

NATIONAL TRANSPORTATION SAFETY BOARD

AIRCRAFT ACCIDENT REPORT

TAG AIRLINES, INC.

DE HAVILLAND DOVE (DH-104), N2300H

IN LAKE ERIE

JANUARY 28, 1970



NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D. C. 20591

REPORT NUMBER: NTSB-AAR-71-5

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SYNOPSIS

A TAG Airlines, Inc., De Havilland Dove, N2300H, operating as Flight 730 of January 28, 1970, departed from Cleveland's Burke Lakefront Airport at 0738 e.s.t., for the Detroit City Airport with two crewmembers and seven passengers on board. The aircraft's radar beacon target disappeared from the Cleveland Air Route Traffic Control Center's radar at 0749. At 0922, it was determined that the aircraft had crashed through the ice into Lake Erie, 26 miles north-northeast of the Cleveland VORTAC. The bodies of five passengers and two crewmembers were recovered and identified. Two passengers are missing and are presumed dead. The aircraft was destroyed and portions of it sank in 80 feet of water.

The Board determines that the probable cause of this accident was the in-flight failure of the lower, right, main wing-to-fuselage root joint attach fitting resulting from undetected fatigue cracks in the wing portion of the fitting. The Board also finds that the Federal Aviation Administration's requirement for the timely replacement of chromium plated root joint fittings was inadequate.

On February 3, 1970, after consultation with the National Transportation Safety Board, the Federal Aviation Administration issued a precautionary telegraphic Airworthiness Directive pertaining to the engine mount framing and engine mount pickup fittings. In essence, this directive shortened the already existing 4-year x-ray requirement to a 2-year interval. The time between visual inspections of the engine mount framing and engine mount pickup was also reduced.

On May 27, 1970, after identification of the fatigue failure in the right main, wing-to-fuselage lower root joint fitting, the Board recommended to the Federal Aviation Administration that an expedited one-time inspection be made of all lower root joint fittings to determine the structural integrity of the aircraft. The recommended inspection was ordered. The Board also recommended that the existing Airworthiness Directives pertaining to the wing fittings and in particular AD 61-18-3, dated September 1, 1969, be reviewed for better clarity and purpose. AD 70-12-8 was issued on June 8, 1970, to accomplish this purpose.

1. INVESTIGATION

1.1 History of the Flight

TAG Airlines Flight 730 of January 28, 1970, was a regularly scheduled passenger flight originating at the Burke Lakefront Airport (BKL) in Cleveland, Ohio, and destined for Detroit City Airport in Detroit, Michigan. The aircraft was a De Havilland Dove, N2300H.

Flight 730 was cleared for takeoff from Burke Lakefront Airport at 0737:16 ^{1/} and operated routinely to the vicinity of Crib Intersection ^{2/} over Lake Erie.

At 0745:23, when TAG 730 was 3 to 4 miles north of Crib Intersection, ATC control was transferred to the Cleveland Center and the flight was instructed to contact the Center. This contact was made without delay and the flight reported at 4,000 feet (the flight planned and clearance altitude.)

After establishing radar contact, the controller provided the current Detroit area altimeter setting of 29.83. This information was acknowledged by the copilot of TAG 730 at 0746:28. This was the last recorded radio transmission from the flight.

Between 0749:25 and 0749:30, the Center controller noted that the beacon radar target of TAG 730 had disappeared at a point 5 to 6 miles northwest of Crib Intersection over Lake Erie on the centerline of Airway Victor 42 East. At 0749:53, he initiated attempts to contact the flight by radio but was unsuccessful.

About 0922, a hole through the ice in the lake, with debris in and around the hole, was located 26 miles on the 021° radial of the Cleveland VORTAC. The debris was confirmed subsequently to be a portion of the wreckage of TAG 730.

The accident occurred during daylight hours. The water at the accident site was 80 feet deep and, at the time, the area was covered by ice 12 to 14 inches thick and extending 3 to 5 miles in all directions.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>
Fatal	2	5	0
Nonfatal	0	0	0
None	0	0	
Missing	0	2	

^{1/} All times herein are eastern standard, based on the 24-hour clock.

^{2/} Crib Intersection (the intersection of the Chardon 258°, Cleveland 027° and the Strongsville 345° radials.)

1.3 Damage to the Aircraft

The aircraft was destroyed.

1.4 Other Damage

None.

1.5 Crew Information

The crew had the appropriate certificates, issued by the Federal Aviation Administration, for the operation involved. (For details, see Appendix B.)

1.6 Aircraft Information

There was no evidence of a departure from the prescribed maintenance procedures or required inspections. (For details of the aircraft's history see Appendix C.)

The fueling and load manifests were examined. The aircraft had been refueled with aviation gasoline, grade 100/130. The aircraft's calculated gross weight for takeoff was 8,637 pounds at a center of gravity reference of 4.27 inches aft of the datum reference. The maximum allowable gross weight for takeoff was 8,800 pounds.

All Federal Aviation Administration Airworthiness Directives (AD), in effect at that time, had been complied with in the prescribed manner.

1.7 Meteorological Information

Surface weather observations taken by EKL Tower personnel on January 28, 1970, were in part as follows:

0700, Estimated ceiling 10,000 feet broken clouds, visibility 7 miles, wind 140°, 25 knots.

0800, Scattered clouds 5,000 feet, estimated ceiling 10,000 feet overcast, visibility 7 miles, wind 140°, 25 knots.

The data provided by EKL Tower personnel to TAG 730 on the initial radio contact were:

"Wind variable 160 (degrees) either side, 25 to 30 knots, altimeter (setting) 29.96."

The Weather Bureau, Cleveland, has certified that no weather briefing was furnished for the flight of N2300H by personnel from that facility. The records of the Cleveland Flight Service Station do not indicate that a weather briefing was provided for N2300H (TAG 730) by personnel of that facility. The accident occurred during daylight hours, with the sun obscured due to an overcast cloud condition.

1.8 Aids to Navigation

The navigation facilities serving the area were not involved in this accident.

1.9 Communications

Normal communications between the aircraft's crew and the various control facilities personnel were established at 0733 and maintained until 0746:28. The copilot handled all communications from Flight 730.

1.10 Aerodrome and Ground Facilities

Not involved.

1.11 Flight Recorders

None were installed or required by regulation.

1.12 Wreckage

a. Recovery

The aircraft crashed into the ice floe covering Lake Erie at latitude 41°42'36"N. and longitude 82°01'12"W. A major portion of the aircraft, including the two engines, broke through the 12 to 14 inch thick ice in two places and sank in 80 feet of water. The two penetrations of the ice were approximately 120 feet and 40 feet in diameter, respectively, and were separated by approximately 60 feet. Concentric, circular cracks radiated outward from the larger hole for approximately 100 feet. These cracks encompassed the smaller hole.

A relatively minor portion of the aircraft structure remained on the surface of the ice. This wreckage was found spread in a random pattern along a line for approximately $\frac{1}{4}$ mile to the north-northwest from the impact point on the ice floe. Included in this portion of the wreckage was approximately 90 percent of the structural components of the left wing, which showed extreme damage, and the outboard 15 feet of the right wing, to which relatively minor damage had been inflicted. The left wing wreckage was on a magnetic bearing of 320°, 130 feet from the outer edge of the larger hole. The right wing section was located 330°, approximately 300 feet from the larger hole in the ice. The piece of wreckage found $\frac{1}{4}$ mile away from the impact hole was a fillet section of light weight and relatively large, flat plate area.

Though the aircraft was destroyed by impact, approximately 95 to 98 percent of the total wreckage, including the engines, was recovered. The right engine was recovered from the bottom of the lake, separated by approximately 75 feet from the rest of the wreckage. The rest of the wreckage, exclusive of those portions recovered from the ice, was taken from an area in the lake that was approximately 25 by 50 feet in size. Included with this major wreckage was the left engine, including mounting frames, and the right engine mounting frames.

b. Examination

Recovered wreckage was taken to a warehouse where a layout and a detailed examination were made.

The outboard section of the right wing, recovered from the surface of the ice, had separated between rib stations 9 and 10 at the leading edge, and the fracture continued inboard toward rib section No. 8 as it progressed aft. The surface of the separation contained sawing/cutting, chisel-like marks from the bottom skin surface upward across the entire width of the wing. The separation commenced 6 feet 7 inches to the right of the outboard engine mount.

The radius of an arc that would be described by a propeller mounted on a Gipsy Queen Model 70 Mark 2 engine installation of a De Havilland Dove aircraft, if that engine were rotated about the outboard engine mount, is 6 feet 7 inches.

The leading edge of the outboard flap of the right wing contained three slash marks between rib stations 12 and 14. The flap was separated from the wing.

A section of wing from rib station 5 outboard to the inboard side of rib station No. 10 was recovered. Upward cuts were observed along the bottom outboard surface of this inboard section of right wing which resembled those discussed previously on the outboard section of the right wing.

The left engine was recovered from the bottom of the lake in the same locale as the fuselage and empennage. The propeller assembly remained attached to the left engine. Blades Nos. 1 and 2 separated from the assembly. There was damage to all the blade packing plates, blade torque shims, index ring, blade gear segment, and the degree scale on the blade shank. The left engine mount framing, the two upper pickup fitting attachments, and all four of the mounting pads were recovered attached to the engine. The bottom inboard pickup fitting and attachment had separated but were recovered.

The right engine was recovered from the lake. This engine was separated from the other wreckage on the lake bottom by about 75 feet. There were no other structural components recovered near the right engine. The propeller assembly remained attached to the right engine but the No. 1 blade was missing from the assembly. The damage in this assembly was similar to that described for the left engine's propeller assembly. All of the right engine mount framing, pickup fittings, attachments and three of four mounting pads were recovered with the inboard sections of the right wing and fuselage. The right engine mounting frames were symmetrically deformed down and to the right. (See Attachment 1.) The inboard frame's tubing was found flattened and compressed into the fire wall structure.

Two sections of bottom wing skin, the forward and aft fuel tank panels between Rib Stations Nos. 1 and 4, were recovered. Attached to the aft panel was a section of the bottom main root joint fitting. This fitting was broken through the 7/8-inch diameter bolt hole at the inboard end of the part of the fitting that had been attached to the wing.

Examination of this fitting was first conducted by the Board in Washington, D. C., where photographs and hardness tests were performed. A visual examination was also completed. The fitting was then taken to Hawker-Siddeley Aviation Limited, Hatfield, Hertfordshire, England, where, at the request of the Board, a detailed examination was conducted. This examination was conducted by Hawker-Siddeley personnel under the auspices of the Air Registration Board and was observed by NTSB and Federal Aviation Administration officials.

1.13 Fire

No evidence of fire was found.

1.14 Survival Aspects

This was a nonsurvivable accident.

1.15 Tests and Research

Following the accident, samples were drawn from the fuel truck used to service H2300H. These samples, from the "sump" and the fuel nozzle, were taken by the Safety Board to Wright-Patterson AFB where an analysis of the fuel was made. The tests confirmed that the fuel met the specifications for aviation gasoline (100/130 octane) and no contaminants that could contribute to the cause of this accident were found.

Samples of paint markings were taken from the upper surfaces of the right wing panel, the deicer strip from the right wing, and sections of engine cowling. These samples were taken to the FBI laboratory in Washington, D. C., where it was established that the paint smears found on the right wing were from the engine nacelles.

Samples of a black, rubberlike substance also found on the deicer strip from the right wing, and samples of the material used to make the propeller deicer boot were tested and determined to have been of the same material.

Samples of a foreign material taken from the lower surface of the right flap for analysis were determined to be feathers from a gold finch.

1.16 Aircraft Modification and Pertinent Airworthiness Directives

The manufacturer and the FAA have, at various times, issued documents relating to the inspection and maintenance of the wing main lower root joint fitting, the wing lower spar boom, and the fuselage center section lower spar boom. The manufacturer's documents were entitled Technical News Sheets (TNS) and were recommendations or information items, rather

than mandatory changes to be accomplished, in as far as U.S. operators were concerned. The Airworthiness Directives (AD), on the other hand, were mandatory and frequently based on the related TNS.

The FAA issued a revised AD 61-11-3 on June 20, 1961, which prescribed the accomplishment of the manufacturer's recommended modification to the wing lower spar boom (Mod. 780) and the fuselage center section lower spar boom (Mod. 799) in order to increase effectively the service life of the wing. In order to accomplish this AD, the wings of the aircraft would have to be removed from the airframe.

The manufacturer issued TNS 178, issue 1, effective July 10, 1961, which prescribed a method of inspecting and testing of the wing lower root joint to determine whether or not the bore of the bolt hole had been chromium plated. If the bolt hole was found to have a chromium plated bore, the following action was directed:

"7. RECTIFICATION AND RE-ASSEMBLY

7.1 When the results of the test prove that chrome plating is present, the wing lower root joint fitting Part No. 4W.271 must be changed as follows:

- (a) Fittings with less than 10,000 flying hours.
At next wing removal or at 10,000 flying hours whichever is the sooner.
- (b) ***"

On September 1, 1961, AD 61-18-3, issued by the FAA, became effective. This AD was based on TNS 178 and directed, in part:

*** parts were fitted to the aircraft or supplied as spare items with the bore of the hole for the main wing-to-fuselage attachment bolt chromium plated. Tests have shown that hard chrome plating reduces the fatigue life of the part. Therefore, the following inspection shall be accomplished:

- (a) Wing lower root joint fittings, P/N 4W.271, with 9,970 or less hours' time in service must be inspected at or prior to accumulating 10,000 hours' time in service. Remove the lower main wing-to-fuselage attachment bolt and inspect the bore of the bolt hole for chromium plating in accordance with De Havilland Technical News Sheet Ct (104) No. 178 issue 1. Fittings showing evidence of chrome plating must be replaced prior to accumulating 10,000 hours' time in service.
- (b) Fittings exceeding ***."

The manufacturer, on September 21, 1964, issued a revised TNS 168, issue 3, which discussed an inspection for corrosion and fretting of the main lower root joint fitting. This TNS also prescribed the actions to be taken to minimize these problems. Based on this TNS, the FAA issued AD 67-32-3, effective December 18, 1967. The intent of this AD was to prevent fatigue failure of the main wing lower root joint fitting. The AD established an inspection interval of 6 years or 5,400 flying hours, whichever occurred first.

In 1965, TAG Airlines sent N2300H to an FAA Authorized Repair Station to have major maintenance performed on the structure. A Major Repair and Alteration Form (FAA Form 337) was issued by the repair agency as a part of this maintenance procedure. Specifically listed on this form were the following entries:

"Installed de Havilland modifications No. 779 and 780."
"Complied with de Havilland Technical News Sheet CT(104),
No. 168 Issue 3, dated 21-9-64."

* * * * *

"Total aircraft hours this date: 4998:50"

A handwritten notation just below the above-typed entries was:

"Comprising
AD Notes 61-11-3 & 61-18-3 DC"

In the block on the aircraft logsheet where corrective actions taken were entered, the following notation, in part was:

"11-10-65
Complied with Mods 779 & 780, Complying also with TN-No.
168 iss. 3 New pins were installed which complys with
AD 61-18-3. Instl of Mods 779 & 780 Comply's with AD
61-11-3. * * *"

The entries on the aircraft logsheet, the FAA Form 337 and the handwritten notation were signed or initialed by the same individual.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

It was apparent from the initiation of this accident investigation that an in-flight structural separation had occurred. Evidence of a structural failure included: the relatively undamaged outer right wing panel; the heavily damaged left wing; two holes through the ice; and the sawing/cutting, chisel-like marks across the butt of the separated outer right wing panel. These cutting marks were at the point where the right propeller would have struck the wing if the engine, with the propeller assemble attached, had pivoted around the outboard engine mount attach fitting. Additionally, the paint samples taken from the outer right wing surface and the wing's deicerstrip were found to be the same as the paint

NATIONAL TRANSPORTATION SAFETY BOARD



DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C.--20591

Safety Information

For Release:

SB 70-37
(202) 382-7273

IMMEDIATE
Thursday, May 28, 1970

Office of the Chairman

The National Transportation Safety Board today released the attached Safety Recommendations to the Administrator of the Federal Aviation Administration.

The recommendations are based on findings just uncovered by the Safety Board's investigation of the fatal crash involving a TAG Airlines De Havilland Dove (DH-104) aircraft which occurred after takeoff from Cleveland, Ohio on January 28, 1970. All nine occupants on board, two crew members and seven passengers, lost their lives in the accident.

After recovering 95 percent of the aircraft wreckage from the bottom of Lake Erie the Safety Board's examination of the right wing has revealed the presence of a fatigue failure in the right main wing spar lower attachment fitting, where the wing joins the fuselage, that requires immediate air safety corrective action.

The Board's recommendations are self-explanatory. It is understood that the Federal Aviation Administration is proceeding along the lines of the Safety Board's recommendations.

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DEPARTMENT OF TRANSPORTATION
NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20591

OFFICE OF
THE CHAIRMAN

May 27, 1970

Honorable John H. Shaffer
Administrator
Federal Aviation Administration
Washington, D. C. 20590

Dear Mr. Shaffer:

The Board's initial investigation on January 28 to February 9, 1970, of the TAG Airlines De Havilland DH-104 accident in Lake Erie on January 28, revealed that a 15-foot section of the outer right wing panel had come in contact with a rotating propeller while in flight.

The relatively undamaged right wing panel and approximately 90 percent of the severely ice impact-damaged left wing were the only major portions of the aircraft wreckage recovered at that time. The remainder of the wreckage penetrated the frozen lake surface in two locations, approximately 60 feet apart, and sank.

Due to the weather conditions and the heavy ice concentrations in the area, the U.S. Coast Guard advised the Board that it was too dangerous to personnel and equipment to attempt further recovery of the aircraft at that time.

Based on the recovered wreckage during the initial investigation, your engineering staff personnel, after discussions with the Safety Board's personnel, issued a precautionary telegraphic Airworthiness Directive pertaining to the engine mount framing and pickup fittings. This Airworthiness Directive revised and superseded Airworthiness Directives 55-20-1 and 65-20-2, which had pertained to the same subject.

On April 25, 1970, the Board reconvened the on-scene investigation since the weather and lake conditions were conducive for recovery operations. To date, we have recovered approximately 95 percent of the total aircraft wreckage.

Our investigation of the total wreckage recovered has revealed a failure which requires immediate corrective action. The examination of the right wing to fuselage joint fittings has revealed the presence of a fatigue failure. The fatigue failure involved the right main wing spar lower attachment fitting, P/N 4W.271. Fatigue cracks started on both the forward and aft edges of the bolt hole on the top side of

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the fitting. On one side of the hole, the fatigue crack progressed almost completely through the fitting and on the opposite side, it had progressed through about 50 percent of the cross sectional area before the fitting failed completely.

We are aware of the number of Airworthiness Directives which have been issued previously pertaining to the main wing spar joint fittings, namely: AD-67-32-3, AD-61-11-3, and particularly AD-61-18-3, which is applicable to the failed part in this accident.

Our review of the Airworthiness Directive compliance data of TAG Airlines has indicated that AD-61-18-3 and AD-61-11-3, were complied with on November 10, 1965, at which time the aircraft had accumulated a total service time of 4,992 hours. The total service time on the aircraft at the time of the accident was 9,383:41 hours.

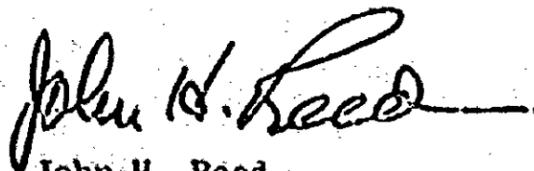
Our metallurgical examination of the failed parts is in progress and pending the results of this examination, further corrective action may be necessary, at which time we will advise you.

Based on the findings in this accident to date, the Safety Board recommends the following action:

1. Conduct a one-time inspection on an expedited basis by approved methods of all lower main wing spar fittings P/N 4W.271 on all De Havilland DH-104 and 105 aircraft to assure the structural integrity of the aircraft.
2. Review the adequacy of Airworthiness Directive 61-18-3 and revise as necessary to assure adequate service limits. Consideration should also be given to a reduction in the present inspection period of 9,970 hours as well as requiring repetitive inspection periods so as to establish an adequate service life.

Members of our Bureau of Aviation Safety staff have discussed these findings with members of your Engineering and Manufacturing Division, Flight Standards Service. If we can be of any further help in this matter, please feel free to contact us.

Sincerely yours,



John H. Reed
Chairman

used on the aircraft's engine nacelles, and the sample of black rubber residue from the wing's deicer strip was identified as the same material as the rubber deicer boots mounted on the shank of each propeller blade. These indications strongly suggested the possibility that the causal area for the in-flight structural separation was the failure of the right, inboard engine mount attach fitting.

However, upon resumption of the recovery of the wreckage, evidence was found that the failure had not been in the engine mount attach fitting or the engine mounting frames. The almost identical bending of both the inboard and outboard engine mounting frames was a clear indication that the attach fittings had maintained structural integrity until the engine had rotated almost 90° to the right. The frame tubing would not have bent if it had not been anchored to the wing structure. Additional substantiating evidence of the integrity of the inboard mount was the flattening of the inboard engine mounting frame tubing as it was crushed against the firewall. It is apparent that if the engine mount attach fittings had failed, the framing would have gone with the engine and would not have been deflected to the right at the time of impact.

The examination of the fuselage structure revealed no evidence of fire, explosion, or in-flight failure. All fractures were typical of failures due to overloads.

The deflection and bending of the left wing structure indicated that the wing was attached to the fuselage at impact and that the flightpath angle at impact was 60° or greater.

There was no evidence of fire, internal distress or other operational distress in either engine. Blade angles of the propellers were determined to be approximately 28°. Examination of the recovered engine mount components showed no evidence of in-flight separation due to material failure or structural weakness.

Obviously, since the evidence established that the right outer wing was severed from the aircraft by the right propeller prior to impact with the ice, the single component or combination of components that would induce such a failure mode had to be found. These conditions were satisfied with the recovery from the lake, during the last scheduled day of recovery operations, of the failed right wing lower root joint attach fitting.

The lower root joint attach fitting carried the entire load which is transmitted from the fuselage to the wing in the vertical lift/weight plane. The failure of this fitting resulted in the right wing folding upward along a hinge line at the fuselage.

The combination of inertial and gyroscopic loading on the right engine when the right wing failed upwards, caused the engine to separate from its mounting in an apparent down and to the right movement. The engine then passed across the bottom surface of the wing with the propeller cutting through the structure, precipitating a complete wing failure at that point.

The metallurgical examination of the failed lower root joint attach fitting established it had failed through the 7/8-inch diameter bolt hole at the inboard end of the part of the fitting that had been attached to the wing. (See Attachment 1.) The face of the break of this part contained well defined characteristics of fatigue failure across nearly all of the fracture surface on one side of the bolt hole and across 50 percent of the area on the other side of the hole. The remainder of the break on the latter fracture was typical of tensile overload. (See Attachment 2.) The tensile overload evidence was present in approximately 25 percent of the total cross sectional area of the failure face.

A metallurgical examination conducted on the failed root joint fitting confirmed that the final fracture of the component was from tensile overload. This overload resulted from the structural weakening of the component by the fatigue crack.

The bore of the bolt hole had been chromium plated and the plating exhibited a pattern of crazing cracks and numerous larger cracks which had penetrated through the chromium layer but had not entered the parent metal. The fatigue failure originated at the periphery of the hole in an area where the chromium plate was chipped and irregular. (See Attachment 2.)

There was no evidence of material defects in the structure of the root joint fitting.

The manufacturer had long been aware of the problem caused by the chromium plating process and had reduced the "safe life" of this fitting to 10,000 flying hours in July 1961 (TNS 178). At this time, it was recommended that an inspection for the chromium plating of the root joint attach fitting be carried out at the next convenient opportunity and, in any case, prior to the accumulation of 10,000 flying hours. It was recommended that any fitting found to have the chromium plating be changed at the next removal of the wing or before 10,000 hours, whichever came first. The above recommendation had the approval and concurrence of the United Kingdom's Air Registration Board. These requirements became mandatory for aircraft registered in the United Kingdom but not for those registered in the United States.

Based upon this recommendation by the manufacturer, the Federal Aviation Administration issued Airworthiness Directive 61-18-3, effective September 1, 1961. This directive repeated the opening preamble of the TNS 178 but adopted only the requirement to inspect the fitting for chromium plating and to replace it, if so plated, prior to the accumulation of 10,000 flying hours. The recommendation to replace any chromium plated fittings at the next wing removal was not made a part of the requirement by the FAA on the U. S. registered aircraft.

In November 1965, the wings of this aircraft were removed for the incorporation of modifications 779 and 780. An entry was made on the Repair and Alteration Form (337) and on the aircraft logsheet that AD 61-18-3 had been complied with. The logsheet entry stated erroneously that the incorporation of "new pins" complied with "AD 61-18-3." It is

apparent, from this entry, that the repair station personnel had misinterpreted the AD as requiring replacement of the pin as well as the replacement of any chromium plated fittings. Personnel of the repair station stated, during an interview, that they knew the fitting had to be replaced prior to 10,000 hours, however, upon re-reading the AD, they had no explanation for the incorporation of new pins.

The failure of this wing lower root joint attach fitting had occurred at a total aircraft time of 9,383:41 hours and the inception of the fatigue crack with its growth to the failure point occurred within the last 4,386:51 hours after it was inspected. Both the total time on the part and the time since it was inspected for a crack are below the 10,000 hours "safe life" limit (AD 61-18-3) and the 5,400 hour time period established for their inspection (AD 67-32-3). Obviously, the time limits established for the part were not realistic.

As was noted earlier, the recommendation to replace any chromium plated fittings at the next wing removal was not made a part of the requirements of AD 61-18-3. It has not been possible to document the reasons for noninclusion of this requirement in the AD. It is, of necessity, the prerogative of the regulatory agency to accept all or portions of recommendations of a manufacturer and the decisions made in these cases can only be as good as the data supplied by the manufacturer. In order to insure the maximum protection, it would seem, however, that at any time the recommendations of the manufacturer are going to be changed or modified, the more stringent of two alternatives should be considered as preferable. In this particular instance, if the requirement to change chromium plated fittings at the next wing removal had been mandatory, it can be adduced that the failure of the fatigue-weakened fitting would, in all probability, not have occurred.

During the early stage of the investigation, foreign matter was found impinged on the bottom rear surface and flap of the relatively undamaged right wing outer panel. This matter was examined by the FBI laboratory and found to be feathers from a *Spinus Tristis*, commonly referred to as a "gold finch." This bird is resident of Eastern North America. The bird's size and weight, approximately 5 inches in length and weighing 10 to 15 grams, is not considered sufficient to have damaged the aircraft structure, either singly or in small groups. The lack of any great number of feathers or other remains or evidence of damage that could be related to birds, eliminates this possibility from the causal area.

2.2 Conclusions

(a) Findings

1. The crewmembers were certificated for the duties they were performing.
2. The aircraft was certificated and the aircraft records indicated the aircraft had been maintained in accordance with the existing company and Federal Aviation Administration regulations.

3. The performance of the crew was not a factor in this accident.
4. The weather was not a factor in this accident.
5. The ATC handling and control of the flight were not factors in this accident.
6. All of the effective Airworthiness Directives issued by the Federal Aviation Administration had been accomplished.
7. Airworthiness Directive 61-18-3 required that chromium-plated wing joint fittings were to be replaced prior to accumulating 10,000 hours but omitted the requirement to change the fittings at the "next wing removal" as had been recommended by the manufacturer.
8. During aircraft modification in 1965, the repair station erroneously stated that the replacement of the pins had complied with AD 61-18-3.
9. The right, lower main wing-to-fuselage root attach joint fitting had a chromium-plated bore of the bolt hole.
10. The right, lower main wing-to-fuselage root attach joint failed in flight.
11. The wing portion of the wing to fuselage root joint attach fitting had a fatigue crack across 75 percent of the fracture face.
12. The fitting had been in use for approximately 9,384 flying hours.
13. The fitting had been in use for approximately 4,387 flying hours since it had been inspected for cracks.

(b) Probable Cause

The Board determines that the probable cause of this accident was the in-flight failure of the lower, right, main wing-to-fuselage root joint attach fitting resulting from undetected fatigue cracks in the wing portion of the fitting. The Board also finds that the Federal Aviation Administration's requirement for the timely replacement of chromium-plated root joint fittings was inadequate.

3. RECOMMENDATIONS

On February 3, 1970, and after discussions with National Transportation Safety Board personnel during the initial field phase of the investigation, the Federal Aviation Administration issued a precautionary telegraphic Airworthiness Directive pertaining to the engine mount framing and engine mount pickup fittings. This Airworthiness Directive superseded AD 55-20-1 and AD 65-20-2 which pertained to the aforementioned components.

In essence, the telegraphic AD shortened the previous X-ray requirement for the engine mount framing from a 4-year to a 2-year interval. The time between visual inspections of the engine mount framing and engine mount pickup fitting was also reduced. In addition, a visual inspection of the engine mount framing and engine mount pickup fitting was required within 25 hours of service. If, during this inspection, indications of internal corrosion, cracks, or structural defects were found, immediate corrective action was required before further flight.

On May 27, 1970, after identification of the fatigue failure in the right wing lower root joint fitting of the crashed aircraft, the Board recommended to the FAA that an inspection of all lower root joint fittings be made on an expedited basis to determine the structural integrity of the aircraft and to review the adequacy of AD 61-18-3.

The Administrator issued a telegraphic AD ordering an inspection for corrosion, fretting, or cracking of the fitting within the next 25 hours of flight, but did not specify a check for and removal of the chromium-plated fittings.

On June 6, 1970, as a result of the inspection required by the telegraphic AD, an operator reported that a crack had been found in a nonchromium-plated fitting. On the basis of this finding, he grounded his aircraft. Based on this report, the Safety Board recommended to the Administrator that he consider a similar action for all DH-104 aircraft until an inspection of the fittings could be made. The Safety Board also initiated action to acquire the suspect fitting for examination. Coordination between the Safety Board, the FAA, and the United Kingdom Air Registration Board resulted in the suspect part being removed from the aircraft, delivered to the Safety Board representative in New York, and flown to England for examination. In the interim, the Administrator issued another telegraphic AD requiring the inspection of the fitting prior to further flight. This telegraphic AD, included the inspection for, and removal of, the lower wing root attach fittings that had chromium-plated bores of the bolt holes, or any fitting found to be fretted or corroded past acceptable limits.

The examination of the suspect part established that there was no crack in the nonchromium-plated fitting, and the time requirements for the inspection of this part were relaxed so as to be accomplished within 25 flying hours. A repeat inspection cycle time of 2,500 flying hours or 3 years was also established.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/	<u>JOHN H. REED</u>	Chairman
/s/	<u>OSCAR M. LAUREL</u>	Member
/s/	<u>FRANCIS H. McADAMS</u>	Member
/s/	<u>LOUIS M. THAYER</u>	Member
/s/	<u>ISABEL A. BURGESS</u>	Member

January 6, 1971.

INVESTIGATION1. Investigation

The Board received notification of the missing TAG flight at approximately 0840 e.s.t. on January 28, 1970, and confirmation of the accident at 0947. The decision to dispatch a Washington-based investigative team was made at 1045. The team departed Washington National Airport at 1330 and arrived at Cleveland's Burke Lakefront Airport at 1515.

Utilizing U. S. Coast Guard helicopters, the Board's investigators surveyed the hole in the ice prior to establishing working groups. The working groups were: Operations/Human Factors, Air Traffic Control, Structures/Systems, Powerplants, and Aircraft Maintenance. A weather study was initiated in Washington, D. C.

Parties to the investigation included the Federal Aviation Administration, TAG Airlines, and the Air Line Pilots Association. Hawker-Siddeley (DeHavilland) was invited to participate and sent a representative on a limited basis.

The recovery of wreckage was interrupted by existing weather conditions, and the moving ice on Lake Erie. As a result, the on-scene investigation and wreckage recovery were not completed until May 28, 1970.

2. Public Hearing

There was no public hearing held in this case.

3. Preliminary Report

A preliminary report of the available facts and conditions was adopted by the Board on March 18, 1970, and released to the public on March 30, 1970.

Flightcrew Historya. Captain Jake Feldman

Date of Birth: October 20, 1925
 Height : 68 inches
 Weight : 170 pounds

Captain Feldman held Airline Transport Pilot Certificate No. 1004985, airplane multiengine land, commercial privileges, and airplane single-engine land ratings. He also held a Class I medical certificate issued January 10, 1969, without limitations or waivers. He had no significant illnesses or hospitalization in the last 8 years. Captain Feldman's latest electrocardiogram reading was reviewed by the Aeromedical Certification Branch in Oklahoma City with negative results.

Captain Feldman was employed by TAG Airlines in May 1965. He was previously employed by Boone County Aviation in Cincinnati, Ohio, and by Zantop/Capital Airways/Aaxico. His total flying time was approximately 10,200 hours, of which 2,000 hours were in the DH-104 aircraft. He had flown 272:17 hours during the last 90 days (October to December) and 60:49 hours since January 1, 1970. During the past 24-hour period, he had flown 2 hours and 9 minutes. Captain Feldman's crew rest period was 18 hours and 30 minutes. His most recent proficiency check on the DH-104 was passed on November 26, 1969. He was also route qualified on November 26, 1969. Both checks were given by Captain John A. Lyszczyk, an FAA-designated company check pilot.

Captain Feldman's annual recurrent ground school was completed on April 26, 1969. His latest FAA administered flight check was first taken January 4, 1968, in a Piper Aztec and retaken on January 8, 1968 because of inadequate techniques on autopilot, flight maneuvers and other procedures.

b. First Officer Robert Grant Arthur

Date of Birth: August 13, 1943
 Height : 72 inches
 Weight : 190 pounds

Mr. Arthur held Commercial Pilot Certificate No. 1708036 with ratings ASMEI, Flight Instructor - Airplane and Instruments. He also held a Class I medical certificate issued April 8, 1969, without waivers or limitations. No significant illnesses or hospitalization were recorded in his medical records.

Mr. Arthur had been employed by TAG Airlines since April 1969. His previous employment had been with Beaver Aviation, Beaver Falls, Pennsylvania, as a flight instructor, and as a high school teacher in Rochester, Pennsylvania. His total flying time was approximately 1,475

hours, of which approximately 700 hours were in the DH-104. His recent flying experience was essentially the same as that of Captain Feldman: 268:3 hours during the last 90 days, 46:47 hours since January 1, 1970, and 2:09 hours during the last 24 hours. Crew rest prior to the accident was 18 hours and 30 minutes.

Mr. Arthur received monthly proficiency ratings by Captain Feldman. He was given a competency check on June 19, 1969, in the DH-104 by Captain Robert D. Bellenbaum, company chief pilot. Annual recurrent ground school was accomplished on May 6, 1969. Mr. Arthur was checked out as a copilot on the DH-104 on April 3, 1969, by Captain L. Gossen, company check pilot.

Aircraft Historya. Aircraft

The aircraft, a De Havilland Dove Model DH-104-6A, serial No. 04444 was manufactured by De Havilland Aircraft Company, Ltd., in 1953. It was placed into "line service" by TAG Airlines, Inc., on December 5, 1963. The "N" number was changed from 1588V to 2300H, and the aircraft model changed from a DH-104-6A to a DH-104-5A. These changes were signed off as completed on May 28, 1964.

An FAA Operating Certificate No. 5-CE-30 for Air Taxi Commercial Operators was issued on August 29, 1968, to TAG Airlines, Inc. The aircraft was operated under Federal Aviation Regulation (FAR) Part 135 and was maintained in accordance with FAR Part 43, using a 100-hour and annual inspection system.

The total aircraft time, at the time of the accident, was 9,383:52 hours. The last postflight inspection had been performed on January 27, 1970, at an aircraft time of 9,383:41 hours. The last 100-hour inspection was performed on January 15, 1970, at an aircraft time of 9,347:52 hours. The last annual inspection was completed on May 23, 1969, at an aircraft time of 8,677:34 hours. The last weight and balance calculation was accomplished on January 15, 1970, with an empty weight of 6,207.5 pounds, a 6.47 inch center of gravity, and a maximum gross weight limit of 8,800 pounds.

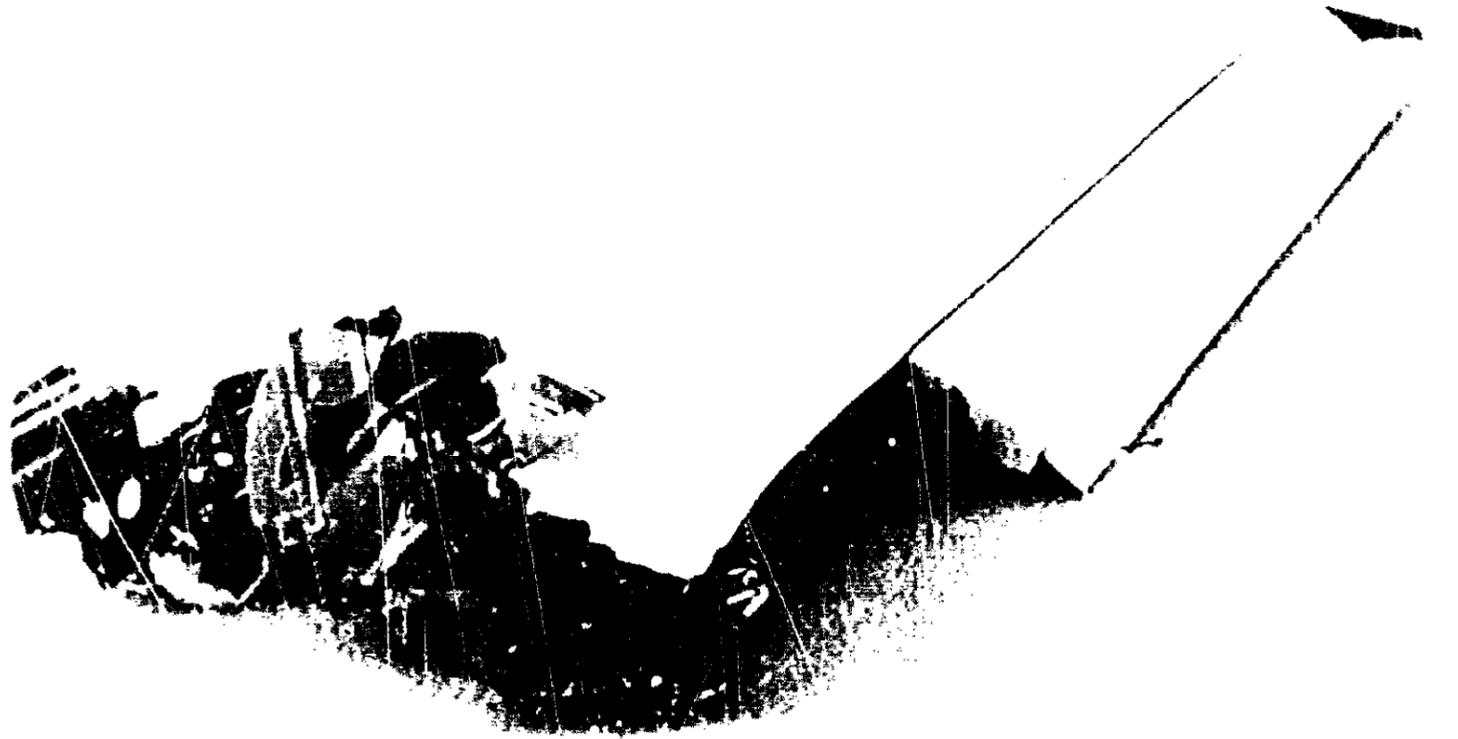
The company maintenance records reflected a general continuity and completeness in the relationship of work accomplished and signoff by Federal Aviation Administration licensed maintenance personnel. Airworthiness Directive compliance was found to be within the prescribed time limits, as were the 100-hour and annual inspection.

b. Engines

The De Havilland Gipsy Queen Model 70 MK2 engine serial No. 66182 was installed in the No. 1 position and serial No. 66822 was installed in the No. 2 position on September 18, 1969, at a total aircraft time of 8,998:02 hours. Both engines had a zero time since overhaul (TSO) at the time they were installed and had accumulated 435:50 hours since installation.

c. Propellers

The propellers were De Havilland Model No. PD 143-312-7. Propeller hub serial No. A12055 with blade serial Nos. BA-515, BA-520, and BA-525, with TSO's of 1,270:52 hours, was installed in the No. 1 position. Propeller hub serial No. 12216 with blade serial Nos. BB-120, BA-217, and BA-264, with TSO's of 1,026:52 hours was, installed in the No. 2 position. Both propellers were installed on September 18, 1969, at a total aircraft time of 8,947:02 hours.



Right Outer Wing Section as recovered from Ice floe.

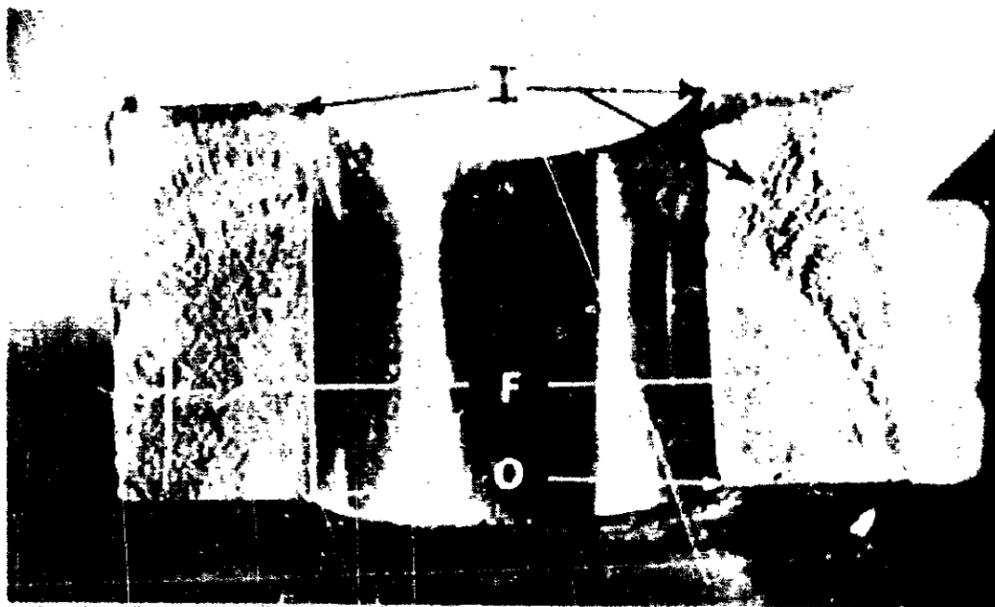


View of right inner wing section lay out from rib station No. 1 outboard to the area between rib stations Nos. 9 and 10.

1. Engine mount framings.
2. Section of top wing skin with fuel tank cap assembly attached.
3. Bottom main spar to fuselage attach fitting.
4. Area of wing separation.
5. Crushed leading edge of wing outboard of engine.
6. Right engine nose cowl panel.



FAILED WING ATTACHMENT FITTING
FROM LAS. ALPINES DOVE, N2100H



SURFACES OF THE FRACTURES
IN THE FAILED FITTING

- "O" - Points where the fatigue fractures originated.
- "F" - Fatigue fracture areas.
- "I" - Instantaneous overload fractures.