

CIVIL AERONAUTICS BOARD

AIRCRAFT ACCIDENT REPORT

ADOPTED: March 30, 1960RELEASED: April 4, 1960

AAXICO (AMERICAN AIR EXPORT AND IMPORT COMPANY), CURTISS C-46,
N 5140B, DYESS AIR FORCE BASE, ABILENE, TEXAS, SEPTEMBER 2, 1959

SYNOPSIS

At 1716, September 2, 1959, AAXICO LOGAIR Trip 7002 crashed on runway 16 at Dyess AFB, Abilene, Texas. The crash occurred while the pilots were attempting to land the aircraft with the elevator controls inoperative. The captain and copilot, the only persons aboard, were killed. The aircraft, a C-46F, N 5140B, was demolished.

Examination of the longitudinal control system of the aircraft disclosed that the aft end of the aft link assembly was disconnected from the clevis in the elevator control horn assembly. This condition would render the elevator control inoperative.

From irrefutable physical evidence the Board concludes that the bolt which normally secures the link assembly-clevis attachment was not in place at impact. It concludes that the bolt worked out following departure from Dyess AFB, resulting in the loss of control which caused the accident. The Board further concludes that the bolt worked out because it was improperly secured, a condition which should have been detected during a No. 2 maintenance inspection completed just prior to the origination of Trip 7002. The inspection was performed by Associated Airmotive, Inc., a certificated repair station which performed under contract the maintenance work for AAXICO.

Investigation

AAXICO Trip 7002 of September 2, 1959, was operated as an air cargo flight incident to the carrier's logistical air support contract with the United States Air Force. Pursuant to the contract, the carrier served numerous Air Force Bases on a regular schedule using 33 C-46F aircraft and flying several million miles annually. Trip 7002 was the first flight for C-46, N 5140B, following a No. 2 maintenance inspection. This inspection was performed by Associated Airmotive, Inc., San Antonio, Texas, an approved repair station which performed, under contract with AAXICO, all maintenance work relevant to the accident.

The assigned flight crew of Trip 7002 consisted of Captain William J. Pagus and Copilot Erceill D. Maher. Both pilots were currently certificated for the flight operation and both were experienced C-46 pilots.

Flight 7002 originated at Kelly AFB at 1403 ^{1/} and proceeded without incident to Dyess AFB where it landed at 1515. There 980 pounds of cargo were off-loaded and 370 pounds, destined for other bases, were on-loaded. No maintenance was performed on the aircraft and no fueling was required.

At 1611 Trip 7002 departed Dyess for Carswell AFB, the next scheduled stop. The flight plan specified that the flight would take about 45 minutes and would be made direct in accordance with visual flight rules. The weather conditions were: Scattered clouds at 4,000 and 15,000 feet with visibility of more than 15 miles. Computations indicated that at departure the gross takeoff weight of the aircraft was 44,128 pounds, well under the maximum allowable of 48,000 pounds. Investigation showed the load was properly secured and distributed within the center of gravity limitations of the aircraft.

At 1631 Trip 7002 contacted the Abilene, Texas, Municipal Tower. The pilot stated he was about 30 miles east of Abilene, declaring an emergency, and returning to Dyess. He reported that he had lost elevator control and was on autopilot. The Abilene controller passed this information to the Dyess Tower and requested the flight to contact Dyess. Dyess promptly alerted the Base emergency facilities.

About 1638 the flight contacted Dyess Tower. The pilot reported the flight was on emergency because of the loss of elevator control and would attempt to land at Dyess. He then requested ground-controlled approach (GCA) assistance ^{2/} and the tower controller immediately gave him the GCA frequency and advised him to switch to that facility. The controller advised local traffic of the emergency and gave Trip 7002 complete latitude of action.

Radio communication was established between the flight and GCA and, about 1645, GCA had positive radar contact. Captain Bagus ^{3/} requested a straight-in approach to runway 16 which is 13,500 feet in length. To this end he transmitted, ". . . vector me for a turn now to get lined up for omni approach for 16. Am going to try dropping my gear pretty soon to see if I can maintain tail trim." Shortly thereafter he transmitted, "Four zero bravo, right, I'm coming straight-in. Have to make a pass or two to try and get my trim and power figured out on this thing. This autopilot is not too easy to operate in this manner, so I'll come directly into one six."

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

^{2/} Weather was no factor in this request. GCA assistance would help Captain Bagus in his visual judgment of alignment, distance, and elevation during the approach.

^{3/} From voice identification of the recorded radio transmission between the flight and GCA it was learned that Captain Bagus made nearly all transmissions from N 5140B and made them in an extremely calm manner.

GCA assisted Captain Bagus with alignment, elevation, and distance information and with all other information he asked for. To observers the approach seemed good although the closest observer, a qualified multiengine pilot, noted that control of the aircraft in the pitch plane was jerky and slightly overcontrolled. A short distance from the runway threshold and about 50 feet above the ground the approach was discontinued. At that time Captain Bagus transmitted, "I'm going out north a couple miles. I'm going to try to land this thing on elevator tab instead of autopilot. I get a little better control using power and trim." The flight then proceeded several miles north of the Base.

During the interim other aircraft landed. One provided information for Trip 7002 that little, if any, turbulence was experienced on final approach. The alert GCA controller also kept Trip 7002 advised of current landing conditions including the surface wind, 7 knots from 170 degrees.

Trip 7002 maneuvered with GCA assistance for a long (about nine miles) final approach. Alignment was very good and when the glide path was intercepted, the GCA controller gave, as Captain Bagus had requested, glide path information. The position of the aircraft on the glide path was good. The closest observer noted that pitch control was better but still jerky and overcontrolled. A C-46 pilot suggested, through GCA, that Captain Bagus roll in forward trim as soon as touchdown occurred. The captain responded, "Roger, we've already got that figured out."

Touchdown occurred at 1715. It was a "wheel landing" with the aircraft speed greater than normal and with considerable power. The wing flaps appeared to be extended between 10 and 20 degrees. The touchdown was considered excellent by all observers. The aircraft rolled on the main wheels for the next 500-1,000 feet without an audible power reduction. It then skipped about 1-2 feet above the surface and again contacted the runway on the main gear only. This contact caused the tail to rotate downward and the aircraft "porpoised," leaving the runway nose-high. It reached 4-6 feet, then descended slightly nose-down and again contacted the runway, this time with greater force on the main gear. The force amplified the downward tail rotation causing a second, more severe, "porpoise." At this time power, estimated by several observing pilots as full power, was applied. The aircraft climbed in a steep nose-up attitude to 150-200 feet above the runway. There it stalled, pitched down violently, and crashed on the runway in a nose-down angle in excess of 45 degrees.

The fuselage forward of the leading edge of the wing was demolished by impact. This section was torn off and moved 425 feet ahead of the remaining aircraft structure when the cargo broke loose and shifted forward with great force. Relatively, the remaining fuselage and empennage were undamaged. The left wing was sheared off at the attachments to the fuselage and the right wing remained attached only by control cables. Both engines were torn from the mounts. A fire occurred but was extinguished in seconds by the efficient and well-equipped Dyess rescue and firefighting team.

Because Captain Bagus had indicated an elevator control failure, investigation was immediately directed to the longitudinal control system of the aircraft. Upon removal of the yoke assembly access panel, it was immediately noted that the aft or bearing end of the link assembly was not connected to the clevis in the elevator control tail section assembly. (See attachment 1.) The bolt which normally connects the clevis and link assembly was missing.

The effect of this disconnect condition would be the loss of all longitudinal control except that obtained through use of the elevator trim tab system and that which could be obtained by manipulation of engine power. Under this condition the autopilot could not be used for pitch control; however, both the manual control system and the autopilot system could be used normally to furnish lateral and directional control.

During a search of the tail area, a bolt of the same size and specification, AN5-12, as the missing bolt was found. It was found lodged on the right side of a shelf of a bracket in the tail compartment. The shelf where the bolt was found is located aft of and above the link assembly and clevis attachment and separated by a bulkhead containing 3-1/2-inch lightening holes. The bolt did not have a washer, castellated nut, or cotter key on it and no such item which would fit the bolt was recovered.

Examination of the bolt showed it had been in recent use. The shank surface was moderately bright and there was no evidence of rust, corrosion, or grease film on the bolt. The peaks of the threads revealed minor wear and polishing. A small amount of loose residue was found in the cotter key hole. This residue appeared to be the same as residue which was accumulated in the bottom of the fuselage in the area below the link assembly-clevis attachment. Relatively, the shelf where the bolt was found was clean.

At the request of the Board, the recovered bolt, clevis, and link assembly were examined by the National Bureau of Standards. From the examination it was not possible to identify the bolt with the specific link assembly and clevis from N 5140B. It was possible, however, to determine from marks on the bolt that it had been installed in an assembly with the same dimensions as the clevis forks and bearing bore of the link assembly. (See attachment 2-A.)

It is worthy of note that the AN5-12 bolt is not specified for any other attachment or assembly in the empennage section of the C-46.

The units composing the link assembly and clevis attachment (see attachment 2-B) were examined. The aluminum alloy push-pull tube, the fore-and-aft end riveted attachments, the clevis unit, and clevis bolt holes showed no damage. The bearing on the aft end of the tube rotated freely and was undamaged.

Although there was no physical indication that an AN5-12 bolt had connected the bearing end of the link assembly to the clevis at impact, personnel of Associated Airmotive, Inc., insisted it was possible for a bolt to have been properly in place at impact. It was further contended

that impact forces could have sheared the bolt and that the pieces could have fallen free and could have been lost. In this contention it was surmised that the bolt could have sheared without causing any damage to the attachment components. The contention concluded that the recovered bolt was not the one installed in the assembly but rather it was one left in the tail compartment during the course of normal maintenance activity. It was stated that in the opinion of Associated Airmotive the radio transmission made by Captain Bagus, hereinbefore quoted, indicated without doubt that Captain Bagus had elevator control while using autopilot and that such control was not possible assuming the disconnected link assembly-clevis attachment. They therefore concluded that the failure must have existed forward of the autopilot servos.

In an effort to satisfy the aforestated contention, the longitudinal control system was reexamined in its entirety. In addition, the stress analysis data on the pertinent parts of the link assembly-clevis attachment were carefully reviewed and tests to failure were made on the attachment assembly. The tests were performed by the National Bureau of Standards at the request of the Civil Aeronautics Board.

The stress analysis data showed that the strength of the AN5-12 bolt was greater than the strength of several other components which comprise the link assembly-clevis attachment; this therefore showed other components in the assembly would fail first. As stated, all components of the attachment recovered from N 5140B were undamaged.

The tests to failure confirmed the stress analysis data. With the attachment assembled, compression loading caused the aluminum alloy push-pull tube to buckle. (See attachment 2-C.) ^{4/} Under tension loading applied to the assembly, the rivets attaching the forked-end component to the forward end of the push-pull tube sheared and the unit pulled off. (See attachment 3-A.) At the end of these tests the AN5-12 bolt used was marked but otherwise undamaged. Another test was then made in which loading was applied to the Clevis unit and bearing end fitting with the bolt in place. The units were positioned in the test as they are installed in the aircraft. This test resulted in a failure of the shank of the clevis unit and a complete functional destruction of the bearing. (See attachment 3-B.) At the completion of the test the bolt was only slightly bowed.

In the course of the examination and reexamination of the other portions of the longitudinal control system, a fracture was found in the forward link assembly which is located below the cockpit area and should not be confused with the link assembly-clevis attachment hereinbefore described. In addition to the fracture, a short section of the aluminum alloy tube was missing. Because the failed surfaces under visual inspection exhibited certain characteristics which resembled a fatigue fracture, it was also examined by

^{4/} In the testing when failure was clearly shown by a drop in the measured loading, the loading was relieved to preserve the parts for further tests.

the National Bureau of Standards using laboratory equipment. With respect to the fracture, the Bureau of Standards report stated that the fracture surface that remained on the yoke was well preserved and showed no evidence of fatigue; the deformation associated with the fracture indicated it was caused by overload. Examination of the surfaces which mated with the missing portion of tubing showed no evidence of fatigue but clear evidence of abrasive action, indicating the missing portion of tubing was ground away. It is noteworthy that a failure of this unit, had it occurred, would not permit complete autopilot control of the elevators. Nose-down control would be available, nose-up control would not. Manually, nose-up control would be available, nose-down control would not.

All other damage found to the other portions of the longitudinal control system was clearly the result of impact.

Examination of the elevators, their associated mechanisms, and attachments, showed the elevators overtravelled with great force in both the up and down throws. One direction occurred when the aircraft struck the runway and the other occurred when the fuselage crashed to the runway from the near-vertical impact attitude.

According to the maintenance records on aircraft N 5140B, the last time the link assembly-clevis attachment was disconnected during maintenance was March 4, 1959. At that time the attachment was disconnected to replace the bearings following a writeup that, "Elevator torque tube clevis excess loose through yoke." Following this work an inspection of the work was signed off by an Associated Airmotive inspector. Thereafter, during a No. 3 inspection on June 10, 1959, a No. 4 inspection on July 22, 1959, and a No. 2 inspection on September 1, 1959, all of which require inspection of the link assembly-clevis attachment for wear, proper assembly, and security, this inspection item was signed off as completed by an inspector of Associated Airmotive. Except on July 22, 1959, the inspections were signed off by the same inspector, Milton T. Parker.

On September 2, 1959, Mr. Parker signed the aircraft and engine maintenance log that the No. 2 inspection was completed. Within two hours of flying time the accident occurred.

Inspector Parker testified that he recalled his September 1959 inspection of N 5140B, including that portion pertaining to the link assembly-clevis attachment. He stated that he had personally removed the inspection plate which permitted access to the attachment because it had been improperly left in place when the aircraft was "opened up." Inspector Parker stated he inspected the bearing for wear and the attaching bolt for wear and security. He stated that he found the nut was tight and the cotter key in place. Inspector Parker concluded that his inspection was complete, the components of the attachment were in good condition, and the attachment was properly secured.

Analysis and Conclusions

Examination of the longitudinal control system of N 5140B revealed the link assembly was disconnected from the Clevis and all of the components

which comprise the link assembly-clevis attachment were undamaged. Stress analysis data and tests by the National Bureau of Standards conclusively proved that had an AN5-12 bolt been in place in the attachment, high impact forces could not have sheared the bolt but would have badly damaged the components. It is on this irrefutable physical evidence that the Board concludes the AN5-12 bolt which normally secures the link assembly-clevis attachment was not in place when the aircraft crashed.

In addition to the above it is the Board's opinion that the recovered bolt is not evidence that a bolt of the required specification for the attachment, one of recent use, and one with markings matching the bearing bore and clevis forks, was left in the tail during previous maintenance. On the contrary, it is the Board's opinion that this is evidence that the bolt was the one holding the attachment together immediately prior to the accident. Considering the inflight jostling, the forward forces when the aircraft struck the runway, and the aft forces when the tail toppled to the runway, it is entirely possible for the bolt to have reached the location where it was found.

In view of the aforestated analysis and conclusions, it is the judgment of the Board that the bolt worked out of the attachment, causing the loss of elevator control. It follows that the bolt could have worked out only because it was improperly secured, a condition which had to exist and should have been discovered when the No. 2 maintenance inspection was made less than two flying hours before the accident. In the opinion of the Board it also follows that, had the inspection of the attachment been performed by the inspector as he described it, the insecurity of the bolt would have been detected.

In its conclusions the Board has carefully considered the radio transmissions made by Captain Bagus, the important portions of which have already been quoted, together with the reasons for their importance. While the Board would agree that the meaning of the transmissions is not entirely clear, it would not agree that they are subject to the single interpretation that Captain Bagus had elevator control when the autopilot was engaged. In light of the circumstances and physical evidence, the Board believes that the most reasonable interpretation is that all pitch control was lost except that which could have been obtained from power and trim and that this condition was not altered by using the autopilot.

It is clear that Captain Bagus did use the autopilot but not that its use restored the lost elevator control which was initially reported. It is believed that the pilot used the autopilot for lateral and directional control in combination with power and trim for pitch control. This is suggested when Captain Bagus said, "This autopilot is not too easy to operate in this manner." The words "in this manner" particularly suggest the combination, the autopilot itself not being hard to operate in the normal manner.

That longitudinal control was not provided by the autopilot is clearly suggested when Captain Bagus was using the autopilot and transmitted, "Am going to try dropping my gear pretty soon to see if I can maintain tail trim." Also, when he said, "Have to make a pass or two and get my power

and trim figured out on this thing."

Following the first approach the pilot transmitted, "I'm going to try to land on elevator tab instead of autopilot. I get a little better control using power and trim." Out of context this transmission could indicate the pilot had or thought he had pitch control on autopilot. In context with the other transmissions and in consideration of the emergency, it is the Board's judgment that the pilot meant he was discontinuing use of the autopilot and the power and trim combination. It meant he would use manual control for lateral and directional control and power and trim for control in the pitch axis.

Operationally, without normal elevator control, landing the aircraft using power and trim would be a most difficult task. During the approach the pitch control would lack "feel" normally obtained through the yoke. Over-control would be unavoidable because of the jerky and lagging response of the aircraft to power and trim. Further, these difficulties would be increased greatly because the manner of control required increased hand movements and would entail a sudden departure from orthodox procedures. Once the aircraft was on the runway the slightest irregularity in the runway or wind gust could cause it to bounce or "porpoise." Considering all the operational circumstances, to prevent the bounce from becoming a "porpoise" or to damp the "porpoise" using power and trim would be extremely difficult. In view of the foregoing, the Board is of the opinion that there were no operational factors that caused or contributed to the cause of this accident.

Probable Cause

The Board determines that the probable cause of this accident was loss of elevator control because of an improperly secured bolt, a condition which was undetected because of an inadequate inspection.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. DURFEE
Chairman

/s/ CHAN GURNEY
Vice Chairman

/s/ G. JOSEPH MINETTI
Member

/s/ WHITNEY GILLILLAND
Member

/s/ ALAN S. BOYD
Member

S U P P L E M E N T A L D A T A

Investigation and Taking of Depositions

The Fort Worth office of the Civil Aeronautics Board was notified of this accident shortly after it occurred September 2, 1959. An investigation was made in accordance with the provisions of the Federal Aviation Act of 1958. Depositions were taken September 21, 24, and 28, and October 23, 1959.

Air Carrier

American Air Export and Import Company, AAXICO, is a Florida corporation with its principal offices in Miami. It holds a valid certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Federal Aviation Agency. Under the authority the carrier is principally engaged in an air freight operation pursuant to a contract with the U. S. A. F. Under the contract it serves numerous Air Force Bases on a regular schedule.

Maintenance work pertinent to this accident was performed by Associated Airmotive, Inc., a Texas corporation with its principal office at San Antonio. Associated Airmotive, Inc., is a certificated repair station approved by the Federal Aviation Agency.

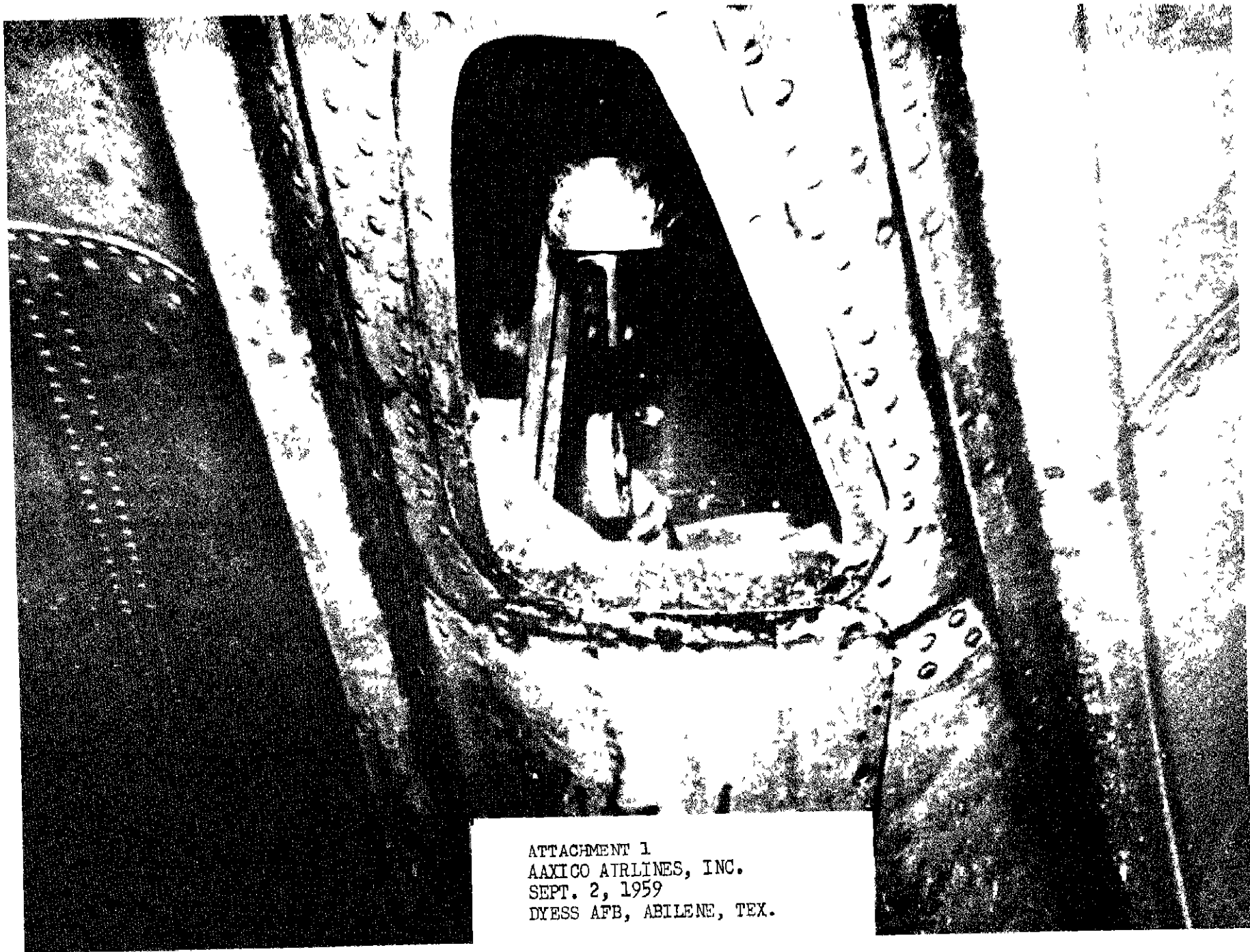
Flight Personnel

Captain William J. Bagus, age 36, was employed by the company October 12, 1955. He was promoted to captain January 19, 1957. He held a valid airman certificate with airline transport and C-46 ratings. Captain Bagus had accomplished 7,294 flying hours, of which 3,656 were in the C-46. His last first-class medical examination was satisfactorily accomplished June 29, 1959.

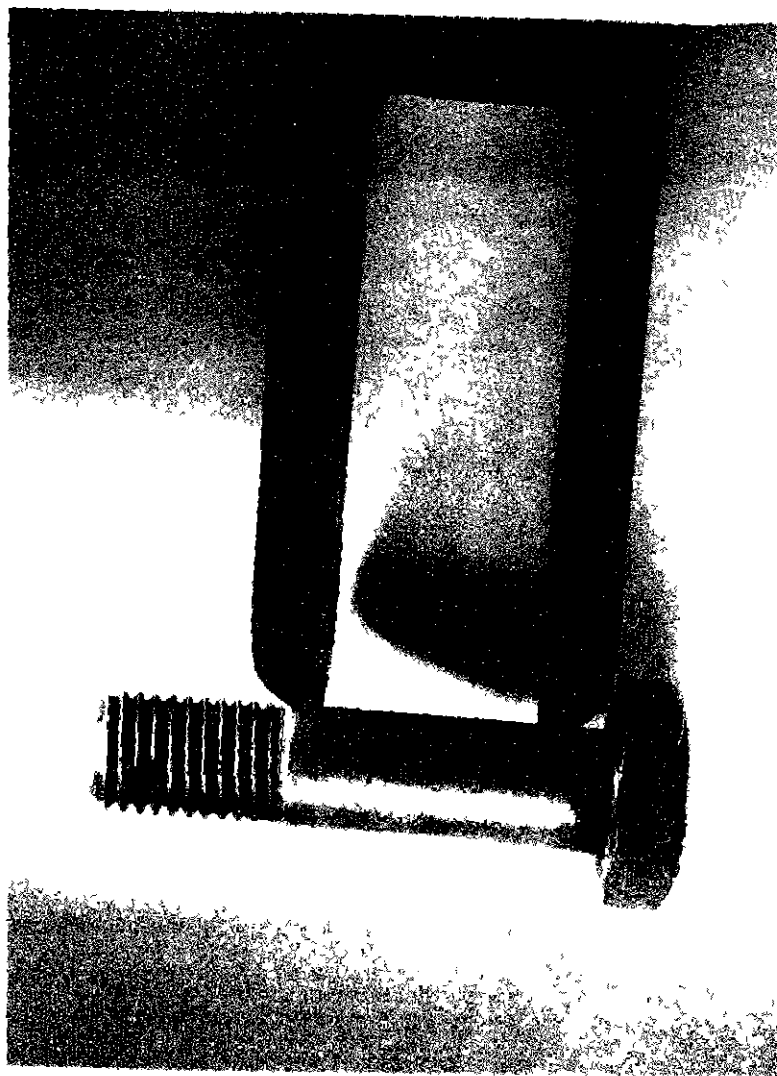
First Officer Erceill D. Maher, age 38, was employed by the company June 11, 1959. He held a valid airman certificate with commercial and instrument ratings. He had a total of 4,839 flying hours, of which 287 were in the C-46. His last medical examination was satisfactorily completed on July 20, 1959.

The Aircraft

Curtiss Wright C-46F, N 5140B, bore manufacturer's serial number 26809 and was built in 1942. The aircraft had flown 289 hours since the last No. 4 inspection and less than two hours between the emergency and the last No. 2 inspection. It was powered by Pratt and Whitney engines, model R2800-51ML, and the engines were equipped with Hamilton Standard, model 23E50, propellers.

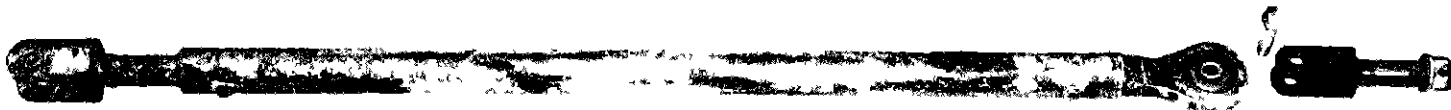


ATTACHMENT 1
AAXICO AIRLINES, INC.
SEPT. 2, 1959
DYESS AFB, ABILENE, TEX.

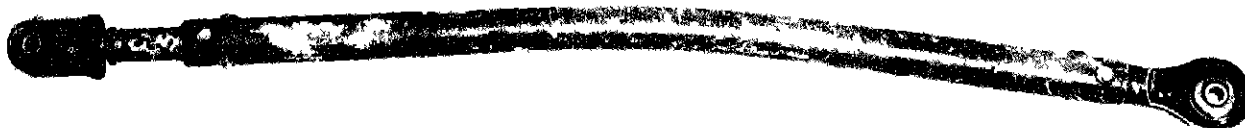


ATTACHMENT 2-A
AAALCO AIRLINES, INC.
SEPT. 2, 1959
DYESS AFB, ABILENE, TEX.

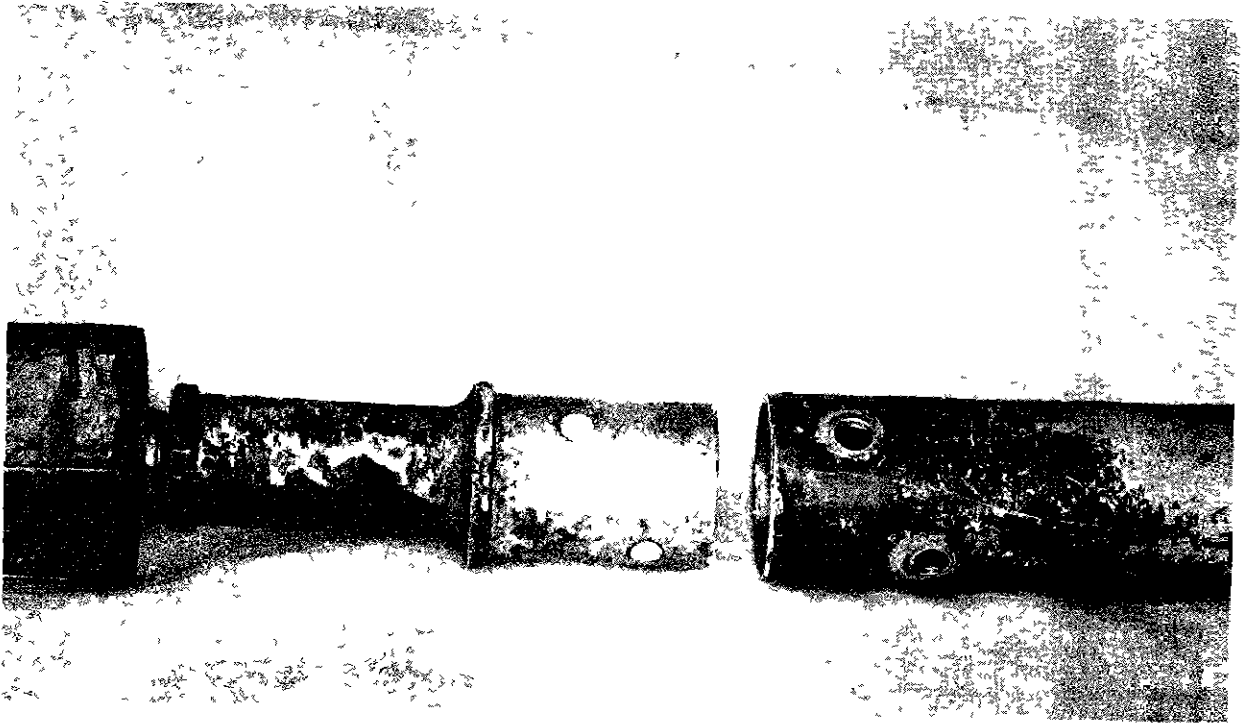
ATTACHMENT 2-A
AAXICO AIRLINES, INC.
SEPT. 2, 1959
DYESS AFB, ABILENE, TEX.



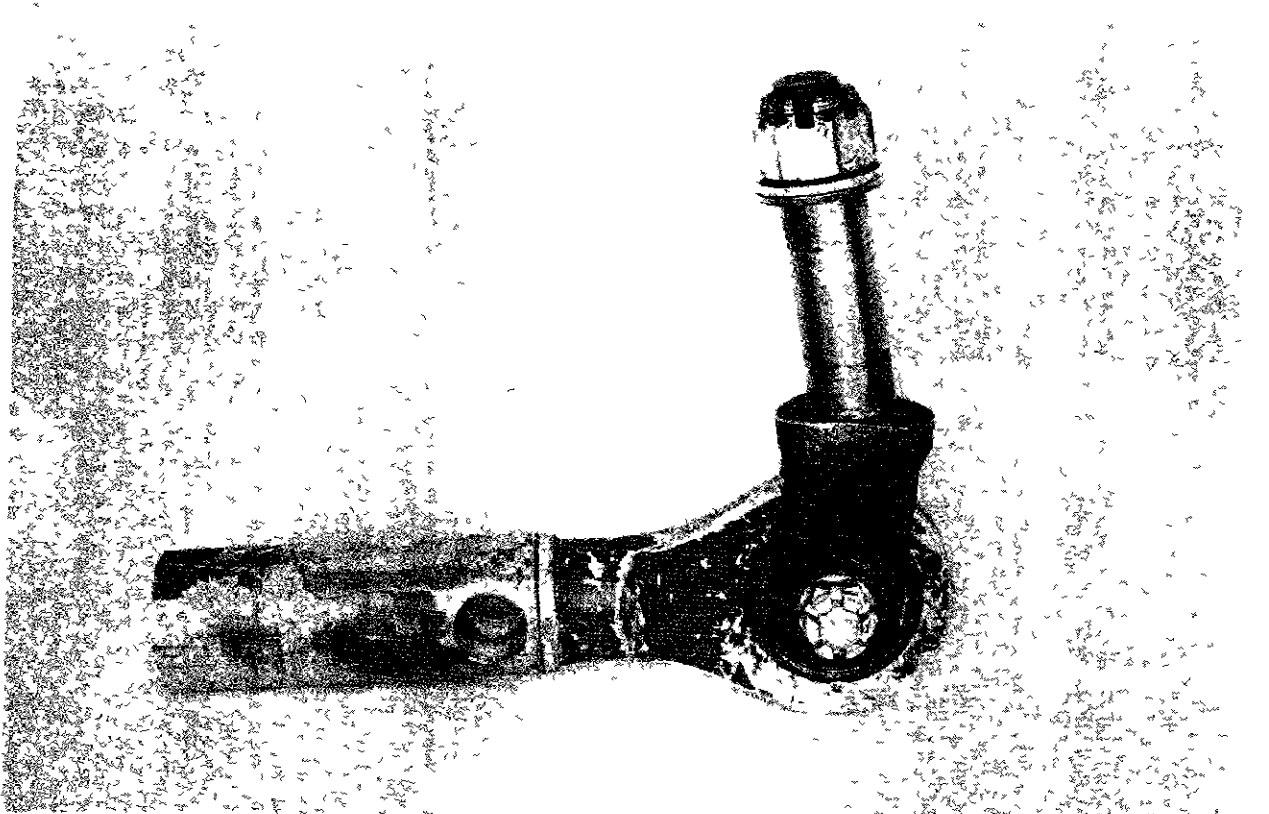
ATTACHMENT 2-B
AAXICO AIRLINES, INC.
SEPT. 2, 1959
DYESS AFB, ABILENE, TEX.



ATTACHMENT 2-C
AAXICO AIRLINES, INC.
SEPT. 2, 1959
DYESS AFB, ABILENE, TEX.



ATTACHMENT 3-A
AAJICO AIRLINES, INC.
SEPT. 2, 1959
DYESS AFB, ABILENE TX.



ATTACHMENT 3-B
AAJICO AIRLINES, INC
SEPT. 2, 1959
DYESS AFB, ABILENE, TEX