on Tuesday, 19 August 1964, for transmittal to the American Ambassador in Taiwan, one copy for the Chinese CAA, and one copy for the Embassy. Mr. Morgan of the State Department confirmed that the copies had been sent to the American Ambassador in Taiwan. An additional copy has been provided Mr. Fred Hatquist, the FAA representative in Taipei.

Also enclosed is a copy of a letter we received today from Mr. Wensan Wang. We are taking care of Mr. Wang's airlines tickets pursuant to his request in the next to last paragraph of his letter.

James H. Bastian

JHB:bj

Enclosures

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STRUCTURES INVESTIGATION REPORT
CONCERNING ACCIDENT TO CIVIL AIR TRANSPORT
C-46 DM, B-908, NEAR TAICHUNG, TAIWAN,
ON JUNE 20, 1964

INTRODUCTION

This report, as originally issued, contained the observations made by examination of the wreckage of C-46 DM, B-908, at the Air Asia facilities in Tainan, Taiwan, during the period from July 4 through 11, 1964. This August 14 revision retains all of the original report, with several typographical errors corrected and several clarifying details added. Further, this revision includes Appendices I through III: (I) giving more detailed information on the laboratory examination of the elevator trim tab cables, (II) the results of laboratory examination of the right aileron down cable separation, and (III) pertinent information on C-46 modifications and FAA approved limitations.

To facilitate the examination at Tainan the many pieces of wreckage were laid out on the ground in one major mock-up simulating the general shape of the airplane in expanded form and in several lesser mock-ups. The loose fuel tanks were positioned on the ground forward of the corresponding wing wreckage in the main mock-up. The lesser mock-ups consisted of separate layouts of the loose flight control system wreckage, crew seat parts, cabin seat wreckage, and the landing gears. Due to limited time prior to the inquiry in Taipei on July 14, the notes on the auto-pilot servos and landing lights were included on pages 19 and 20 of the "Report of Investigation of Powerplants, Civil Air Transport C-46 Accident", prepared by Mr. Hallman.

The written matter contained herein is supplemented by various photographs of the wreckage, both general views and specific details, the only copies of which were submitted at the accident inquiry on July 14. At the end of this report the results of the examination are summarized.

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RESULTS OF EXAMINATION

Main Entry and Cargo Door

The main entry door remained in one piece with distortion of the lower part and the rear part of the inside lining pulled loose and distorted. A two foot portion of the forward cargo door remained attached to the main entry door by the upper door hinge. The lower hinge was broken. The inside handle of the main entry door operating mechanism was found in approximately the door open position being 10 degrees short of the straight up position and was jammed in this position by the rear portion of the circular plate being bent forward over the handle. The surface of the cabin side of this handle was practically free of any marring or other indication of loading by any hard object. Both inside and outside door handles were undistorted. The outside handle was in the corresponding position and the entire latching mechanism was intact except that the rod to the bottom latch pin was bent in the area where the door was distorted and the rear and top latch pins were out of position. At the rear latch pin position, the door frame was broken and distorted, being curled both up and down at the break. The top latch pin was found to be protruding approximately one-half inch through the door frame, having punched through from the inside at a point approximately 2 inches inboard and slightly aft of its normal location. The door frame was broken in line with the forward edge of the hole through which this latch pin normally protrudes.

The inside handle and inside cover of the door were removed to permit detailed inspection of the operating mechanism. This mechanism was intact and in operating condition except for the previously mentioned damage to the lower rod and the latch pins. The rear end of the "CLOSED" plastic placard was broken off through the rear attach screw hole. The inner surface of the circular plate was not marked by the door handle except through an arc from about 10 degrees to about 20 degrees from the fully "OPEN" position of the handle.

The top latch hole for the main entry door was undistorted. The rear hole was deformed at the bottom corner. The bottom hole was distorted at the outer (flat) edge.

All four of the pin type latches on the bottom of the front and rear cargo doors were found in the extended "CLOSED" position and most of them

Main Entry and Cargo Door (continued)

jammed in this position. Three of the toggle latches were still attached and in operating condition but the rear one on the rear door was torn off and missing.

Three latch pin holes in the door sill for the cargo doors showed no noticeable distortion; the most forward one was not found. The most forward plate for the toggle latches also was missing, the next two were torn out and the most rearward was intact and undistorted.

Passenger Cabin

All of the 53 passenger seats and the two stewardess seats were accounted for. In general, the leg structures were buckled and broken due to loads acting to the left, downward, and forward and with the legs separated from the Wedgit fittings. Most of the seat belts were unbuckled without any noticeable damage due to high impact loads, although several remained buckled and two were cut through the webbing after being mud splattered. No indication of fire damage or other damage than that consistent with crash impact destruction was noted.

The other wreckage from the cabin area disclosed no evidence of damage other than that due to crash impact loads except that in the extreme rear end two indications of burning were noted. One instance of this was burned fragments of fiberglass insulation and one small section of cabin lining remaining attached to the upper fuselage shell between Station 688 and 704 in the lavatory area. Scorching and charring was predominant at free edges of the torn material in a manner consistent with short period burning after crash impact. The painted skin in this area showed only very minor indication of heat damage, most of it being in the zinc chromate finished area normally covered by the dorsal fin which was free of fire damage.

The other instance of fire damage was found in a crumpled piece of fuselage shell from the left side in the area of Stations 651 to 688. Fragments of fiberglass insulation and the edges of paper towels in a container on this piece of wreckage were charred. However, the painted metal structure showed no indications of heat damage. The charring of the fiberglass insulation was most predominant on exposed edges of the torn material with little or no damage to the areas wedged into folds of the crumpled skin. This is indicative of very short period exposure to burning after the crash impact damage occurred.

Access Door From Cabin to Cockpit

The access door from the cabin to the cockpit was broken out of its bulkhead, the piano hinge remaining attached to the door, and the lower half of the door was fragmented. The spring type latch and handles remained

Access Door From Cabin to Cockpit (continued)

in operable condition. The slide bolt on the cockpit side of the door was missing from its housing, without any noticeable deformation of the housing to indicate the position of the bolt at the time of the crash. The portion of the bulkhead containing the latching housing for the slide bolt was not found.

Crew Entrance Door

The crew entrance door was found nearly intact with the latch pins and operating mechanism in the extended door "CLOSED" position. The upper latch pin was displaced forward by crash impact loads. The two hinges were torn out of the door.

Crew Seats

Numerous fragments of the cockpit crew seats, including one seat back cushion, were found with no recognizable evidence of any damage other than that due to crash impact forces. The buckle half of one belt was still attached to one of the pieces of seat structure. The other half of one belt was also still attached to a fragment of seat structure, one spot on the webbing showing indications of high loading. Both of the above belt halves had black webbing and Air Associates type buckles. Another half of a belt with red webbing and a metal to metal type buckle was found attached to a piece of crew seat frame. The webbing and fittings were intact.

Crew Seat Tracks

Four pilot and first officer seat tracks with small pieces of floor structure attached were located. The tracks were not identifiable as to pairs or right and left positions. All were broken through the most rearward hole. Two were broken through the most forward hole and one of these two had a third break through the fourth hole from the front. A third one was broken through the second hole from the front and the fourth one was broken through the fifth hole from the front. There is no apparent pattern to the track breaks or deformations of the locating pin holes indicating seat positions on the tracks at the time of impact.

Wing Structure

The wing structure was broken into numerous pieces, all of the deformations and fractures being consistent with essentially rearward acting ground loads. In general, there was remarkably little fire damage. There was one small burned area on the top surface area which had covered the rear fuel tank. There was relatively light fire damage in the outer portion of the left center wing structure. Three pieces of right outer panel skin forward of the aileron had the exterior paint charred and burned off in some of their areas. However, there was no continuity of fire damage

Wing Structure (continued)

across tears of mating pieces, indicating that all of the observed fire damage on the wing occurred after the accident.

Flaps

The four wing flaps received moderate crash impact damage and remained attached to sections of wing structure forward of each flap. However, the lower chords of the outer bracket for the right inboard flap and of the inboard brackets for both outboard flaps were fractured just aft of the spar attachment. In addition, the inboard end of the right outboard flap was mangled and separated from the rest of this flap. No fire damage was noted on the flap wreckage. All four flaps were in the retracted position at the time of the accident as indicated by the retracted positions of the hydraulic actuator struts.

Ailerons

The right aileron was torn into six pieces by crash impact forces, one of which just outboard of the tab was missing. No fire damage, not even to the fabric covering, was noted. All six hinges were broken in random patterns, but the hinge bolts connected parts of both wing and aileron fittings in all cases. The entire tab was still attached to one portion of aileron by means of the complete piano hinge. All sections of the counterbalance weight remained attached to the leading edge except short sections bridging breaks in the aileron.

The left aileron was torn into two pieces. The separation occurring just outboard of the No. 3 hinge. The Nos. 1, 2 and 3 hinges still attached the inboard section of aileron to wing trailing edge and rear spar structure. Portions of the No. 4 and 5 hinge brackets were separated from wing structure and still attached to the outboard section of aileron by means of the hinge bolts. The bearing was broken out of the No. 6 hinge fitting riveted to the aileron and all portions of the bracket forward thereof were missing. The counterbalance weights remained attached to the aileron leading edge throughout their entire length. There was no fire damage to the left aileron. The tab remained attached to the inboard section of left aileron by means of the complete piano hinge.

Landing Gear

The tail wheel retract strut was found with the piston rod bent in the fully extended position which corresponds to the gear retracted position. The wheel and tire remained intact and attached to the tail wheel assembly.

The right main landing gear strut showed no significant damage, the inner cylinder appearing to be unbent. The uplatch bolt on the dog leg was

Landing Gear (continued)

bent toward the upper end of the strut. The left main gear strut was in comparable condition, except that the uplatch bolt appeared to be straight. The left main gear uplatch was found intact and still attached to a portion of nacelle wreckage. Both main gear tires were torn by crash impact loads with no indication of prior blowout. The left wheel brake drum rim was crushed inward in one area by crash impact loads. This area was in line with the tire tears. When examined at Tainan the left main gear retract strut was in the extended position with the rod end fitting broken off. The right main gear retract strut was in the compressed position without any damage restraining extension. It was reported that when first observed after the accident both main gear retract struts were in the fully extended position, which corresponds to gears retracted.

Left Horizontal Tail

The horizontal tail on the airplane was the "E & F" type with aerodynamic balance area and spring tabs on the elevators. The left horizontal stabilizer was cut from the aft fuselage section inboard of the stabilizer splice by means of a torch prior to transportation to Tainan. In addition, the stub end of the elevator with spring tab was unbolted from the inboard hinge and the elevator torque tube. Also, the spring tab cartridge, the bellcrank to which it attaches, and the push-pull rod extending into the fuselage were reported to have been removed at this time. Nothing observed at Tainan would indicate disconnection at any of these points prior to the accident.

Almost the entire leading edge of the left horizontal stabilizer was crushed by rearward and upward acting ground loads. In addition, the stabilizer structure was folded upward about a diagonal line extending from about Station 80 at the leading edge to about Station 130 at the rear spar. The stabilizer tip was torn off by ground impact loads with little damage except rearward crushing at the leading edge. The inboard No. 1 hinge bracket remained intact with no noticeable distortion. The No. 2 hinge bracket was bent outward and broken off about four inches forward of the elevator hinge line, the two pieces remaining attached to the stabilizer and elevator respectively, with the hinge bearing and bearing block damaged in the breakup. The No. 3 hinge bracket was found as a separate piece which was torn out of the stabilizer with about 10 inches of rib forward of the rear spar still attached. The hinge bolt remained in the hinge bearing having broken off the lugs of the hinge fitting bolted to the elevator. The most outboard hinge bracket, No. 4, was bent outward and broken at about mid-point, the forward portion remaining with the stabilizer tip, and the aft portion still being attached to the outer section of elevator by means of the hinge bolt and elevator hinge fitting.

The left elevator was separated into two pieces by crash impact. One

Left Horizontal Tail (continued)

section extended from the tip to Station 87 (No. 2 hinge point) at the leading edge with a tear running rearward and slightly inboard from the spar, just inboard of the No. 2 hinge, to the trailing edge at the outboard side of the trim tab balance weight cutout. This portion of the left elevator was buckled upward in line with the No. 2 hinge and downward about half way between the Nos. 3 and 4 hinges. Most of the left elevator outboard of the No. 4 hinge was missing, the remaining fragments showing both distortion due to ground impact and melting due to fire after being distorted. The paint on most of the top surface of this piece of elevator and some of the bottom surface was charred and burned away by fire after ground impact. This heat damage extended to the tear at the inboard end, but the mating skin inboard of the tear had no comparable heat damage. The trim tab remained attached to this section of elevator by means of all three hinges. Both balance weights of this trim tab remained intact and undistorted. The tab itself was buckled in line with the previously mentioned upward buckling of the elevator.

There was one heat scorched section of the elevator upper leading edge skin between Stations 70 and 85. Other than this the inboard (Station 87 to the root end) section of elevator, which remained attached to the stabilizer by means of the No. 1 hinge, and to the fuselage by means of the elevator torque tube and the spring tab push-pull rod, was practically undamaged. The spring tab remained attached by all three hinges and its balance weight was undamaged. The push-pull rod extending forward from the spring tab remained attached to the tab horn and was in an undamaged condition. The spring tab cartridge, which had been removed, was the proper left hand part. Both it and the removed bellcrank were in good condition.

The trim tab push-pull rod in the left elevator remained attached to the tab horn and to the tab idler at the elevator hinge line. The idler part number was unknown with a bolt center length of approximately 2-11/16 inches which is the same as the length of the P/N S20-530-5722-1 idler used on the right elevator. The aft end of the shaft from the trim tab motor also remained bolted to the idler. This consisted of the rod end which was bent inboard. The shaft tube was broken off at the forward edge of the rod end. The main part of this shaft was bent outward and remained attached to the tab motor in the left horizontal stabilizer. The left tab motor shaft on this airplane did not incorporate the compression spring normally used on C-46 E & F type horizontal tails. Air Asia Aircraft Maintenance Circular No. 47, dated February 27, 1956, describes this modification. The tab motor was still installed in its bracket with the pivot studs properly safetied. The motor was in the full forward adjustment, cables taking off at the forward end of the cable drum, which corresponds to full down tab travel, and the motor was jammed in this position. The upper cable extended 32 inches from the motor where it terminated in a cut end. The lower cable extended 14 feet 4 inches from the motor where it terminated in a cut end. It is understood that a short piece was cut from the end of

Left Horizontal Tail (continued)

one of these cables for Mr. McBride of the Federal Aviation Agency, to be examined for type of failure. Captain Teeters testified at the inquiry in Taipei on July 14 as to which cable had been cut for this purpose.

Right Horizontal Tail

The right horizontal stabilizer had been cut from the aft section of fuselage by means of a torch prior to transportation to Tainan. It was reported that the elevator had been disconnected from the stabilizer by removal of the No. 1 hinge bolt, the Nos. 2, 3 and 4 hinge bearing block bolts, the bolts connecting the elevator torque tube to the elevator, and the bolts at both ends of the spring tab push-pull tube extending from the elevator floating horn to the spring tab bellcrank at the end of the torque tube extension. No condition was observed at Tainan to indicate any disconnection at these points prior to the accident.

The right horizontal stabilizer was undistorted except for rearward flattening of the leading edge over a six foot span by crash loads and inward crumpling of the tip section by crash impact loads. The Nos. 1, 2 and 3 hinge brackets remained intact without noticeable distortion. The No. 4 hinge bracket was displaced inward with an inward bend several inches aft of the stabilizer rear spar and an outward bend just forward of the hinge fitting. The paint on the outer surface of the stabilizer was not discolored by heat or fire, but the fabric patches covering three holes in the closing skin just forward of the elevator leading edge were brittle from heat charring.

The only significant damage to the right elevator was distortion of the area from the No. 3 hinge to the tip in a manner consistent with the ground impact damage to the stabilizer tip and the distortion of the No. 4 hinge. The damage consisted of inward buckling along a chordwire line just outboard of the No. 3 hinge, upward displacement of the surfaces aft and inboard of the No. 4 hinge, with a compression buckle in the upper skin extending inboard and aft from the No. 4 hinge, and upward displacement of the elevator tip section outboard of the No. 4 hinge. At both the Nos. 3 and 4 hinges the leading edge upper skin and nose ribs were deformed by interference with the bottoms of the corresponding hinge brackets as the outer part of the elevator accorded inward due to the ground loads at the tip. When the wreckage was examined at Tainan the right elevator was in two pieces, having been served along a chordwire line approximately 23 inches inboard of the No. 4 hinge. However, it is obvious that this was done by cutting, hacking and bending after the previously described impact damage had occurred.

The spring tab remained attached to the right elevator by all three hinges and the counterbalance was intact. However, the tab skin was buckled just outboard of the counterbalance with the inboard end of the tab and the counterbalance displaced about 10 degrees nosedown relative to

Right Horizontal Tail (continued)

the rest of the spring tab. The spring tab push-pull rod was still bolted to the tab horn and to the bellcrank at its forward end. The spring tab cartridge also was still properly installed and was the correct right hand part. The bellcrank was undamaged and properly attached to the bracket at the end of the torque tube extension. It was reported that prior to removal of the horizontal tail surfaces from the aft fuselage at the scene of the accident, the entire spring tab and the spring tab control assembly were in operable condition. Nothing observed during examination of the wreckage at Tainan would indicate otherwise.

The right elevator trim tab was in one piece but distorted in a manner consistent with the previously described ground impact damage to the elevator. The inboard and center hinges were intact, still holding the tab to the elevator. However, the lugs of the outboard hinge fitting attached to the elevator were broken off at the hinge bolt which remained in the fitting attached to the tab, the broken off portions of the lugs still remaining with this assembly. This hinge fracture was consistent with the ground impact damage to the elevator.

The right elevator trim tab push-pull rod was still bolted to the tab horn, but the idler at the elevator hinge line had been unbolted from both the push-pull rod and the pivot fitting. The idler was of proper type and in good condition. The trim tab shaft forward of this idler was still attached to the trim tab motor. The latter was properly installed in its mounting bracket with the pivot studs properly safetied. The tab motor was in operable condition with the cables leading off the drum at its forward end which corresponds to the tab full "UP" position. The upper cable extended approximately 12 feet 6 inches from the cable drum where it terminated in a cut end. The lower cable extended approximately six feet from the drum where it terminated in a cut end. It was reported that a short section of cable with a broken end was cut from one of these cables for Mr. McBride of FAA, to be examined in the laboratory for type of cable failure.

This section of cable and the one cut from the left elevator trim tab motor were examined by the CAB metallurgist, Mr. W.L. Holshouser, in Washington, D. C., who reported by cabled message, in substance, the following:

Cable sections are standard twisted steel one-eighth inch aircraft cable, seven strands, seven wires to strand.

Right elevator trim cable appears to be overload tension failure. No evidence of significant damage or wire failure prior to failing overload.

Left elevator trim cable: Entire eight inch length shows serious wear to extent that all exposed wires around most of periphery in each

Right Horizontal Tail (continued)

twist of outer strands are worn to about one half original diameter. In the last half inch preceding raveled end there are thirteen wire ends showing in a straight line along side. Center strand failed in pure tension with no sign of previous damage or wear. Of the six outer strands:

1. Shows four wires of the seven worn completely through at one point, two failed in tension and the seventh with earlier crimping break.
2. One wire worn 80 percent prior to failure, four wires failed in tension, two wires severed earlier by wear in the unraveled area.
3. Three wires have crimping failure, one wire worn through one failed in tension, two separated in the unraveled area.
4. Three wires have crimping failures, two tension failures, two broken in unraveled area.
5. One wire worn through, one crimped, and five failed in tension.
6. Five wires failed in tension, two disconnected in unraveled area.

Left cable wear and crimping pattern may be indicative of cables sliding over frozen pulley, turning axle of a split pulley, or some similar cable problem.

Vertical Tail

The vertical tail on this airplane was the "D" type with only a trim tab on the rudder. The vertical tail was found to have been unbolted from the aft fuselage subsequent to the crash. The rudder had also been detached from the fin subsequent to the crash by removal of the hinge bolts and unbolting of the rudder torque tube.

There was no noticeable distortion of the fin structure due to aerodynamic or crash loads. All hinge brackets remained intact. Ground fire burned the paint over most of the left side of the fin, annealing much of the skin, only the lower two feet of the left side being essentially free of fire damage.

The rudder was in comparable condition to that of the fin, the left skin being heat damaged from the top down to about three feet from the bottom. All hinge fittings and both counterbalance weights were intact. The tab was still attached to the rudder in an undistorted condition

Vertical Tail (continued)

with the push-pull rod still attached to the control horn and intact. When the wreckage was examined at Tainan the rudder tab motor had been disconnected from the push-pull rod and idler at the rudder hinge line and had been removed from the fin. Both the idler and the tab motor mounting bracket were undamaged. The rudder tab motor remained in operable condition and the pivot stud holes and the mating surfaces of the tab motor and mounting bracket were not damaged by abnormal wear due to loose studs. When examined at Tainan the rudder tab motor was in nearly the neutral position with both cables cut off approximately three inches from the tab motor. The free drum groove between the cables leading off from the drum was approximately one-half groove space forward of the parting plane of the motor housing, which corresponds to approximately one or two degrees left tab position.

Flight Controls

Six major pieces and other small pieces of the control column assembly were available for examination. Included in the major pieces were the upper ends of both columns with the hubs of the control wheels still attached. The left wheel hub was found tight at about 140 degrees displacement from neutral in the left wing down direction. The right wheel hub was free to turn through a range from about 125 degrees from neutral in the left wing down direction to about 100 degrees from neutral in the left wing down direction. With continued rocking of the wheel and pulling on the chains the wheel freed up and could be moved to other positions. The complete chain was still attached to the right wheel sprocket with the cable terminals and short sections of cable still attached to the chain ends. The left cable was severed with moderate fraying and severe bending set near the failure. The right cable was severed short about one inch from the end of the terminal barrel with a severe bending set in this length. The elevator control cable arm was broken off at the control column torque tube and was broken also in about 7 inches from the cable attached point. Approximately three foot lengths of both "elevator up" cables were attached to the aft end of the link at the bottom of the control arm with short severed ends, having the appearance of cuts. The control rod tube extending forward as a part of this link to the forward bellcrank was broken off at the forward end of the forged terminal attached to the control arm. The bellcrank, P/N 20-530-3044, was missing.

The elevator bellcrank, P/N 20-530-5724, from the aft fuselage was in good condition with short lengths of all four cables still attached and with the ends cut. The push-pull rod which extends aft from this bellcrank had been unbolted from it and was in good condition. The lower end of the elevator floating control horn was still attached to the aft end of this push-pull tube with the casting fractured about 3 inches from the swivel clevis. The fracture surfaces disclosed a rather coarse grain structure. Examination of the fracture area by means of a binocular microscope disclosed cracks in the finished surfaces adjacent to the fracture

Flight Controls (continued)

due to high overload stresses in this general area, which would not have occurred if there had been a fatigue crack starting at a stamped part number through which the fracture occurred.

The elevator torque tube was intact with the two hinge fittings still attached. Both spring tab push-pull rods, which extend from the floating elevator horn to the bellcranks in the elevators, were intact and in good condition. The left spring tab bellcrank and cartridge, the latter of which was the proper left hand part, were intact and in good condition. The remaining parts of the spring tab system are described in the sections of this report on the left and right horizontal tails.

Three rudder pedals and all four rudder pedal arm assemblies were accounted for. On each arm assembly the push-pull tube to the sector was broken off at or adjacent to the arm assembly attachment. All four of the cable sectors were intact except that on one of them, one of the lugs at the pivot bolt was broken. All four pivot bolts remained in the sectors. The aft end of the push-pull rod from the pedal assembly remained attached to each sector. Short lengths of both cables also remained attached to each sector. Both pedal adjustment mechanisms were accounted for in a damaged condition consistent with crash impact loading. The rudder control system parts in the aft fuselage are described in a following section of this report.

The aileron cross-over and booster mechanism mounted on the wing rear spar at the center line of the airplane was broken into six major pieces of crash impact forces. The three bellcrank arms to which the cables in the wing attach and the arm to which the right hand cables in the fuselage attach were broken from the hub assembly. The arm for the left hand cables in the fuselage was bent upward about 40 degrees.

Short sections of the two right hand cables from the cockpit were still attached to their cross-over control arms. The connector assembly for the left hand cables from the cockpit was still bolted to its arm in an undamaged condition, but the cable connecting bolt was missing. Short sections of two cables with the turnbuckles which attached at this point were found with bends in the turnbuckles, including the clevis ends, indicating that they were probably attached to the connector link at the time of the crash. The connector assembly for the balance cables between ailerons was still attached to its control arm but knocked off its bearing. A short section of left aileron balance cable was still attached to this connector with the free end of the cable frayed. The right end of the connector fitting was broken off in downward bending about 1 inch from the cable connector bolt position. The clevis end of a turnbuckle for $\frac{1}{4}$ cable was still attached to the arm for the right aileron up cable. This clevis was bent and the threads were clean while the rest of the clevis was muddy, indicating that the turnbuckle barrel had been attached until after the accident. About six feet of the

Flight Controls (continued)

left aileron up cable remained attached to its arm with the free end of the cable frayed. The boost cylinder assembly was broken off at all three connections to the cross-over bellcranks, the connecting bolts and portions of the attach fittings remaining in place. The pivot bearings were missing from the boost assembly bellcrank, P/N 20-530-1064. The booster piston worked freely in the cylinder, so its position was meaningless.

The aileron differential bellcrank from the right wing, when examined at Tainan, was intact but separated from its mounting bracket, which also was intact. The pivot bolt was missing, but the condition of the pivot bearings in both parts had the appearance of the bolt having been removed after the accident, rather than having failed at crash impact or having been missing prior to the accident. A short section of the forward 3/16 inch cable was still attached to the bellcrank, the free end of the cable 47 inches from the crank attach bolt was extensively frayed in the failure area. This and the matching end of fractured cable were removed for laboratory examination of the cable failure by the CAB metallurgist in Washington.

The rear, $\frac{1}{4}$ inch, cable end was not attached to the differential bellcrank, the ball bearing at this attach point having been forced out of the bellcrank with noticeable distortion of the hole for the bearing. The forward rod end of the aileron push-pull rod was still attached by its bolt, but the push-pull rod itself had been unscrewed from the rod end without damage to the threads. The check nut remained on the threaded shank of the rod end in a normal position. The rod was bent about 20 degrees at its mid-point and was still attached to the aileron horn.

The aileron differential bellcrank from the left wing was found detached from wing structure. The arm for the forward cable was broken in downward bending about 4 inches from the cable attach point, a long piece of the 3/16 inch cable remaining attached. The aft aileron cable fitting assembly remained attached to the bellcrank, and the cable attaching bolt was in place with its nut nearer the end of the bolt than normal and no cotter, indicating that the cable terminal had been disconnected at this point after the crash. A long piece of this cable remained entangled in left wing wreckage with the terminal which attaches to the differential bellcrank undamaged. The pivot bearings were missing from the bellcrank, their holes not showing any pronounced distortion. The mounting bracket for the differential bellcrank was broken and all except part of one leg still attached to a portion of rear spar, was missing. The major portion of the aileron push-pull rod was still attached to the differential bellcrank, the tubular portion of the rod having separated about 5 inches forward of the aft end in sharp sideward bending. The aft end of the push-pull rod remained attached to the aileron horn.

The left aileron trim tab mechanism remained intact in a section of wing

Flight Controls (continued)

rear structure and aileron except that the push-pull rod between the idler and the tab was separated at about mid-point where the tube wall was crippled due to sharp downward bending. Short lengths of the trim tab cables with frayed ends led off the tab motor drum one groove from the aft end of the drum on top and two grooves from the aft end at the bottom. This corresponds to nearly the full "UP" tab position.

The right aileron tab motor was found lying loose in the trailing edge of a section of the right wing wreckage, having been pulled rearward out of the mounting bracket with bending deformation of the two pivot studs. These studs were still properly safetied. The tab motor was intact, but the shaft was bent about 25 degrees just aft of the threaded section. The end of the idler and the forward end of the push-pull tube to the tab were still bolted to the aft end of the motor shaft, the idler being broken in sideward bending and the tube of the push-pull rod separated at the aft rivet and edge of the rod end in tension and side bending. The rest of the push-pull rod remained bolted to the tab with a sharp bend in the middle and the fractured forward end battered by interference with metal after the separation. The tab cables led off the tab motor at its mid-point, corresponding to about the zero tab deflection position.

The cockpit control for the aileron trim tab was found jammed in the neutral position with the hand wheel broken off. The cockpit control mechanism for the elevator tabs was found in the neutral position with all except one spoke of the two hand wheels broken off. The mechanism could be turned about one-half hand wheel rotation. The cockpit control mechanism for the rudder trim tab was missing.

There were numerous pieces of assorted control cables in various lengths, some still entangled with pieces of wreckage and others free. Nothing was observed in the condition of these pieces indicating any abnormality or damage other than that due to crash impact forces or cutting for removal of the wreckage.

Rudder Controls In Aft Fuselage

The rudder controls in the aft fuselage were not removed for transportation to Tainan. All parts from the main bellcrank to the flexible interconnecting rod between bellcranks, to the second bellcrank, to the push-pull rod, to the rudder torque tube, remained properly installed and attached to each other and operated freely. The counterbalance on the rudder torque tube was undamaged.

The rudder cables attaching to the left end of the main bellcrank were broken off short at the forward ends of the turnbuckles at the bellcrank. The rudder cables attached to the right end of the main bellcrank extended 6 feet 9 inches from the bellcrank where they terminated in tension failures with severe set indicating that they were bent around some obstruction during breakup while under excessive load leading to failure. The rear stop bolt on the main bellcrank was bent approximately

Rudder Controls In Aft Fuselage (continued)

90 degrees and the forward one was broken off. The head ends of each stop bolt extended approximately six threads from the rear surface of the stop nuts, approximately 3/8 inch* on rear bolt and approximately 3/16 inch* on the front bolt. The stop lug on the second bellcrank was gauged on both sides by abnormal loading from the stop bolts. The link rod between the two bellcranks was slightly bowed by abnormal loading. This link rod connected to the two points at which a hydraulic boost cylinder had originally been provided by Curtiss-Wright. It did not transmit any control system load as long as the stop bolts on the main bellcrank were intact.

* These dimensions may or may not be the one originally written. The original notes are in the possession of the Chinese CAA.

SUMMARY

1. The airplane structure was severely disintegrated by crash impact forces acting, in most instances, rearward, upward, and to the right on the airplane.
2. No indication of fatigue cracking was found in any of the structural wreckage, with the possible exception noted in Item 6 below.
3. Numerous joints had been unbolted for transportation prior to the examination at Tainan, making the examination for any disconnection in service slightly more difficult than examination for this condition would have been at the scene of the accident.
4. No indication of in-flight fire was seen in the structural wreckage or interior equipment.
5. There were only a few pieces of structural wreckage bearing evidence of relatively light and short period fire and/or heat damage after the accident. These were in the right outer wing wreckage forward of the aileron, the outer part of the left wing center section, the left side of the vertical tail, one piece of wreckage comprising the outer section of the left elevator, and the lavatory area of the passenger cabin.
6. Laboratory examination of the left elevator trim tab cable fracture disclosed damage in the fracture area suggestive of that which might be produced by dragging over a binding pulley or other rubbing surface. It is possible that some of the individual wire fractures included fatigue cracking.
7. The aileron down cable, 3/16", which attaches to the forward arm of the differential bell crank in the wing forward of the aileron, separated 47 inches from the bell crank attach bolt with extensive fraying. This portion and the matching end of the fracture were removed for laboratory examination of the cable failure by the CAB metallurgist in Washington. This examination disclosed that the separation was the result of abnormal loading at crash impact.

John F. Pahl

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Bureau of Safety
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APPENDIX I

LABORATORY EXAMINATION OF ELEVATOR TRIM TAB CABLE FRACTURES

Figure I-1 shows the two short sections of elevator trim tab cables as they were received in Washington for laboratory examination by the CAB metallurgist. Pages 9 and 10 in the main body of this report gives the results of his examination which were dispatched to Taipei on July 11, 1964. This appendix is the result of more detailed examination.

Right Elevator Trim Tab Cable

All wires exhibit tension overload characteristics, with necking down adjacent to the fractures. Figure I-2 shows a typical wire end terminating in fracture. No observed condition of the wire indicates significant wear or other unairworthiness of the cable prior to the high overload which caused failure when the airplane disintegrated on impact with the ground.

Left Elevator Trim Tab Cable

Approximately 3/4" from the main fracture there are two damaged areas resembling wear on the outside of the cable almost opposite one another (approximately 160 degrees apart). These damaged areas are shown in Figures I-3 and I-4. Before the cable was unraveled for detailed examination, broken wire ends were visible in the more severely damaged area, Figure I-3. About 15 degrees from the damaged area shown in Figure I-4, at the damaged area end farthest from the main cable fracture there were some wires pulled up, as shown in Figure I-5.

The failed ends of the 49 wires in this 7 x 7 cable have three distinctly different appearances, as follows: 17 exhibit necking down, 18 are crimped, and 14 show wearlike damage characteristic of deformation due to one or a few interferences with a hard surface at very high pressure, rather than often repeated dragging over a surface at pressures consistent with those produced by a lightly loaded cable such as this one is in normal service. These three types of failed ends are shown in Figure I-6.

The center strand of seven wires failed from tension overload, as shown in Figure I-7, with no indication of wear or other previous damage.

Examples of the more severe wearlike damage on the exterior wires of the other six strands are shown in Figures I-8 and I-9. This too is typical of damage due to one or a few interferences with hard surfaces at very high pressure, rather than normal service wear of a lightly loaded cable dragging repeatedly over some stationary surface.

Left Elevator Trim Tab Cable (continued)

It is possible that some of the individual wire fractures could have included fatigue cracking, with subsequent obliteration of the characteristic fracture surfaces due to moving interference with a hard surface at high pressure. However, it appears more probable that both the wire fractures and the wearlike damage on exterior wires of the cable occurred during the disintegration of the airplane on impact with the ground. No positive indication of significant wear or other unairworthy condition of this cable prior to impact of the airplane with the ground was found during this examination.

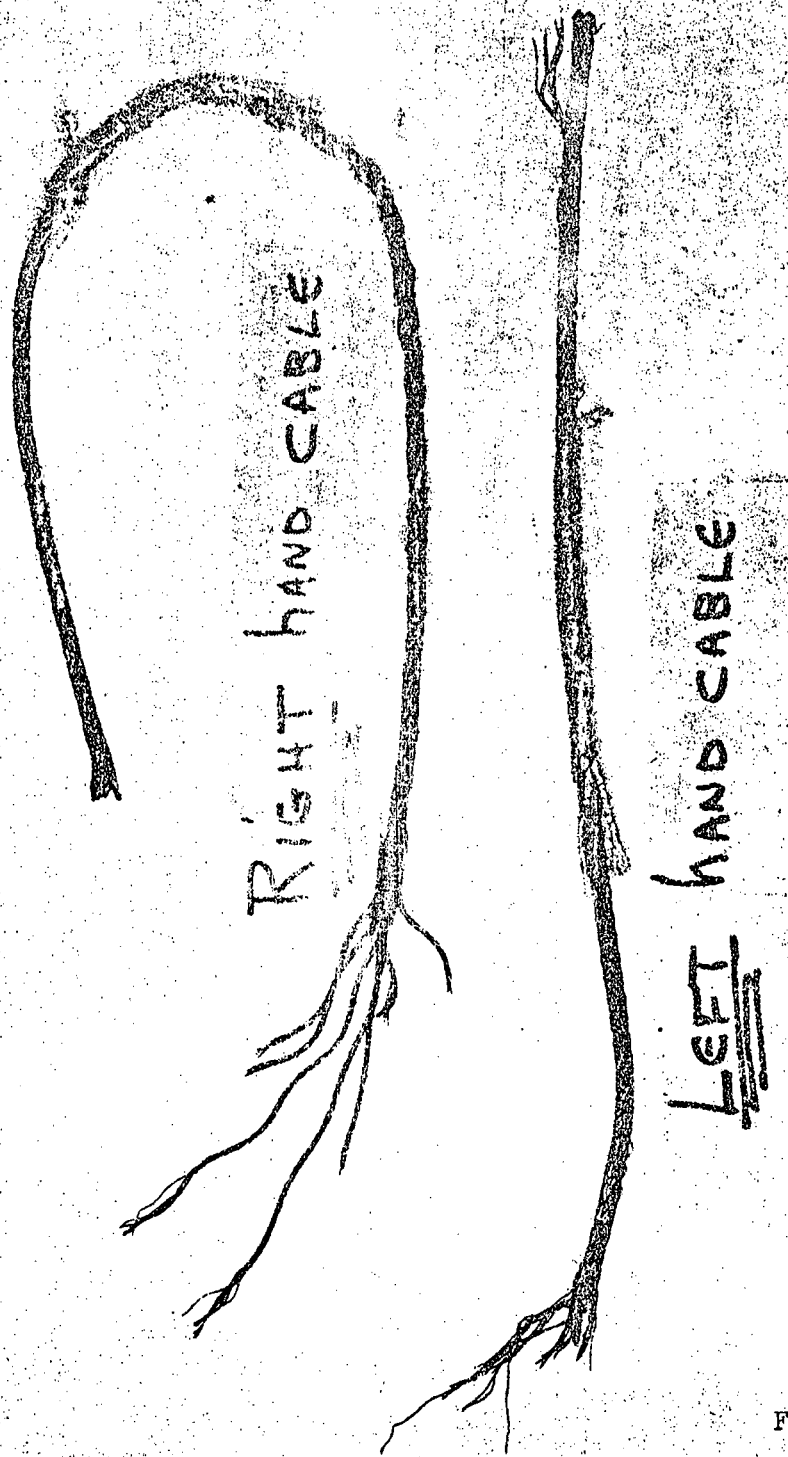


Fig. I-1

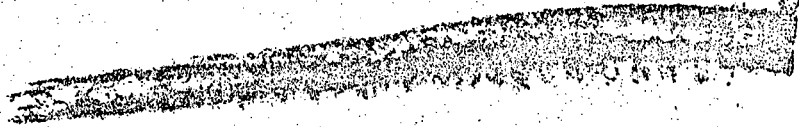


Fig. I - 2

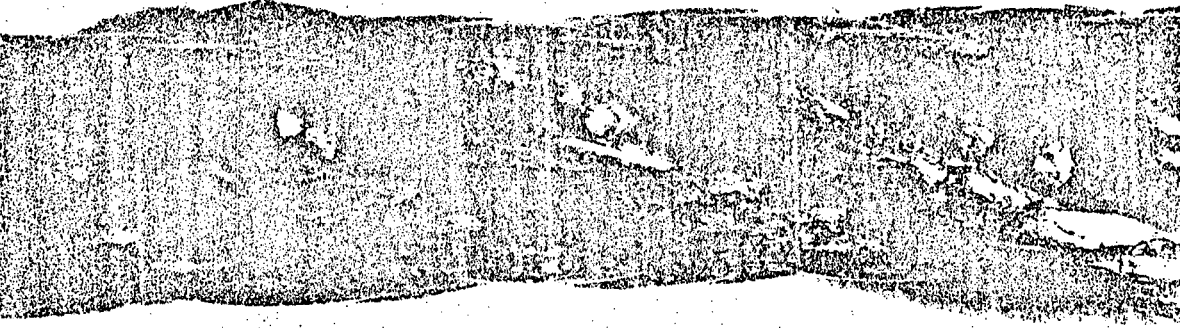
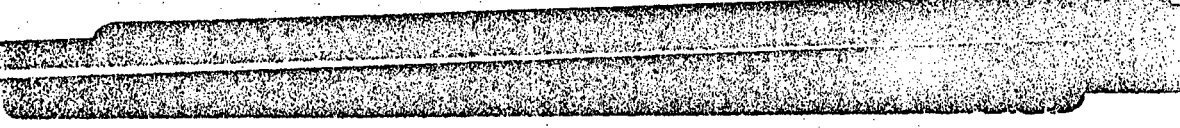


Fig. I - 3
X-15

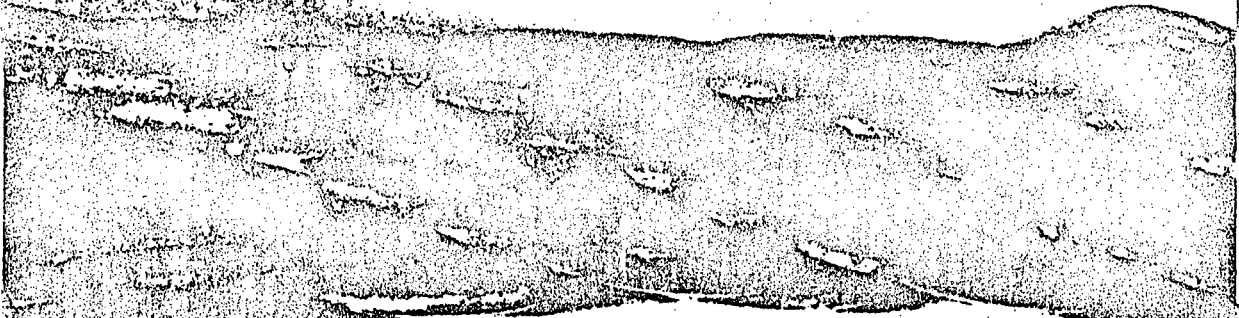


Fig. I - 4

X 15

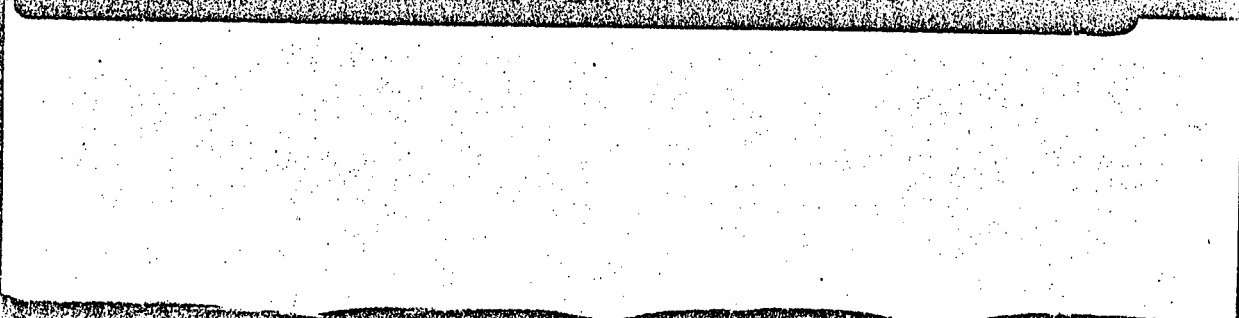


Fig. I - 5

X 15

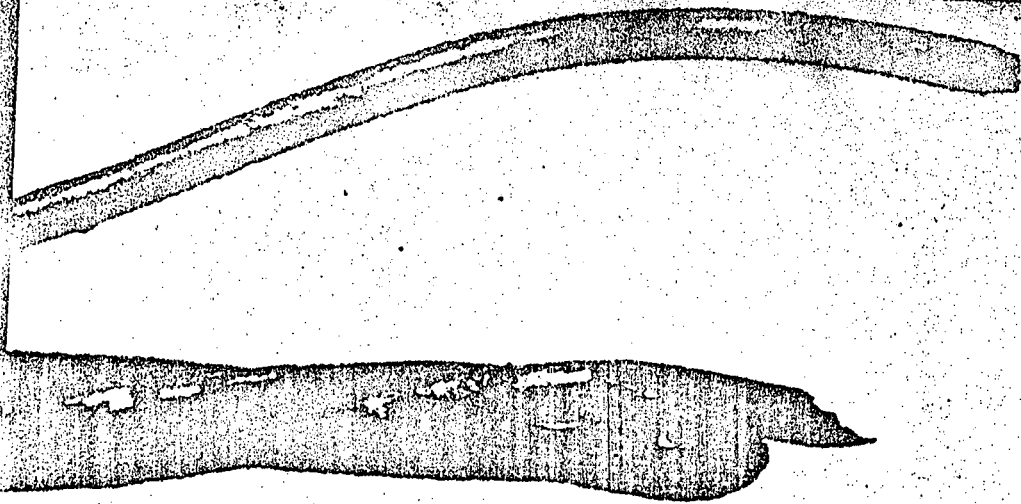


Fig. I - 6
X 25

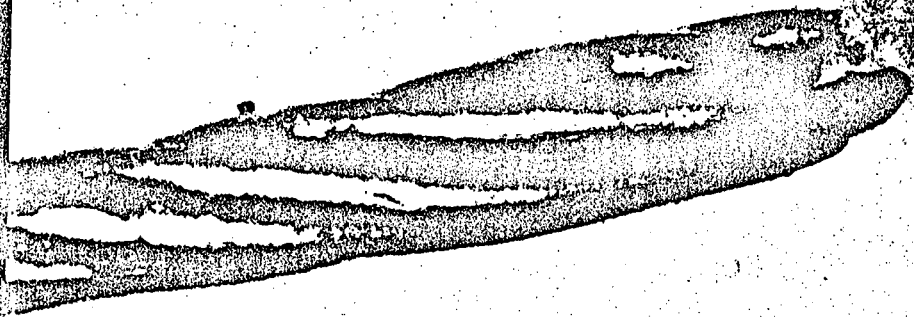
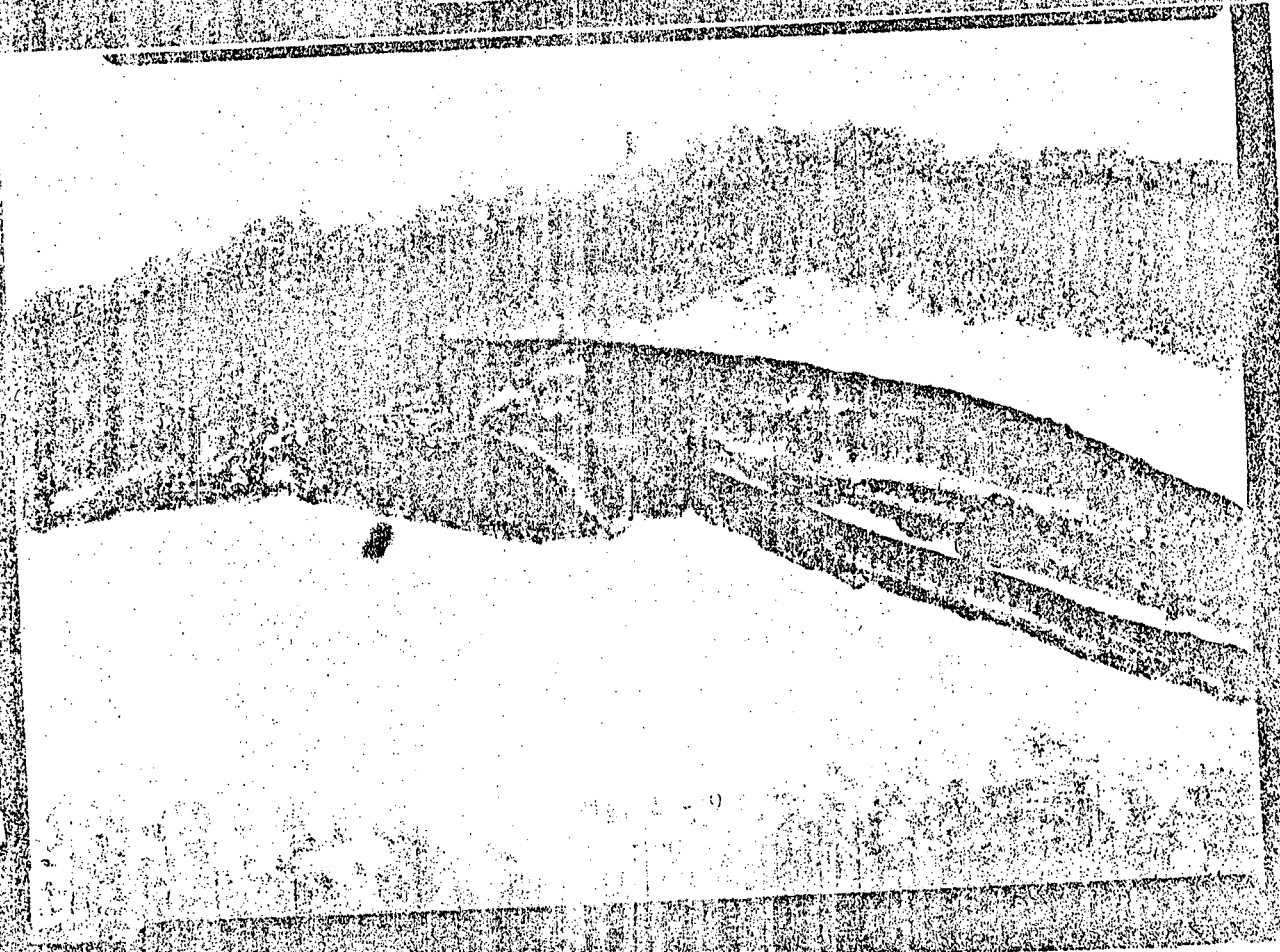


Fig. I - 7

Fig. 1 - 3
X 25



APPENDIX II

LABORATORY EXAMINATION
OF RIGHT AILERON DOWN CABLE FRACTURE

Figure II-1 shows the two pieces of right aileron down cable removed from the wreckage for laboratory examination, with the two frayed ends of the fracture area positioned adjacent to each other. This cable is 3/16" diameter 7 x 19 construction. The Engineering and Manufacturing Branch of the Federal Aviation Agency at Atlanta, Georgia, has advised that this is the proper diameter for the aileron down cable assembly, P/N 20-530-1212.

All wires of this cable failed due to tension overload. Figure II-2 shows a typical wire end with necking down adjacent to the fracture. No indication of significant wear or other unairworthy condition prior to disintegration of the airplane on impact with the ground was found in this examination.



Fig. II-1
X 1/3

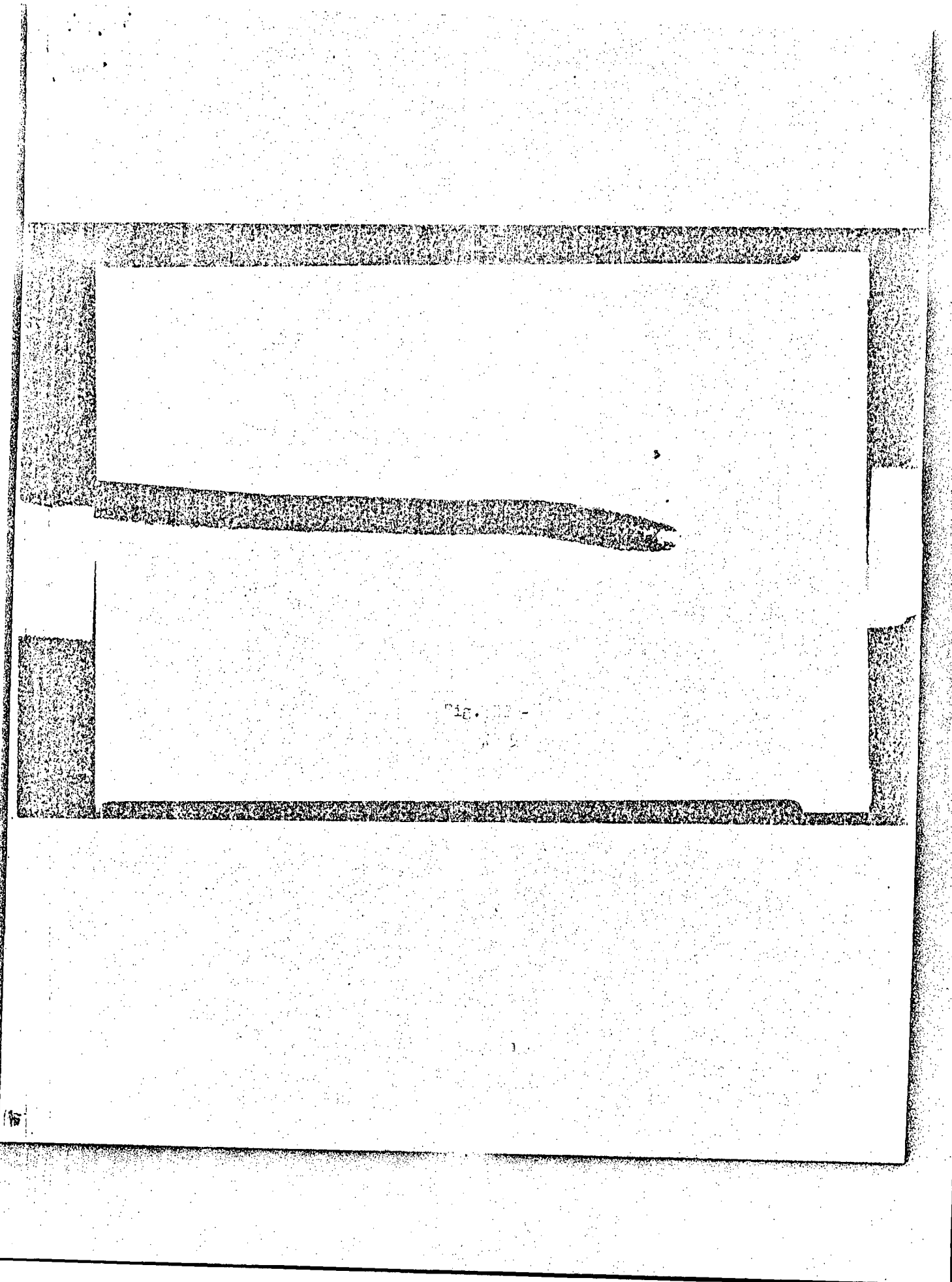


Fig. 1 -

APPENDIX III

C-46 MODIFICATIONS
AND FAA APPROVED LIMITATIONS

Numerous modifications of the Air Force C-46A through F aircraft have been approved for civil certification by the U.S. CAA and its successor, the FAA. The principal modifications are as follows:

<u>Spec. No.</u>	<u>Type Certificate Holder</u>	<u>Models</u>
3A2	Riddle Airlines	C-46F, C-46A & D, C-46R
A-808	Skyways International	C-46F
A-789	L.B. Smith Corp.	C-46A & D, C-46F, Super 46C
A-786	Curtiss-Wright Corp.	C-46E
A-772	Flying Tiger Line	C-46A & D, C-46E & F

All of the above, with maximum takeoff weights ranging from 42,500 pounds to 50,650 pounds, and approved for cargo only or passenger operation, incorporated the C-46F type horizontal tail with "Vee" tabs and, with two exceptions, either the C-46A & D vertical tail with hydraulic rudder boost or the C-46 E & F vertical tail with the spring tab in addition to the trim tab. One exception was developed by the Aircraft Engineering Foundation. This consisted of a C-46 A & D vertical tail, minus the hydraulic boost cylinder in the rudder control system, but with the vertical tail trim tab push-pull rod replaced by a double acting hydraulic cylinder with metering pins giving two way boost and blow-down features. The other exception, developed by L.B. Smith used the "D" rudder without the rudder system hydraulic cylinder, but with a new idler at the rudder hinge line making the rudder trim tab a servo tab as well.

With these design features the various modifications were approved for civil certification with a rear C.G. limit of 324.4" (29.7 % m.a.c.) gear extended (effect of retracting landing gear / 21,029 in. lbs.), except for the Riddle C-46R which was approved for a rear limit of 324.9" (30.0 % m.a.c.) gear extended. The military forces had used various versions at higher weights and more rearward c.g. limits under military requirements, but these extensions did not comply with either CAR 3 or CAR 4b and were not required to for military use.

The reason for the U.S. civil requirements relative to the vertical tail and rudder control system was to provide a minimum control speed, V_{mc} .

consistent with what are considered safe operational requirements. The civilly required features produced a V_{mc} of 92 to 98 mph as contrasted to a V_{mc} of 120 to 126 mph on military versions. In V_{mc} tests the CAA measured a rudder pedal force of 160 pounds to hold the airplane straight at an airspeed of 95 mph indicated on the "F" rudder with the servo tab. On the "D" rudder without the hydraulic boost cylinder the required pedal force would be much higher at this speed.

The military values tend to result in the airplane taking off at speeds considerably lower than V_{mc} , under which conditions an engine failure can necessitate a landing straight ahead. Under U.S. civil requirements an engine failure at any speed greater than V_1 should permit continuation of takeoff and climb under standard sea-level conditions, V_1 usually being near V_{mc} .

Separate flight tests by Curtiss-Wright, the CAA, and the Aircraft Engineering Foundation disclosed that, with the "F" type elevator, the "Vee" tab feature was necessary for longitudinal stability complying with U.S. civil requirements at the approved rear c.g. limit of 29.7 % mac gear extended. Without the "Vee" tab on the "F" type elevator the use of high elevator angles at low airspeed and rearward c.g. can produce control reversal, which is prohibited by U.S. civil requirements at any point within the approved operating range of an airplane. The preloaded spring in the left elevator tab motor shaft, producing the "Vee" tab action, was a source of serious difficulties during the early military operation of the C-46F, with the result that the military authorities decided to operate the C-46F without this feature as a safety measure under the conditions existing at that time.

Different versions of the C-46 family have minor variations of the hydraulic system. However, the attached copy of Figure 10 from T.O. 1C-46A-1, Section II, page 18, shows a hydraulic system schematic drawing representative of most C-46 airplanes in regard to the general arrangement of the main hydraulic system and the lines to the autopilot. It is pertinent to add that the normal main system pressure was 1040 to 1350 psi on serial numbers prior to AF 44-77895 and 1100 to 1350 psi on serial numbers AF 44-77895 and up.

Figure 203 on the attached copy of page 258, Section IV, Paragraph 17 of T.O. AN 01-251A-2 is a representative autopilot schematic drawing. The autopilot pressure reducer is designed to limit the hydraulic pressure in the autopilot system to 130 to 150 psi. With the maximum pressure of 150 psi a pilot can easily overpower any axis of the autopilot in the event of unwanted action thereof.

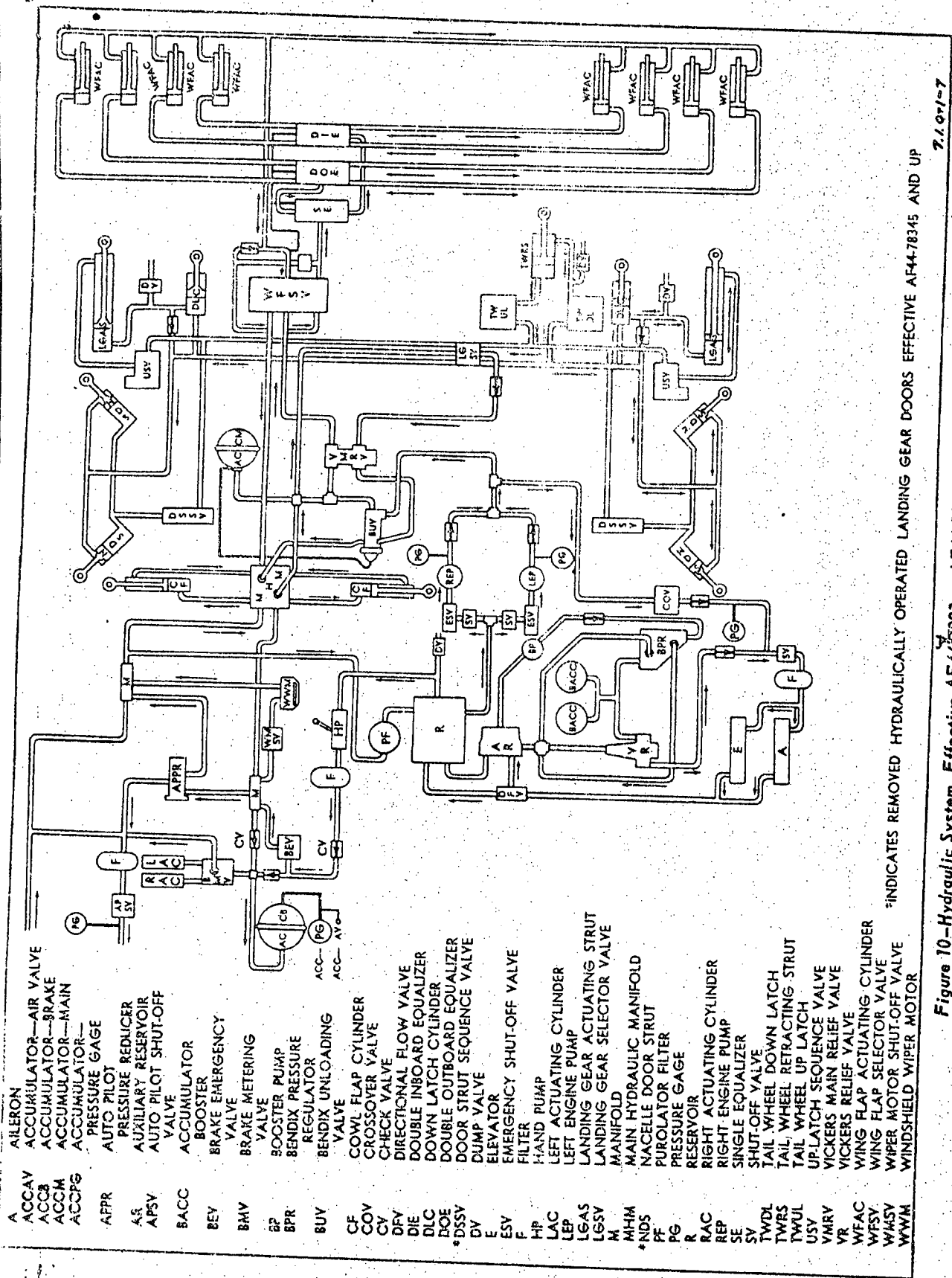
However, sufficient contamination of the hydraulic system to cause blockage of the main system filter, which returns fluid directly to the

main reservoir, can, with jammed check valves, cause back pressure in the brake and autopilot servo return lines capable of operating either, whether either system is "OFF" or "ON". This back pressure to any autopilot servo can approach nine times the normal maximum autopilot system pressure. If such a back pressure should occur it could require an extremely high pilot effort to overpower an unwanted action of the autopilot servo. The direction in which an autopilot servo will respond to any such back pressure is dependent on the position of the corresponding control valve at the time.

Difficulties of this type led to the design of various U.S. CAA approved modifications by different agencies to bypass unwanted back pressure from the autopilot servo return line directly to the main reservoir, or to produce similar results. The writer of this report has no information relative to the condition of hydraulic system main reservoir or any modification of the hydraulic system of B-908.

There is no Airworthiness Directive issued by the U.S. CAA or FAA requiring design modifications to overcome the above-mentioned type of hydraulic system difficulty.

Attachments



- A AILERON
- ACCAY ACCUMULATOR—AIR VALVE
- ACCB ACCUMULATOR—BRAKE
- ACCM ACCUMULATOR—MAIN
- ACCPG ACCUMULATOR—PRESSURE GAGE
- APPR AUTO PILOT PRESSURE REDUCER
- AS AUXILIARY RESERVOIR
- APSV AUTO PILOT SHUT-OFF VALVE
- BACC ACCUMULATOR BOOSTER
- BEY BRAKE EMERGENCY VALVE
- BMV BRAKE METERING VALVE
- BP BOOSTER PUMP
- BPR BENDIX PRESSURE REGULATOR
- BUY BENDIX UNLOADING VALVE
- CF COWL FLAP CYLINDER
- COV CROSSOVER VALVE
- CY CHECK VALVE
- DRY DIRECTIONAL FLOW VALVE
- DIE DOUBLE INBOARD EQUALIZER
- DLC DOWN LATCH CYLINDER
- DOE DOUBLE OUTBOARD EQUALIZER
- DSSV DOOR STRUT SEQUENCE VALVE
- DV DUMP VALVE
- E ELEVATOR
- ESV EMERGENCY SHUT-OFF VALVE FILTER
- F FILTER
- HP HAND PUMP
- LAC LEFT ACTUATING CYLINDER
- LEP LEFT ENGINE PUMP
- LGAS LANDING GEAR ACTUATING STRUT
- LGSV LANDING GEAR SELECTOR VALVE MANIFOLD
- M MAIN HYDRAULIC MANIFOLD
- MND NACELLE DOOR STRUT PURULATOR FILTER
- PG PRESSURE GAGE
- R RESERVOIR
- RAC RIGHT ACTUATING CYLINDER
- REP RIGHT ENGINE PUMP
- SE SINGLE EQUALIZER
- SV SHUT-OFF VALVE
- TWDL TAIL WHEEL DOWN LATCH
- TWRS TAIL WHEEL RETRACTING-STRUT
- TWUL TAIL WHEEL UP LATCH
- USV UP-LATCH SEQUENCE VALVE
- VMRY VICKERS MAIN RELIEF VALVE
- VR VICKERS RELIEF VALVE
- WFAV WING FLAP ACTUATING CYLINDER
- WFSV WING FLAP SELECTOR VALVE
- WMSV WIPER MOTOR SHUT-OFF VALVE
- WWM WINDSHIELD WIPER MOTOR

INDICATES REMOVED HYDRAULICALLY OPERATED LANDING GEAR DOORS EFFECTIVE AF44-78345 AND UP

Figure 10—Hydraulic System, Effective AF44-7893 to AF44-7854 (Sheet 2 of 3 Sheets)

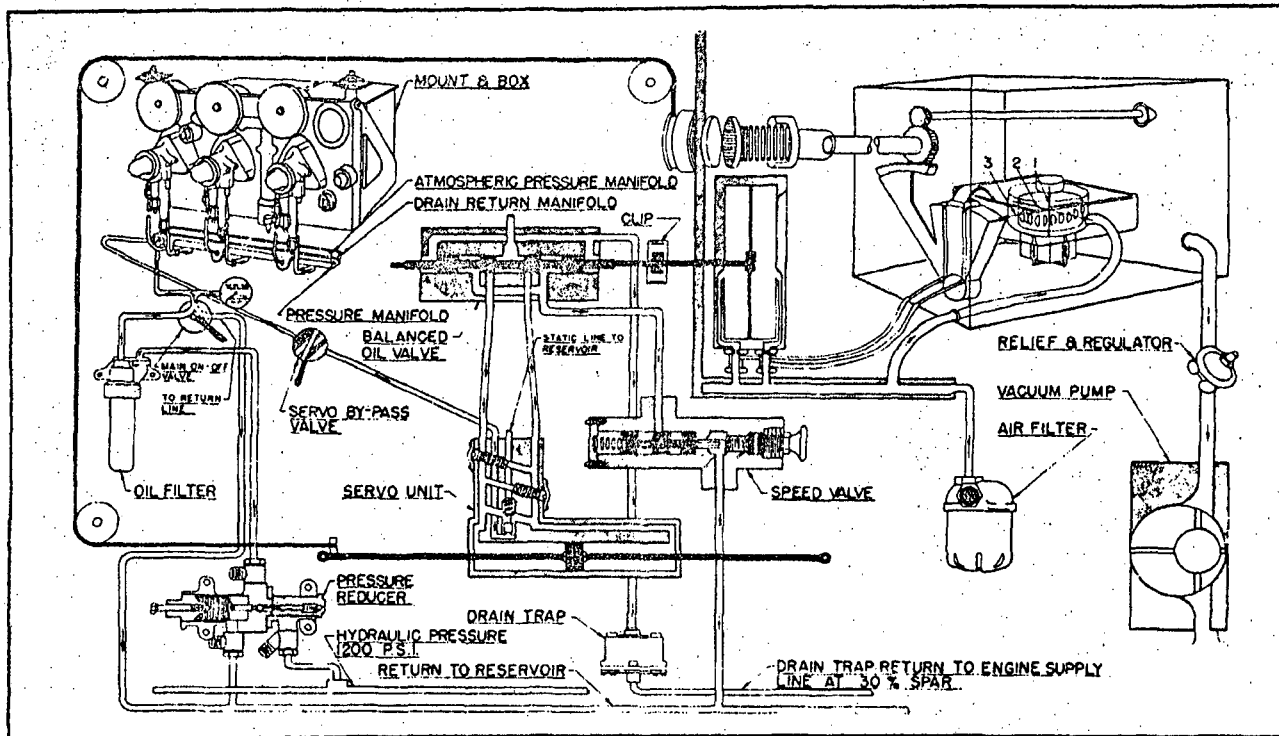


Figure 203—Automatic Pilot Schematic

6. Turn the aileron knob until its follow-up index matches the zero point in the banking scale at the top of the bank-and-climb control dial.

7. Turn the elevator knob until the elevator follow-up index matches the elevator alignment index at the side of the bank-and-climb control dial.

8. Open the speed control valves at least four turns, or turn the adjustable bleed dials to the maximum counterclockwise position. With the hands and feet on the controls to prevent a sudden movement, set the bleed valve to "NORMAL" and slowly turn the main valve to "ON."

9. Check to see that the oil pressure is within range of 130 to 150 psi.

10. Rotate the automatic pilot hand-control knob corresponding to the control being adjusted until the control surface has reached its stop. Continue rotating the control knob beyond this point until the follow-up indices are approximately 5 degrees apart.

11. Note the readings on the two gages teed into the servo being adjusted. If the differential pressure (difference between the gage readings) is equal to the indicated automatic pilot oil pressure, insert a screw driver in the overpower valve adjusting screw on the side where the piston rod is fully extended, and turn the adjusting screw counterclockwise. If the differential pressure is 75 percent or less of the operating pressure, turn the adjusting screw clockwise.

12. Rotate the automatic pilot hand-control knob in the opposite direction to move the control

surface hard over against the opposite stop. Adjust the other overpower valve in a similar manner.

13. To check the adjustment for each direction of control, rotate the hand-control knob until the control surface is centered. Then manually overpower the control first in one direction, then the other, while the test gages are being observed. The difference in the gage readings for each direction of control should be between 75 and 100 percent of the operating pressure and should be approximately equal.

14. Adjust the overpower valves of the other two servos in a similar manner.

Note

When the test gages are moved to adjust the overpower valves on another servo, it will be necessary to turn the automatic pilot "OFF."

15. When the overpower valves of all three servos have been properly adjusted, tighten the lock-nuts, remove the test gages, replace the plugs in the servo, and replace the overpower valve end plates. Bleed the air from the hydraulic system.

16. If flight tests disclose that the overpower valves open during normal flight conditions, it will be necessary to reset them to open at a differential pressure which is a higher percentage of the automatic pilot operating pressure.

(12) SPEED CONTROLS.—On airplanes prior to AF42-60942, the speed valves control the flow of hydraulic fluid from each servo cylinder to the reser-

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REC'D WAS AUG 21 1964

Washington, D. C.
August 13, 1964

REPORT OF EXAMINATION OF TACHOMETER, CIVIL AIR TRANSPORT
C-46 ACCIDENT, TAIWAN, CHINA, ON JUNE 20, 1964

Examination of the pointer drive gears from S/N 20286 tachometer from the subject aircraft was to determine if there was any physical evidence by which the engines RPM's at impact could be determined.

RPM calculations are based on: 90 teeth/360°
4500 RPM/330°
1 tooth/4°/54.5 RPM

Photograph No. 641103 shows the No. 1 tachometer gear with the locations of tooth damage noted. Photographs Nos. 641129 through 641133 are photographs of each of the noted areas. The string tied to the gears was for the purpose of identifying the areas to be photographed.

No. 1 Tachometer

<u>Damage on Photograph 641103</u>	<u>Photograph of Details</u>	<u>RPM</u>
No. 12	641129	487
No. 18-19	641130	801 Average
No. 31-32	641131	1510 Average
No. 52-57	641132	2776 Average
No. 61	641133	3116

No. 52 is the most severely damaged tooth and represents RPM 2627.

Photograph No. 641104 shows the No. 2 tachometer gear with the locations of tooth damage noted. Photographs Nos. 641125, 641126 and 641127 show teeth 38 through 54, a broad area of tooth damage. The mean of this damage represents 2305 RPM. Within this broad area are two specific locations which show more severe damage. These more severely damaged locations are teeth 38, 39 and 40, and 49 through 53, the mean of each representing 1913 and 2576 RPM respectively.

In operation, the tachometer pointers are relatively lightly restrained at an indicating position and sudden movement of the instrument will cause the pointers to swing widely. This fact greatly compromises

Rpt. of Examination of Tachometer, Civil Air Transport C-46
Taiwan, China, 6/20/64

-2-

the reliability of any impact induced damage as an RPM indication.
The multiple damage areas on the teeth support this statement.

Allan B. Hallman
Senior Powerplant Specialist

AEB/cza

CIVIL AERONAUTICS BOARD
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REC'D WAS AUG 21 1964

Washington, D. C.
August 13, 1964

REPORT OF EXAMINATION OF MANIFOLD PRESSURE GAGE, CIVIL AIR
TRANSPORT C-46 ACCIDENT, TAIWAN, CHINA, JUNE 20, 1964

The manifold pressure gage dial, pointers and pointer shafts from the subject aircraft were examined in detail for the purpose of establishing the manifold pressure indication at the time of impact if possible. The actual position of the pointers at the time the instrument was located after the accident is not known to the writer. However, because damage to the dial indicates the pointers were at, at least, three positions during the crash sequence, the pointer position when found is of no particular significance.

Photograph No. 641067 depicts the dial deformed irregularly around its periphery. The pointers are bent such that they conform generally with the deformed dial at approximately 40 inches. This conformity does not occur at any other location on the dial. Both pointers are bent similarly and seized together by the crash damage to the pointers and their concentric shafts.

Further examination of the dial revealed two scuff formed shoulders on the dial where the surface was displaced toward the pointers when the gross peripheral distortion occurred. The raised shoulders matched the pointers at 28 inches and 45 inches manifold pressure. They could be moved through the 28 inch to 45 inch arc on the dial. Photographs Nos. 641068, 641072 and 641069 show this evidence at the 45 inch position and photographs Nos. 641071 and 641072 show like evidence at the 28 inch position. Photograph No. 641068 also shows lack of pointers conforming with the bent face at the 45 inch position and photograph No. 641071 shows the same condition at the 28 inch position.

Chipped paint on the edges of the No. 1 pointer coincide with the abrasions at the 28 inch and 45 inch locations and abrasions on the underside of this same pointer coincide with the 45 inch dial abrasions. Photographs Nos. 641074, 641075 and 641124 depict this evidence.

The shafts on which the pointers as well as the holes in the No. 2 pointer were deformed. Likewise, the hole in the fixed plate through which the pointers pass was deformed. Aligning these deformations resulted in a pointer position of 32 inches to 33 inches manifold pressure. This evidence is shown on photographs Nos. 641100, 641101, 641070 and 641102.

Rpt. of Examination of Manifold Pressure Gage, Civil Air Transport -2-
C-46, Taiwan, China, 6/20/64

Summarizing, the physical evidence indicates the manifold pressure gage pointers were seized together by impact damage while indicating approximately the same reading. During the impact period, one or both pointers were at 28 inches, 32-33 inches, 40 inches, and 45 inches manifold pressure. As found, the two pointers, locked together, could be moved between the 28 inch and 45 inch extremes. The pointers conformed most nearly and reasonably close to the dial deformation at the 40 inch manifold pressure location.

Allen B. Hallinan
Senior Powerplant Specialist

ABHallinan/cze