SA-431 File No. 1-0001

AIRCRAFT ACCIDENT REPORT

MOHAWK AIRLINES, INC.

Fairchild Hiller FH-227B, N7818M

Albany, New York

March 3, 1972

Adopted: April 11, 1973

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C. 20591
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This report contains Aircraft Safety Recommendations A-73-14 and A-73-15.

16. Abstract

A Mohawk Airlines, Inc., FH-227B, crashed into an occupied house 3.5 miles south of Albany County Airport, New York, at 2048 e.s.t, March 3, 1972. Fourteen passengers, two pilots, and one occupant of the house died in the accident. Thirty-one passengers, the stewardess, and four occupants of the house were injured. The aircraft and the house were destroyed. The weather was: indefinite ceiling 1,200 feet obscured, visibility 2 miles in light snow, wind 360° at 9 knots. The flight was conducting a back course ILS approach when the crew reported difficulties with the left propeller and that they were going to land short. Examination of the propeller system revealed no significant deficiencies. All components were ground or flight tested with no malfunctions. The National Transportation Safety Board determines that the probable cause of this accident was the inability of the crew to feather the left propeller, in combination with the descent of the aircraft below the prescribed minimum altitudes for the approach. The Board is unable to determine why the left propeller could not be feathered. Contributing causal factors for the nonstandard approach were the captain's preoccupation with a cruise pitch lock malfunction, the first officer's failure to adhere to company altitude awareness procedures, and the captain's failure to delegate any meaningful responsibilities to the copilot which resulted in a lack of effective task sharing during the emergency. Also, the Board was unable to determine why the propeller pitch lock malfunctioned during the descent.

There were two recommendations.

17. Key Words
Cruise pitch lock, Dowty Rotol propeller, fire, crew coordination, FH-227, nonprecision approach, survival, weather, crew shoulder harness, stewardess seats, fire and rescue equipment, flight recorders, spectograph analysis, ground damage, impact loading, altitude awareness, aircraft performance, judgment, reasoning, stress

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FAIRCHILD-HILLER FH-227B, N7818M
ALBANY, NEW YORK
MARCH 3, 1972

SYNOPSIS

A Mohawk Airlines, Inc., FH-227B, Flight 405, with 45 passengers and a crew of three aboard, crashed into an occupied house about 3.5 miles south of Albany County Airport at 2048:07 eastern standard time on March 3, 1972. Fourteen passengers, the two pilots, and one occupant of the house received fatal injuries in the crash. Thirty-one passengers, the stewardess and four occupants of the house suffered nonfatal injuries.

Flight 405 made a back course Instrument Landing System approach to Runway 1 at Albany County Airport. When the flight was about 8.5 miles south of the airport, the crew reported to Mohawk Operations in Albany that the left propeller was "hung-up on the cruise pitch lock." About 5 miles from the airport, the crew advised Albany Approach Control that they were having a problem and were feathering the left propeller. Approximately 32 seconds later, the crew advised the controller that they were going to "land short." Crew comments, recorded on the cockpit voice recorder during those 32 seconds, indicated that their attempts to feather the propeller were unsuccessful.

The aircraft struck the house near ground level and came to rest, with the passenger section almost completely buried under the collapsed wreckage of the house. There was no fire or explosion. Rescue operations began about 10 minutes after impact and were completed about 3 hours later.

The Albany County Airport weather conditions, as given to the crew of Flight 405 at 2040:09, were: ceiling indefinite, 1,200 feet obscured, with 2 miles visibility in light snow; surface winds were 360° at 9 knots. Another Mohawk crew conducting an ILS approach behind Flight 405 stated that the weather conditions were as good as or better than those reported at the airport.

Examination of the airframe, control systems, engines, engine accessories, and propellers disclosed no evidence of structural failure, malfunction, or abnormality, except a worn cam follower roller in the left propeller pitch control unit. Both pitch control units and feathering pump units were tested and found to be capable of normal operation.

The National Transportation Safety Board determines that the probable cause of this accident was the inability of the crew to feather the left propeller, in combination with the descent of the aircraft below the prescribed minimum altitudes for the approach. The Board is unable to determine why the left propeller could not be feathered. Contributing causal factors for the nonstandard approach were the captain's preoccupation with a cruise pitch lock malfunction, the first officer's failure to adhere to company altitude awareness procedures, and the captain's failure to delegate any meaningful responsibilities to the copilot which resulted in a lack of effective task sharing during the emergency. Also, the Board was unable to determine why the propeller pitch lock malfunctioned during the descent.

As a result of this accident, the Safety Board recommended changes in the FH-227 air carrier operations manuals and ground training that deal with cruise pitch lock malfunction. The Board also made recommendations to the FAA with regard to the installation and use of shoulder harnesses in air carrier operations.

After reviewing the evidence in this case, the Board further recommends that: (1) The FAA take the required action to have the arming of the emergency cabin lights included in checklists used before each takeoff and landing; and (2) The FAA bring this accident to the attention of appropriate FAA and air carrier personnel with the intent of ensuring that aircrews are trained in task sharing during abnormal and emergency flight conditions.

1. INVESTIGATION

1.1 History of the Flight

The crew of Mohawk Airlines, Inc., Flight 405 (MO405), reported for duty at LaGuardia Airport, New York, at 1545 1/ on March 3, 1972. The captain and stewardess had been off duty for 17:03 hours prior to reporting for this flight. The first officer had not been on duty during the preceding 24-hour period.

The flightcrew was scheduled to fly two round trips between LaGuardia and Albany, New York. The first round trip was completed

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

in N7818M, a Fairchild Hiller, FH-227B, two-engine turboprop, with no recorded difficulties. The same aircraft was used on the second trip.

MO405 departed from LaGuardia on the first leg of the second round trip at 2005 on March 3, 1972. Forty-five passengers, including one infant, and the three crewmembers were aboard. The flight proceeded through the areas controlled by LaGuardia Departure Control and the New York and Boston Air Route Traffic Control Centers without reported difficulty.

At 2038:30, the Boston Air Route Traffic Control Center released control of MO405 to Albany Approach Control (AAC). At that time, MO405 was at an assigned altitude of 11,000 feet mean sea level. 2/

The AAC controller cleared MO405 to descent to 3,000 feet, and at 2039:32, MO405 reported leaving 11,000 feet. In response to the controller's query as to MO405's airspeed, the first officer replied, "It'll be about, ah two -- two forty on descent."

The controller, at 2040:09, gave weather and landing information to MO405 and two other Mohawk flights (MO545 and MO463) as follows:

> "OK four oh five, four sixty three, and five forty five, all copy. You're all being vectored for the localizer back course ILS, Runway One final approach course. The weather is indefinite ceiling one thousand two hundred sky obscured, visibility two miles with light snow, the wind is three six zero degrees at one zero and the altimeter three zero five, the runway has one-quarter inch of snow over a thin layer of hard packed snow, scattered bare spots, it's been sanded, braking action poor by DC nine, four oh five acknowledge."

MO405 acknowledged this information at 2040:43.

At 2041:13, the controller reported MO405's radar position as 10 miles south of Greenbush 3/ and cleared the flight for a back course Instrument Landing System (ILS) localizer approach to Runway 1 at Albany County Airport. This clearance was acknowledged by MO405. The controller then informed the flight that he would call the 7-mile and 4-mile radar fixes. Crew comments recorded by the cockpit voice recorder indicated that at 2042:09.5, the captain of MO405 said, "going down to twenty-six, huh?" The first officer responded, "All right (pause) well, twenty one hundred feet at seven mi---ah, seven miles,

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2/ All altitudes and elevations are mean sea level unless otherwise stated.

3/ Greenbush is a navigation fix about 11 miles south of the Albany County Airport; it is defined as the intersection of the Albany VOR 194° radial and Cambridge VOR 232° radial.

fourteen hundred feet at four miles." The captain acknowledged, "All right."

At 2043:26, the captain commented, "Pitch light, huh?" and the first officer responded, "Yeah." The captain then said, "Watch the TGT (turbine gas temperature) on that side.", and the first officer replied, "Yeah, okay.", followed by, "First time I've ever seen that."

The first officer, at 2044:13.5, stated, "We're approaching fourteen hundred feet." He then asked the approach controller for MO405's range from the field and received the response, "Four zero five, you're eleven miles."

At 2045:32, the first officer informed Mohawk Operations in Albany of the problem with the left engine. At 2046:01, the approach controller informed MO405 that it was approaching the 7-mile radar fix. The altitude derived from the flight data recorder was approximately 1,000 feet at that time. At 2046:16, the approach controller requested MO405's airspeed and was told that the airspeed was 130 knots. The recorded airspeed at that time agreed with this value.

At 2046:38, the captain said to the first officer, "Better shut it down." Approximately 40 seconds later, the first sounds of a decelerating engine were recorded. At 2047:22, the first officer informed the controller of the problem with the left engine and that the flight would continue inbound. At 2047:29.5, the stewardess began her landing announcement on the passenger address system; it was completed in 13.2 seconds.

At 2047:38, the captain said, "(Didn't or see if you can) 4/ get it to feather!" At 2047:51, he said, "Tell 'em we're gonna land short, we're in trouble."

At 2047:54.5, the first officer informed AAC that MO405 was in trouble and would land short. At 2048:01, the approach controller informed MO405 that they were at the 4-mile radar fix. No response was received.

At 2048:07, all recording by the cockpit voice recorder ceased. (For details of the cockpit voice recorder transcript, see Attachment 2.)

The approach controller stated that the radarscope target display of MO405 disappeared at a position 3.5 miles south of the airport.

Eight ground witnesses located at various points along the flightpath of MO405 reported that the aircraft was low, or lower than normal,

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4/ The interpretation of these words is inconclusive.

and that the landing gear was retracted. These witnesses were located at various distances from the accident site, ranging from 400 to 12,600 feet.

The engine sounds were reported to be loud and were described by one witness as having a surging or pulsating characteristic. A witness 1,500 feet from the impact area reported that only one engine was running. He also reported a strong odor of kerosene but did not see any fluid coming from the aircraft or fuel deposits on objects on the ground.

The witnesses who were closest to the accident reported that the engine sounds ceased or reduced to a "hum" just prior to impact. They also reported that the aircraft began a turn to the left before it struck the ground. The aircraft was observed to strike the ground, left wing down and slightly noseup.

Passengers stated that the main landing gear was extended 5/ before the aircraft entered the clouds and that the landing gear was retracted before the crash. Their estimates of the time between landing gear retraction and impact with the ground varied from 3 to 5 minutes. The stewardess saw the landing gear extend and then retract almost immediately. She stated that this occurred before she made the landing announcement to the passengers at 2047:29.05, approximately 37 seconds before impact. She also stated that the seatbelt and no smoking signs were illuminated.

The aircraft struck a two-story frame residence located about 3.5 miles south of the airport at an elevation of 245 feet. The latitude is 42°40'27" N., and the longitude 73°48'02" W.

The accident occurred at night under an overcast sky, with light snow falling.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	2	14	1
Nonfatal	1	31	4
None	0	0	

Of the surviving passengers, 17 had spinal injuries, nine had leg or ankle fractures, eight had fractured ribs, and seven suffered facial fractures.

5/ The main landing gear is extended for use as a drag brake to increase the rate of descent without increasing the airspeed.

The stewardess suffered a spinal fracture and head injuries. The first officer sustained a fatal skull fracture but no other injuries. The captain sustained a skull fracture, as well as fractures of both legs and wrists, a spinal compression, and several fractured ribs. The autopsy of the captain disclosed evidence of ingestion of an amphetamine. Based on medical evaluation of this evidence, it was judged to have been indicative of a therapeutic dose and would have had no effect on his ability to perform his duties.

Five persons were in the house when the accident occurred. One occupant received fatal injuries from the impact. The other four occupants of the house suffered nonfatal injuries and were taken to the hospital with the survivors from the aircraft.

1.3 Damage to Aircraft

The aircraft was destroyed.

1.4 Other Damage

The house into which N7818M crashed was destroyed. An automobile and an adjacent house were slightly damaged.

1.5 Crew Information

Both pilots were certificated for the flight. All crewmembers had received the training required by the company training programs, which had been approved by the Federal Aviation Administration (FAA). (See Appendix B for detailed information.)

1.6 Aircraft Information

The aircraft was a Fairchild Hiller FH-227B, N7818M. It was owned and operated by Mohawk Airlines, Inc. The date of aircraft manufacture was April 25, 1967, and the serial number was 541.

N7818M was powered by two Rolls-Royce Dart Model 532-7 turbojet engines equipped with Dowty Rotol R-257/4-30-4/60 propellers. Both powerplants were installed in N7818M on January 19, 1972, to prepare the aircraft for return to service.

N7818M had been out of service from June 18, 1971, to January 20, 1972. It was equipped and maintained in accordance with existing regulations, and applicable Airworthiness Directives had been accomplished.

The weight and center of gravity were within established limits at the time of the accident.

The aircraft departed from the terminal in New York with 6,500 pounds of Jet A fuel aboard and the fuel weight was approximately 4,600 pounds at impact. (See Appendix C for details.)

1.7 Meteorological Information

The aviation terminal forecast issued by the National Weather Service Forecast Office at Albany, New York, at 1740 on March 3, 1972, and valid from 1800 March 3 to 1800 March 4, 1972, was, in part, as follows:

Albany - 1800-2300 - Ceiling 2,500 feet overcase, visibility 3 miles, light snow, wind 350° at 15 knots, occasional ceiling 1,000 feet overcast, visibility 1½ miles, light snow.

On March 3, 1972, the surface weather observations for Albany County Airport at the times indicated were in part:

Albany - 1955 - Record special, ceiling indefinite 1,200 feet obscured, visibility 2 miles, light snow, temperature 14° F., dew point 10° F., wind 360° at 9 knots, altimeter setting 30.05 inches.

Albany - 2055 - Ceiling indefinite 1,000 feet obscured, visibility 2 miles, light snow, temperature 13° F., dew point 9° F., wind 010° at 12 knots, altimeter setting 30.07 inches.

The crews of MO545 and MO463, which were being vectored to land behind MO405, confirmed that the weather conditions at the Albany County Airport were essentially as reported. They also reported that light turbulence, but no icing, was encountered on their descents and approaches to the airport.

The captain of MO463 stated that he was clear of all clouds at 7,000 feet en route from Islip, New York, and the tops of the clouds in the Albany area were approximately 2,600 feet. He acquired ground contact below the clouds about 7 miles south of the airport at 2,100 feet and estimated that the forward visibility was 2 to 3 miles at that point. He had Runway 1 at Albany in sight, from 1,400 feet, at the 4-mile radar fix.

1.8 Aids to Navigation

The Albany County Airport is equipped with VOR and ILS approach facilities. The inbound course on the back course ILS localizer approach to Runway 1 is 011° magnetic. There are no marker beacons or compass locators on the back course approach, and Albany Approach

Control radar is required to establish ranges for descent altitude restrictions. The minimum altitude from Greenbush to the 7-mile radar final approach fix (FAF) is 2,100 feet. The minimum altitude from the FAF to the 4-mile radar fix is 1,400 feet. Descent to the minimum descent altitude of 680 feet is authorized after passing the 4-mile radar fix. The minimum visibility required for this approach in the FH-227B, is three-quarters of a mile.

On March 3, 1972, there were no outstanding Notices to Airmen or pilot reports concerning the status of the aids to navigation at Albany. The ILS and Albany Approach Control radar were ground checked by the FAA on March 3, 1972, and were flight checked on March 4, 1972. Both facilities were operating within prescribed tolerances.

1.9 Communications

There were no air-to-ground radio communication difficulties associated with this accident.

1.10 Aerodrome and Ground Facilities

The Albany County Airport is located approximately 6 miles north northwest of the downtown area of the city of Albany. The airport elevation is 288 feet.

Two intersecting runways are available -- Runways 1-19 and 10-28. The former is 6,000 feet long by 150 feet wide and latter is 4,500 feet long by 150 feet wide.

The Runway 1 back course ILS localizer extends southward over the western and northwestern sections of the city of Albany. The crash site of N7818M was near the Runway 1 centerline, extended, in a residential section of the city.

Runway 1 is equipped with high-intensity runway lights, which were set at step 4 (80 percent of maximum intensity) at the time of the accident. Runway 1 is not equipped with approach lights.

The airport firefighting and crash rescue services are provided from four stations of the Albany County Volunteer Fire Department (ACVFD). These stations are located in the communities surrounding the airport.

A full-time airport fire chief is employed by the airport manager, and four pieces of firefighting equipment are located at the airport. This equipment is manned by the ACVFD personnel.

Five ambulances and five rescue vehicles manned by ACVFD personnel also respond to emergency alarms. The equipment is located at the various ACVFD stations.

Direct telephone communications are provided from the Albany control tower to the Colonie ACVFD station, which serves as the primary central dispatch for the other stations involved. In this case, a *Code* II 6/ alarm was received at the Colonie station at 2050. Personnel from the four stations responded, and the airport equipment was in place at the airport in a short time. This equipment was held at the airport. When the Colonie dispatcher received notification of the location of the crash site, he diverted the ambulance and rescue equipment that were en route to the airport. This equipment arrived at the crash site at approximately 2120.

1.11 Flight Recorders

N7818M was equipped with a Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR).

The FDR was a Sundstrand Corporation, United Control Data Division Model F-542, Serial No. 1529. Although the recording foil magazine was slightly damaged, the foil itself was in good condition.

The FDR readouts are included as Attachment 1 to this report. Graph No. 1 is the readout of the last 5 minutes of recorder operation and Graph No. 2 is the readout of the preceding 5 minute period.

Accuracy checks were made of the FDR altitude trace by comparing known departure point altitudes with the previously recorded altitudes. These checks showed that the recorder altitude trace was 179 feet low at LaGuardia and 193 feet low at Albany, the last two departure points.

Correlation of the FDR and CVR data resulted in a FDR altitude trace reading of about 1,300 feet at the time the first officer said, "We're approaching fourteen hundred feet."

The recording accuracy tolerances for the FDR are:

Airspeed	± 10 knots
Pressure Altitude	± 100 feet at sea level to
	± 700 feet at 50,000 feet
Magnetic Heading	± 2°
Vertical Acceleration	± 0.2 g
Time	± 1% minute in 8 hours

6/ Emergency in which an aircraft approaching the airport is in major difficulty.

The Cockpit Voice Recorder (CVR) was Collins Radio Co. Model 642-C-1, Serial No. 29. There was no evidence of any damage to the recorder. A transcript was made of the last 8:51 minutes of the recording. The voices were identified by persons familiar with the voices of the captain and first officer. (See Attachment 2 for the CVR transcript.)

An approximate flight profile of the final 6 minutes of flight was constructed from FDR and meteorological information. Pertinent CVR comments were correlated with the FDR plots, based on the assumption that FDR and CVR operations were terminated simultaneously at impact. (See Attachment 3 for the approximate flight profile.)

1.12 <u>Aircraft Wreckage</u>

The aircraft penetrated the front of a two-story frame house located at 50 Edgewood Avenue, Albany, New York. It came to rest with the forward fuselage section from Fuselage Station (FS) 229 protruding from the rear of the house and the aft fuselage section, from FS 475 aft, extending from the front of the house. The center section was buried under the wreckage of the house. (See Attachment 4 for wreckage distribution details.)

Examination of the wreckage revealed no evidence of the separation of aircraft components, control surfaces, or structural members prior to contact with the ground and house.

All powerplant components were buried under the wreckage of the house. Both propellers had separated from their engines, but all the blades remained attached to their hubs.

Both engines were taken to an overhaul facility for disassembly and examination. No evidence of preexisting discrepancies was found in the engines or the installed accessories. There was no evidence of distress or a lack of lubrication, and all bearings rotated freely.

The left engine reduction gear coupling quill shaft and rear bearing housing flange were intact. Uncharred leaves and wood chips were found in the combustion and turbine areas. The low- and high-pressure rotating guide vanes, impeller vanes, and turbine blades bore no evidence of foreign object damage, distortion, or overheating. The engine control rods and levers were complete; however, they were extensively damaged.

The right engine reduction gear coupling quill shaft was sheared, and the bearing housing flange was fractured. Blackish, oil-soaked debris was present throughout the compressor section and forward area of the combustion chambers. Substantial amounts of black, dry debris were packed between the outer air casings and the flame tube rear outer bore ring. Ashlike deposits were found on all stages of the turbine. Foreign object damage was evident on the low-pressure rotating guide vanes and the turbines. The engine control rods and levers were intact and undamaged.

Both fuel trimmer actuators were found in the fully extended position, which corresponded to a zero fuel trim condition. The electrically operated fuel tank shutoff valves and the cable-operated emergency fuel shutoff valves for both engines were in the open position. Both water/methanol tank shutoff valves were closed. The left tank contained approximately 18 gallons of water/methanol; the right tank contained approximately 33 gallons.

The two cabin pressurization system spill valves 7/ were examined and functionally tested. The left spill valve was found in a partially open position. When tested, the valve moved to the open position in 3 seconds. The valve moved from the open position to the closed position in 26 seconds. The reverse cycle took 22 seconds. The prescribed operating tolerances were 19 to 26 seconds.

The right spill valve was found in the open position. When tested, the valve moved from the open position to the closed position in 71 seconds. The reverse cycle also took 71 seconds.

The spill valve throttle switch bypass switch on the pilot's cabin pressurization control panel was found in the normal position with the coverguard down. The master cabin pressurization switch was also in the normal position.

The electrical wiring of the propeller control circuits was checked for continuity and grounding. One wire of the cruise pitch lock circuitry was grounded and another wire was open circuited. These electrical faults were found in a damaged area of the center wing section. After being repaired, the circuits were complete, and normal resistance readings were obtained. There was no evidence that the grounded circuit or the open circuit existed before the accident.

7/ Cabin pressurization is provided by two blowers, one mounted on each engine and driven through the related accessory gear box. Electrically operated spill valves are provided downstream of each blower to permit dumping of the blower output, which reduces each engine load by approximately 32 horsepower. The blower output is dumped automatically when: (1) the aircraft is on the ground, (2) the related engine power lever is advanced beyond the 14,700 r.p.m. position (unless the spill valve throttle switch bypass switch is placed to "Bypass"), (3) the related propeller is feathered, or (4) the master cabin pressurization switch is placed in the "Dump" position.

The electrical circuits for all other components of the propeller electrical systems were found to be continuous and ungrounded. Functional tests were made of the cruise pitch lock withdrawal relay (Part No. R15CC3P1C), the left propeller feathering relay (Cutler-Hammer Part No. 6042H166), and both propeller feathering units. All functioned within their prescribed tolerances.

All of the flight controls were recovered in the main wreckage area. There was no evidence of distress or malfunction. Continuity of the control cables was established, although some of them were fractured in areas of structural damage.

The wing flap jackscrews were measured and found to be in a position corresponding to flaps up. Continuity was established for the wing flap electrical circuits and when the associated electrical components were tested, they functioned within the prescribed tolerances.

The rudder trim was found with the trailing edge 7° left of the rudder chord line. The right aileron trim actuator was in a position corresponding to approximately 1.5°, left wing down. The elevator tab was found 14.5° below the neutral position.

The captain's altimeter was set at 30.02, and the first officer's altimeter was set between 30.03 and 30.04. The cruise pitch stop switches were in the normal position. Both high-pressure fuel valve levers were in the emergency out position. The engine synchronization switch, both ignition switches, the cabin emergency light switch, and both water/methanol switches were in off position. The no smoking and seatbelt sign switches were on. The left engine emergency fuel shutoff handle was extended 1 inch, and the right handle was stowed. The 1-inch extension of the left shutoff handle could not be related to a normal position of the handle.

The cabin emergency light switch on the stewardess panel was guarded and safetied in the Auto position.

The configuration of the passenger compartment of N7818M is depicted in Attachment No. 5.

The aircraft fuselage was tilted about 20° to the left of the upright position. The bottom of the fuselage was demolished, and the passenger compartment floor was fractured longitudinally. The floor structure, to which the seat units were attached, was deformed upward on each side of the longitudinal fracture. The top of the fuselage was compressed downward, and many of the fuselage side panels had separated. The cockpit was deformed longitudinally to the extent that the instrument panels were displaced rearward to the front edges of the pilot seats.

The main entry door was jammed. The aft cargo door was operable and slid freely on its tracks. The forward cargo door, as well as some of the surrounding fuselage structure, had been torn away from the rest of the fuselage.

The captain's seat was attached to its floor track. The seatpan had collapsed downward, and the seat support structure was deformed but essentially intact. The seat back was complete and both seatbelt halves were attached to their respective anchor points.

The first officer's seat was attached to its floor track. The support structure was deformed to the left against the center control pedestal and the left armrest was resting against both high-pressure fuel valve levers. The seatpan was deformed upwards against the instrument panel and control yoke, and the seatback was distorted. Both seatbelt halves were intact and attached to their anchor points.

The stewardess' seat support brace had collapsed and the seatpan had folded downward. The right shoulder support had failed outward and was jammed between the lavatory wall and the entry door operating mechanism. The seatbelt was intact.

All but one of the passenger seats were removed from the aircraft by rescue personnel prior to the arrival of the investigative team. Examination of the seats showed that varying degrees of failure had occurred. In all cases, the front legs exhibited either compressive collapse or complete failure at a point just below the leg-to-chassis attachments, whereas bending and tension failures showed in the rear leg supports. The force components were in a left and downward direction. Additional failures had occurred by fracture of the lip of the front leg-to-track studs in at least five cases and by the pulling out of the front leg of the entire stud and its shank in at least four cases. No failures of the rear leg double stud arrangements were found. In two instances, a section of the floor track remained attached to rear studs.

The frames of all but three seats were intact. The seatbacks were deformed in varying degrees, and four of them were detached from the frame. Several armrests had broken off, and others were bent to the left.

The floor track extrusions in the airplane showed failures in numerous places from excessive side and forward loading.

All seatbelts were found intact and properly attached. In two cases, the seatbelts had been cut by a knife to facilitate removal of the occupant.

1.13 Fire

There was no fire before or after impact. Most of the fuel remained in the right wing tanks and there was no ignition source in the area where fuel was spilled. The free air temperature was 13° F., which would inhibit the vaporization of the spilled fuel and the creation of a combustible mixture. The flash point of this fuel was between 95° and 145° F.

1.14 Survival Aspects

Albany City Fire Department vehicles arrived at the accident scene 7 or 8 minutes after the crash occurred, and the Albany County Volunteer Fire Department arrived at approximately 2120, 32 minutes after the crash occurred. Rescue activities were started immediately and were completed in about 3 hours.

Most of the 44 passengers had been thrown into the forward cargo compartment area. Those passengers who remained conscious reported that there was total darkness in the cabin. The cabin emergency lights did not come on, and, as previously stated, the switch in the cockpit was in the off position. Those passengers were trapped when their legs were pinned underneath their seats or when other passengers piled up on top of them. Serious fractures also contributed to their immobility. Only one passenger was able to escape from the airplane before the fire department arrived. All the others were removed, still strapped to their seats, by rescue personnel -- most of them through the forward cargo door opening. Three passengers were removed from the center wing area and six were recovered from the aft section of the cabin.

The pilots and the stewardess were found at their assigned crew stations.

The stewardess was under a pile of baggage, webbing, and baggage racks from the aft baggage storage area. The pilots were removed from their seats through the right cockpit window. It was necessary to use a pry bar to move the pilot's instrument panel before the captain could be removed.

Of the 14 passenger fatalities, five died of head injuries, six of spinal injuries, two of internal injuries, and one due to shock. Most of these passengers had been seated in the first four rows.

The passenger seats were Aerotherm Model 691-2 seats and were marked as conforming to Technical Standard Order C-39. This seat model had been statically tested to withstand loads of 9.0 G's forward, 7.5 G's downward, 4.5 G's upward, and 3.0 G's sideward. These loads were in excess of the minimum Technical Standard Order requirements.

The pilot seats were manufactured by Aircraft Mechanics, Inc., and marked as conforming with Technical Standard Order C-39. Shoulder harnesses were not installed on the pilot seats, and no Federal requirement existed for their installation. When shoulder harnesses were initially required in air carrier aircraft, the requirement applied only to those aircraft certificated after January 1, 1958. The FH-227B was certificated under rules issued before January 1, 1958.

The stewardess' seat was designed and installed by the aircraft manufacturer. The seat was mounted on the lavatory wall, facing aft toward a baggage storage area. The design load factors were: 9.0 G's forward, 6.5 G's downward, 2.0 G's upward and 1.5 G's sideward.

A calculation of the mean G forces generated in this accident indicated that the following ranges of G loads most likely acted on the occupants during this crash.

Longitudinal	15 to 25 G's
Lateral	5 to 10 G's
Vertical	5 to 15 G's

The Safety Board also calculated that, assuming a 5° noseup attitude, the crash force angle 8/ was approximately 10° upward relative to the longitudinal axis of the aircraft.

1.15 Tests and Research

The propellers were functionally tested and disassembled. Internal impact marks on both propellers were consistent with propeller blade angles of approximately 16°. This is the blade angle corresponding to a propeller on the flight fine pitch stop.

The propeller hubs, pitch locks, and the propeller operating pistons were functionally tested repeatedly and found operable, within the prescribed tolerance and without malfunction. Both propeller control units were tested repeatedly and found to perform within tolerance and without malfunction. The propeller feathering system components were also tested and found operable within tolerance and without malfunction.

Following these tests, the left propeller control unit was disassembled. The cam plate follower roller was found worn into a near-hexagon shape, and the cam plate track was fretted.

8/ Crash Force Angle = resultant G vector angle with the horizontal plus positive aircraft pitch angle.

The unit was further tested to determine what effect the worn roller might have had on the function of the propeller control unit. The tests were performed, using a new roller and a 0.03 undersized roller to simulate the maximum wear on the original roller.

In all tests except one, the propeller control unit operated within the prescribed tolerances, and no malfunctions occurred. In one test, with the cruise pitch lock withdrawal solenoid deactivated, and with the propeller control unit feathering lever being moved very slowly through the emergency-out/open pressure-transition point, oil-pressure fluctuations could be induced. However, these fluctuations did not affect the lock withdrawal or feathering capabilities of the unit. The cruise pitch lock withdrawal solenoid from N7818M was tested and found to be functional. The very slow movement of the feathering lever would not be expected to occur in normal operation.

The right propeller control unit was tested with similar results.

The left propeller control unit was then installed on another FH-227B and flight tested. A series of five flights was flown to determine the effects of a worn cam follower roller on propeller control unit operation and to test the operation of the feathering unit from N7818M. One of the flights was made using a propeller control unit that had been withdrawn from service by the carrier because of reported cruise pitch lock withdrawal problems. Both standard size and 0.03 undersized cam follower rollers were used in these tests. On the last two test flights, the propeller control unit with an undersized roller installed, the feather unit, cruise pitch lock relay, and the feathering-unit thermal overload sensing control from N7818M were installed on the test aircraft.

When the high-pressure fuel valve lever was operated in a normal manner, the cruise pitch locks withdrew normally. Lock withdrawal "hangups" could be induced momentarily by slow manipulation of the lever when the lever was about three-quarters of an inch from the emergency out position. Following these "hangups" when the high-pressure fuel valve lever was properly positioned, the cruise pitch locks withdrew normally on all tests.

Engine shutdowns were made with the propeller blades constrained at a 28° angle, with the propeller constant-speeding, and with and without feathering. No feathering difficulties were encountered with the propeller control unit either operating alone or assisted by the feathering pump.

The test flight engine shutdowns were recorded on the CVR. Spectrographs were made of these recordings and compared with the spectographs of the engine deceleration recorded on the accident tape.

Graphs were constructed on these comparisons, showing engine speed as a function of time and propeller blade angle. Only two of the test engine shutdown graphs were comparable to the graph of the engine deceleration recorded on the accident tape. A composite graph of these three engine decelerations appears herein as Attachment 6.

An energy analysis was prepared to determine the aircraft/powerplant configurations during the landing approach. The performance capability of the aircraft was also considered, and calculations were prepared for several aircraft/powerplant configurations. (See Attachment 7.)

The last 10 minutes of the flight were analyzed, using measurements of the airplane's total energy gradient. 9/ The latter was obtained, first by estimating rate of climb and flightpath acceleration from the flight data recorder, and later through use of the FDR and a somewhat more sophisticated computer routine. Because of analytical constraints, small changes, such as extension of landing flaps to 16.5° or their retraction from that position, could not be detected.

This work indicated that very large negative values of the gradient existed during the latter portion of the descent from 11,000 feet to 1,750 feet. After the aircraft reached 1,750 feet, the rate of descent was reduced substantially. The total gradient increased in a positive direction and stabilized at a relatively low negative value. It was calculated that the thrust-minus-drag values at this point were consistent with two aircraft/powerplant configurations. One configuration could have been a normal two-engine operation with the landing gear and flaps retracted. The second configuration could have been with both engines at 12,000 r.p.m. and with one propeller constrained to a blade angle of 28° and with the landing flaps up and the drag gear down. This total gradient continued to exist until the sounds of a decelerating engine were recorded by the CVR.

At that time, the gradient moved in a negative direction and stabilized. This value is consistent with a configuration of landing flaps up, landing gear up, one propeller windmilling on the flight fine lock at a blade angle of 16°, and the other engine operating at 15,000 r.p.m. Shortly before impact, the gradient moved in a negative direction and then in a positive direction.

A study of the sound spectrograms taken from the recording of the cockpit area microphone showed frequencies which could be associated with certain engine r.p.m.'s (frequency). The recorder was not capable of recording frequencies above approximately 4,125 Hertz, which were equivalent to an engine r.p.m. of approximately 12,100.

9/ Total energy gradient is thrust minus drag divided by the gross weight of the aircraft and expressed as a positive or negative decimal value.

The spectograms showed that from 2040:52 until 2047:20, frequencies associated with two engines were recorded at various times, although there were times when only one frequency was recorded. At these latter times, either the two engines were synchronized or one engine had been advanced to an r.p.m. (frequency) outside the capability of the recorder. At the time the deceleration associated with the shutdown of one engine began, no frequency was detected that could have been associated with the second engine. At time 2048:04.7, two frequencies were again identified and were recorded until 2048:07, the end of the recording.

1.16 Other Information

The Dowty Rotol propeller assemblies that were installed on N7818M are similar to those used on other types of aircraft, including the F-27A and later models, the YS-11, the Convair 600, the Grumman Gulfstream, and the Viscount 810. Cruise pitch lock problems have been experienced on these types of aircraft, but most of the problems have been associated with the F-27A and FH-227 aircraft.

With regard to the FH-227 aircraft, 17 cruise pitch lock problems were reported on the FAA Mechanical Reliability Reports, and 13 others were reported on the FAA Mechanical Interruption Summaries during the period January 1, 1969, to March 30, 1972. Corrective actions varied, but nine of the 30 reports cited cruise pitch lock seals as the cause of the problems.

Two of the malfunctioning cruise pitch lock assemblies were examined and tested by Dowty Rotol in April and May, 1970. The manufacturer reported that subsequent to manufacture, one assembly had received machining alterations to the cruise pitch stop ring chamfers, which eventually caused an intermittent mechanical bind between the stop ring chamfer and spring collet abutment chamfer. The other assembly, in one test, exhibited a high oil leakage rate from the fine pitch oil line to drain. The discrepancy could not be duplicated in additional tests, which indicated that a self-correcting seal malfunction had caused the high oil leakage rate.

In October 1970, Dowty Rotol issued Service Bulletin 61-764 to correct excessive oil leakage rates in the pitch lock assemblies. This Service Bulletin recommended that four small holes be drilled through the pressure face of the seal housing into the seal-retention grooves. This would allow high-pressure oil to enter the grooves and pressurize the seal to reduce leakage rates. This modification had been completed on the pitch lock assemblies installed on N7818M.

No evidence of the existence of the problems identified above were found during the examination of the components of this aircraft.

Mohawk's operational procedures in effect prior to the accident required a daily autofeathering check by the flightcrew which was first to fly the aircraft that day, prior to starting the engines. No entries were required to be made on the flight record to indicate that the check had been made.

Prior to the accident, the Mohawk Operations Manual provided in part that unless turbulence was prevalent, en route descents were to be made at 250 knots. Fuel trim was to be set at full decrease and power set at 11,500 r.p.m., or a minimum of 40 p.s.i. torque oil pressure.

During nonprecision instrument approaches, normal and single engine, the drag brake was to be used only to expedite the descent to the initial approach altitude. At that altitude, the drag brake was to be retracted and, after passing the final approach fix with the flaps at 16.5° and the airspeed at 120 knots, the landing gear was to be extended, the fuel trim set to landing datum, and the landing checklist completed.

After the accident, the carrier issued an Operations Bulletin which, in part, required that the fuel trim be no lower than 50 percent of landing datum during the descent. When the aircraft reached the initial approach altitude, the fuel trim was to be set at landing datum. The bulletin also instructed pilots to attempt to use 100 p.s.i. torque, but in no case less than 60 p.s.i. torque, during the descents and approaches. In addition, the bulletin stated that the power levers should not be retarded to the idle stop, except in an emergency descent.

The carrier's established altitude awareness procedures required, in part, that in a descent, the pilot who was not flying was to call out 1,000 feet above the clearance altitude, at which time the rate of descent was to be reduced to 500 feet per minute, and, during instrument approaches, the pilot who was not flying was to call out 1,000 feet above field elevation, 200 feet above minimums and airspeed, 100 feet above minimums and airspeed, and minimum altitude or runway in sight and airspeed.

The Mohawk emergency checklist for engine failure, fire, or flameout, was a challenge and response checklist. It required that the power be set at full increase on the operable engine, the gear and flaps positioned as required, the engine synchronization switch turned off, the appropriate high-pressure fuel valve lever placed in the feather position, the propeller feathering button depressed, the emergency fuel shutoff handle pulled and the fire extinguisher used, if required.

If the propeller failed to feather normally, the manual provided an alternate method of feathering by attempting to initiate an autofeathering sequence by: (1) pulling the emergency fuel shutoff valve handle, (2) advancing the power lever, and (3) moving the high-pressure fuel valve lever to "Open."

The procedure prescribed for use in the event that a cruise pitch lock did not withdraw in flight at or below airspeeds prescribed for the landing pattern or holding pattern was:

> "Both High Pressure Fuel Valve Levers - Emergency Out Note: This will hydraulically withdraw /the/ cruise pitch locks, enabling /the/ propeller blades to assume a lower blade angle. In some cases of hydraulic or mechanical failure, it is possible that the cruise pitch stop may not withdraw on a single propeller even if emergency out is selected. In such an event, momentarily depressing the appropriate feather button may increase oil pressure sufficiently to actuate the lock withdrawal. If the lock cannot be withdrawn, the affected engine should be shut down and the propeller feathered to avoid the danger of overheating the engine when the airplane reduces speed for landing."

On April 14, 1970, the engine manufacturer proposed that when a cruise pitch lock failed to withdraw, the affected engine should not be shut down until after landing. The proposal was based on a determination made by the engine and propeller manufacturers that the engine could continue to produce useful thrust without damage to the engine while the propeller was restricted to a 28° blade angle, provided the turbine gas temperature was kept within limits. The aircraft manufacturer disagreed with this proposal, stating that the solution to the problem was to correct the cause of the failure of the cruise pitch lock to withdraw. On May 15, 1970, the above-mentioned proposal was issued by the engine manufacturer as a service bulletin. No action was taken by the FAA, Mohawk, or Fairchild Hiller to implement the procedure.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

a. Causal Aspects

The aircraft was certificated, equipped, and maintained in accordance with the existing requirements and regulations. The gross weight and center of gravity were within the prescribed limits at takeoff and during the approach to Albany.

The flightcrew was properly certificated, trained and qualified for the intended flight. Both pilots had adequate rest time before reporting for duty. There was no indication of any medical, psychological, or physiological problem or condition which might have contributed to the disability or incapacitation of either pilot.

There was no evidence of in-flight fire, structural failure, or flight control malfunction or failure; nor was there any evidence that icing, of the aircraft engines or fuel system, was a factor in the accident.

In view of the foregoing, and the information extracted from the CVR, the areas of primary causal concern were those associated with the operational aspects of the approach, including the control and performance of the powerplants. More specifically, the investigation focused on three major areas: (1) the cause of the apparent cruise pitch lock malfunction and the manner in which the crew dealt with that problem; (2) the explanation for the apparent inability of the crew to feather the left propeller; and (3) the reason the aircraft was flown below the various prescribed minimum altitudes throughout the approach after encountering the pitch lock problem.

Before the flights in N7818M on March 3, 1972, there were no recorded discrepancies on either powerplant which would indicate that they were incapable of normal operation. If it is assumed that the automatic feathering circuits were checked by the flightcrew involved in this accident, in accordance with Mohawk procedures, then all associated components functioned satisfactorily at that time, since there is no indication to the contrary.

Examination of the engines disclosed that the left engine was not operating at impact and that the left propeller was rotating at a very low r.p.m. The right engine was operating at a low power setting and rotating at less than 11,000 r.p.m., which is most likely attributable to a power retardation several seconds before impact.

The right propeller-blade angle was determined to have been about 16° at impact, which conforms to the expected angle with an engine r.p.m. of less than 11,000 and with the flight fine pitch lock extended. The left propeller-blade angle also was determined to have been at 16° at impact, thus indicating that at some point before the crash, the blade angle passed through the 28° position where it apparently was hung up for some period during the approach.

Extensive laboratory tests were made of powerplant components related to propeller operation. Both propeller control units were examined and functionally tested, and both were found capable of normal operation. The worn cam follower roller in the left propeller control unit did not affect normal functioning of the propeller control unit. The only malfunction that could be induced occurred when the propeller control unit feathering lever was moved slowly from the run-auto position into the lockout position while the cruise pitch lock withdrawal solenoids were inoperative, which produced intermittent pressure fluctuations in the coarse, fine, and inlet oil lines, accompanied by a flickering cruise pitch lock light.

The left propeller control unit was extensively flight-tested and it performed repeatedly the selected functions, including the emergency-out and feather functions, without fail, delay, or malfunction. The left propeller control unit rigging was extensively damaged. However, all control rods and control rod ends were accounted for, and there was no evidence of a gross misrigging of these controls.

The feathering units from both propellers were examined and functionally tested. Both operated normally. The left feathering unit was flight-tested, with no indications of abnormal performance.

The extensive examination and testing of components associated with propeller operation, as summarized above, indicate that all were capable of normal operation. Consequently, the investigative focus turned toward the operational aspects of the approach to Albany, particularly as reflected by the two recorders.

Shortly after the aircraft commenced the descent from 11,000 feet, a comment, inconclusively interpreted as "Your lights blinkin," was recorded on the CVR. It is unlikely, however, that this comment was related to the cruise pitch lights, since the propeller blade angles at the airspeed and engine r.p.m. then existing would have been at about 35°, or at least 5° above the position where the cruise pitch lights would illuminate.

The flight was cleared for a back course ILS localizer approach, for which the leveloff altitude was 2,100 feet. At 2042:10, the first officer briefed the captain on the altitude restrictions associated with the approach: 2,100 feet to the 7-mile fix and then 1,400 feet to the 4-mile fix. 10/ The captain acknowledged this information.

The leveloff began at approximately 2043:09, as reflected by the increasing r.p.m. detected from a sound-spectrographic examination of the CVR. The aircraft was actually levelled off 12 seconds later at 1,750 feet. At 2043:21, or simultaneous with level off, a popping sound was recorded on the CVR which was similar to the induced electrical signal associated with the operation (starting and stopping) of the feathering pump motor. 11/ These sounds, some 39 in number, continued at irregular intervals until about 2047:18.

There are two possible reasons for the activation of the feathering pump at this point in the flight. The first would have been the actuation of the autofeather system because of low engine-torque pressure. This system is armed when the power lever is advanced above the 13,000 r.p.m. position and is activated when the engine-torque oil

10/ The approach controller had previously advised the flight that he would inform them when they were at the 7-mile and 4-mile fixes.

11/ This sound would not have been audible to the crew.

pressure falls below 50 p.s.i.. 12/ It is possible that these two conditions were sporadically achieved as the aircraft levelled off, thus producing a cyclical activation of the autofeather system. In support of this theory, it is noted that the first of the popping sounds occurred prior to the point in time when the crew apparently recognized the cruise pitch lock malfunction, which recognition would logically have preceded any attempt by the crew to correct the problem by manual activation of the feathering pump. On the other hand, the autofeather theory is somewhat questionable, in view of the fact that there would have been no reason for the power lever to be advanced above the 13,000-r.p.m. position at that stage of the approach.

The second, and more likely, cause of the popping sounds -- particularly with respect to the sounds recorded after the crew had recognized the problem -- was the pilot's intentional activation of the feathering pump motor in an attempt to correct a cruise pitch lock malfunction. Within several seconds of the first popping sounds, one of the pilots said, in words subject to interpretation, "What was it?" The captain then asked, "Pitch light, huh," to which the first officer responded, "Yeah." The ensuing comments by the crew--e.g., "Watch the TGT (turbine gas temperature) on that side" -- indicate that the left propeller blade had failed to pass through the cruise pitch lock at the 28° position. Several indications of such a condition would have been apparent to the crew: decreasing r.p.m. and rising turbine gas temperature as airspeed decreased and a further rise in turbine gas temperature as power was added to equalize r.p.m.'s. The manual procedures designed to correct a failure of the cruise pitch lock to withdraw include movement of the fuel valve levers to the emergency-out position and, if that failed to release the pitch lock, activation of the feathering pump switch in order to remove the lock by increasing the oil pressure. It is apparent that these procedures were followed by the crew during the period of several minutes following their initial detection of the cruise pitch lock problem.

As noted above, the extensive postaccident examinations and testing did not reveal the source of the cruise pitch lock malfunction. This inability to identify the cause of the problem is consistent with previous experience in investigating similar incidents where the cause of many of these types of malfunction could not be determined. Upon consideration of all the evidence, the Board is unable to determine the cause of the initial failure of the cruise pitch lock to withdraw.

As the aircraft continued the gradual descent from 1,750 feet, the CVR reflects that the captain's primary attention was devoted to correcting the pitch lock hangup. To that end, and in accordance with company procedures, he repeatedly activated the feathering pump switch, as reflected by the popping sounds on the CVR which continued until 2047:09. At 2043:31, the captain stated, "Watch the TGT on that side,"

12/ Subsequent to the accident, the carrier issued an Operations Bulletin instructing pilots to use no less than 60 p.s.i. torque during descents and approaches.

which is a recognition of the fact that with the propeller blade constrained at the 28° blade angle, advancement of the left power lever would increase the fuel flow and, in turn, the turbine gas temperature. At 2043:55, the first officer told the captain that they were "a little bit right of course," which the captain acknowledged. At 2044:13.5, the first officer stated, "We're approaching fourteen hundred feet," and immediately thereafter called approach control and was informed that the flight was 11 miles from the field. At this point, the aircraft was levelled off at approximately 1,200 feet. At 2044:36, the captain stated "I don't know whether it can come out but we'll leave it right there," an apparent indication of his intention to leave the power set as it was and accept whatever thrust the left engine would provide.

At approximately 2044:50, the aircraft began to descend again, although at a much lesser rate than the descent from 1,750 to 1,200 feet, which occurred at a rate of roughly 600 feet per minute. At 2045:16, the first officer asked the captain whether he wanted the company notified of the problem, and in accordance with the captain's instructions, transmitted the information to the company agent in Albany.

At 2046:01, the approach controller advised the flight that it was approaching the 7-mile fix. At that time the aircraft was gradually descending through 1,000 feet at an indicated airspeed, as reported to the controller, of 130 knots. 13/

At 2046:38, the captain stated, "Better shut it down," an apparent expression of his decision to shut down the left engine. This decision no doubt was made to comply with the prescribed procedure for shutting down an engine, when the pitch lock cannot be withdrawn, to avoid the danger of overheating the engine when the airplane reduces speed for landing. However, the ensuing events, including the procedures followed, and the steps taken, and by whom, are difficult to assess from the available evidence, which in large part is taken from the CVR.

The procedure for engine shutdown in flight calls for full power on the operable engine, landing gear and flaps as required, engine synchronization switch off, high-pressure fuel valve lever placed in the feather position, the propeller feathering button depressed, the emergency shutoff handle pulled and the fire extinguisher used, if required. There is no verbal indication on the CVR of which of the above items, which should have been covered as part of a challenge and response checklist, were in fact accomplished. Nor is there any direct indication of use of the alternate method of feathering, which involves pulling out the emergency fuel shutoff handle, advancing the power

13/ The speed thus reported coincides with the value reflected on the airspeed trace of the FDR at that point in time.

lever to or above the 13,000-r.p.m. position, and moving the high-pressure fuel valve lever to the open position. These actions, if accomplished, should have induced an autofeather of the left propeller.

Postcrash examination of the various controls involved in feathering a propeller was not conclusive regarding the measures taken by the crew. The emergency fuel shutoff handle was found extended 1 inch; however, the fuel valve was found open, which indicates that if the handle was pulled to close the valve, it was returned to the open position before impact. Both high-pressure fuel valve levers were in the emergency-out position, and both power levers were in the off position. 14/

The CVR affords little additional evidence about what was happening in the cockpit at this time. After the captain announced his decision to shut down the left engine, the series of popping sounds continued (until 2047:18); thus indicating that his efforts to withdraw the pitch lock continued. At 2047:20, or 2 seconds after the last popping sound, the sound of engine spooldown began. It is apparent, however, that although the fuel to the left engine was shut off, the attempts to feather the propeller were unsuccessful, and it was left in a windmilling condition. The deceleration curve recorded by the CVR was not similar to the test deceleration curves for feathering deceleration, but rather indicated that the engine rotating speed decreased to a value of approximately 6,500 r.p.m. Moreover, the left propeller was determined to have been rotating at a very low r.p.m. at impact.

The problems resulting from a windmilling propeller, and the associated high degree of drag, were immediately manifested to the crew. The rate of descent of the aircraft increased, and (at 2047:36) the captain asked for assistance on the rudder pedal. At 2047:38, the captain made a comment that reflected his difficulty in attempting to feather the propeller, which comment could be further interpreted as a request for the first officer's assistance. At 2047:51, the captain instructed the first officer to "tell 'em we're gonna land short, we're in trouble," which was relayed to the controller seconds later. At 2048:07, the aircraft crashed. 15/

14/ Any significance attached to the position of these various controls must be viewed in light of the possibility that they could have been moved by impact forces or during the extraction of bodies from the cockpit.

15/ During the period between engine shutdown and impact, there were a number of clicks, in pairs, recorded on the CVR. However, none of these could be identified with a particular control or switch, and any analysis thereof would primarily involve speculation.

At some time during the attempts to feather the left propeller, the cruise pitch lock withdrew, which allowed the blade angle to decrease to the 16° position, where it was constrained by the flight fine pitch lock. Withdrawal probably was the inadvertent result of the manner in which the power and high-pressure fuel valve levers were manipulated during the crew's attempt to feather the left propeller. Again, however, a determination of the precise sequence of events which caused the withdrawal is not possible from the available evidence.

Performance data indicates that with the left propeller windmilling at a 16° blade angle, level flight was not possible at 125 knots, even with gear and flaps retracted and full power, including water/methanol injection and 100 percent fuel trim, on the other engine. In addition, with the asymmetric thrust condition further aggravated by the windmilling left propeller, control of the aircraft would have been difficult. In this instance, it appears that the right engine -- up until seconds before impact, when the power lever was retarded -- was operating at 15,000 r.p.m. 16/ and the gear and flaps were retracted. The fuel trim setting remained at zero, and the airspeed was approximately 120 knots. In view of the foregoing and the low altitude at which the spooldown occurred (700 feet or 450 feet above ground level), it appears that the accident became inevitable when the left engine was shut down but the propeller failed to feather.

A considerable investigative effort was expended to determine the possible reasons underlying the failure of the left propeller to feather. As noted above, all operating components of the feathering system, including the propeller control unit with the worn cam follower roller, were thoroughly tested, and all performed their prescribed functions. It is possible that a misrigging of the propeller control unit system or high-pressure fuel valve lever, not detectable from the postcrash examination or testing of these components because of their condition, could have accounted for the unsuccessful attempts to feather the left engine. It is further possible that a single discrepancy, perhaps of a transient nature, was responsible both for the failure to feather and for the cruise pitch lock hangup, inasmuch as there are components which are common both to the feathering and the pitch lock withdrawal systems. However, any such discrepancy remains only a possibility, unsupported by any positive evidence.

It is also possible that either the captain or the first officer failed to place the high-pressure fuel valve lever to the feather position but rather placed that lever in the closed position, which could account for the fact that the engine shut down but did not feather.

16/ The position was determined by means of an energy gradient analysis and the fact that the right spill-valve was found in the open position.

In this connection, we note that, to enter the feather position, the high-pressure fuel valve lever must be moved past a detent. It is possible that, in the tense atmosphere existing in a deteriorating situation, the pilots either failed to move this lever past the detent or inadvertently placed it in the closed position.

On the other hand, it is difficult to accept the possibility that two qualified pilots, in attempting to feather a propeller during a period of more than a minute after the decision had been made, could both have committed such a fundamental error as to place the high-pressure fuel valve lever in the wrong position and allow that error to go unrecognized. In the absence of any evidence other than the fact that nothing untoward was detected during the examination and testing of the feathering system components, the Board cannot conclude that pilot misplacement of the high-pressure fuel valve lever was the probable cause of the failure of the propeller to feather. Rather, we conclude that the probable cause thereof cannot be determined.

It is apparent that the descent of the aircraft, subsequent to the first signs of the cruise pitch lock problem, did not conform to the altitude restrictions set forth in the approach procedure. For example, the aircraft levelled off initially at 1,750 feet, or 350 below the minimum clearance altitude. Furthermore, the FDR indicates that the aircraft passed over the 7-mile fix at an altitude of approximately 900 feet, which is 1,200 feet below the prescribed minimum altitude for that point in the approach. The Board therefore carefully considered the possible reasons for the nonconformity to the approach altitude restrictions.

There is no evidence of an altimeter error of sufficient magnitude to account for the deviation from the prescribed altitudes. The barometric settings of the two altimeters were within several hundreds of an inch of the figure given to the flight by the approach controller. Correlation of the FDR and the CVR showed that the altitude trace was indicating about 1,300 feet at the time the first officer said "We're approaching 1,400 feet." It therefore appears that the FDR altitude trace is about 100 to 150 feet too low, but nevertheless quite close to the recorder tolerance of minus 100 feet at sea level.

The Board also considered the possibility that limitations imposed by the performance capabilities of the aircraft permitted nothing else than a descent. An analysis of performance data shows that, with both engines running at about 12,000 r.p.m., 17/ and with the left propeller blades constrained at an angle of 28°, thrust was available, on demand, that would have sustained a climb gradient, even with the drag brake extended and zero fuel trim. It is therefore apparent that,

17/ This figure was derived from the spectrographic analysis of engine sounds recorded by the CVR.

prior to engine shutdown, the descent of the aircraft could have been arrested, level flight maintained, or a climb commenced at any time the captain chose to use the excess thrust available.

It is also obvious that if the gear or drag brake were retracted, and/or the fuel trim were set at 100 percent, the performance capabilities would have been even further enhanced. The fuel trim apparently was not moved above the zero position because such a change is normally not accomplished until after the landing gear is extended during the Before Landing Checklist, and the crew on this flight never reached a point where that portion of the checklist was called for. 18/ The drag brake was clearly down during that portion of the approach preceding the leveloff at 1,750 feet, based on the combination of decreasing airspeed and steady rate of descent. The position of the drag brake thereafter is less clear, although, based on the energy gradient analysis, it appears likely that it was extended during most or all of the period until the left engine was shut down. In any event, the Board concludes that the manner in which fuel trim and the drag brake were handled, although not the best practice under the circumstances, was not a causal factor because: (a) before engine shutdown, adequate thrust was available to climb, even with fuel trim set at zero and drag brake down, and (b) after engine shutdown and the concomitant failure of the left propeller to feather, placement of the fuel trim to 100 percent and retraction of the drag brake, the latter of which was actually accomplished, would not have avoided the crash.

After discounting the above discussed possibilities, and weighing all of the pertinent evidence, the Board is convinced that the continued descent below the approach minimum altitudes was directly related to the crew's preoccupation with the cruise pitch lock malfunction and the associated lack of coordination and effective task sharing in dealing with that problem. Another factor was the crew's lack of adherence to prescribed procedures, particularly those concerning altitude awareness. The initial overshoot of the minimum altitude of 2,100 feet was probably due to the captain's distraction with the initial signs of a cruise pitch lock problem at a time when the first officer was tuning in the Albany ILS frequency. As the aircraft continued the gradual descent from 1,750 feet, it is apparent that the captain's attention was primarily devoted to correcting the cruise pitch lock malfunction, rather than to flying the aircraft. The verbal comments and sounds recorded on the CVR indicate the substantial extent to which both pilots were preoccupied with troubleshooting this problem.

This situation was aggravated by the fact that the captain apparently chose both to fly the aircraft and to attempt to withdraw the pitch lock, rather than to assign one or the other of these tasks to

18/ Company procedures placed in effect after the accident require that the fuel trim be maintained at no lower than 50 percent of the landing datum during the descent.

the first officer. Furthermore, the first officer, perhaps because of his preoccupation with the captain's activities, failed to perform his duty, which was of critical importance in this approach, of calling out the required altitudes and thus assuring that the captain was fully aware of the aircraft's vertical position in the approach. The first officer made only one altitude callout during the approach; namely, that the flight was approaching 1,400 feet. 19/ The captain did not acknowledge this callout, although it might have registered with him since he levelled the aircraft off at 1,200 feet shortly thereafter. However, the first officer did not make the required calls of 1,000 feet above field elevation, 200 feet above minimums, 100 feet above minimums, and the minimum altitude.

The first officer, like the captain, might also have lost track of the altitude after his callout of 1,400 feet. Assuming, on the other hand, that the first officer continued to be aware of the altitude, it is possible that having briefed the captain on the prescribed altitudes at the 7-mile and 4-mile fixes, he felt that no further comment was necessary. Perhaps because of the traditional relationship of a first officer to a captain, it is also possible that the former was somewhat reluctant to bring repeatedly to the latter's attention altitude information when the captain was busily engaged. In any event, it appears that the captain, by trying to perform too many functions, lost track of the altitude of the aircraft, which became critical when the backup altitude awareness normally afforded by the first officer was not provided.

The precise manner in which the captain lost track of altitude, due to preoccupation with the pitch lock problem, is open to question. It is possible that he misread his altimeter by 1,000 feet, a mistake which is not unheard of with respect to the type of instrument involved. This theory is somewhat supported by the fact that when the captain chose to shut down the left engine, the aircraft was at about 800 feet, or 550 feet above ground level. If the captain was in fact aware of his actual altitude at that time, it appears more likely that he would have left the left engine running, since it would still have been producing considerable thrust. On the other hand, he might not have been aware of his actual altitude or, if he were, he might have felt compelled to follow company procedure, which calls for shutting down the engine to prevent it from overheating on landing.

It is also possible that the captain transposed the minimum altitude applicable to the 4-mile fix (1,400 feet) to the 7-mile fix, and further transposed the MDA of 680 feet to the 4-mile fix. However, there is no evidence to support this theory, which is further negated by the fact that the aircraft was well below even the transposed minimum altitudes.

19/ At that point, the plane was already 700 feet beneath the minimum clearance altitude.

In view of the above, the Board concludes that the noncomformity to the approach altitude restrictions resulted from a lack of altitude awareness, which in turn was caused by the crew's preoccupation with the cruise pitch lock malfunction. This type of accident--i.e., in which a relatively minor malfunction or distraction diverts the flightcrew from their primary task of flying the aircraft--is not uncommon in aviation. The potential for this kind of accident can be reduced if all flightcrews recognize the hazards of allowing minor problems to distract them from their primary tasks. The first order of business must be, in all cases, to fly the aircraft. Standard operating procedures and training policies should emphasize the need, when handling emergencies or abnormal situations in flight, to assign one person to the primary task of flying the aircraft. The rest of the crew should then attempt to solve the problem in such a manner as to minimize any distractions that would divert the assigned pilot's attention from the task of flying. Such a division of duties, and the attendant assurance that the prescribed altitudes and airspeeds will be maintained as the troubleshooting procedures progress, is of particular importance when, as in the instant case, the problem occurs during the approach phase of the flight and a substantial cushion of altitude is unavailable.

b. Survival Aspects

The Board considers this accident partially survivable. The forces acting on the occupants did not exceed the tolerable limits of the human body to short-term deceleration. Part of the fuselage collapsed. In addition, the seat anchorages and seat structures failed. However, portions of the fuselage did remain intact and left some living space in the forward and aft ends. The forces which were generated exceeded the design limits of the seat structure in this aircraft. Finally, even though a large amount of fuel was spilled, no fire occurred -- probably because of the low ambient temperature, the fuel vaporization characteristics, and the lack of ignition sources in the areas where fuel was spilled.

The first officer would probably not have been fatally injured had he been restrained by a shoulder harness in addition to his seatbelt. It is also possible that had the captain been restrained by a shoulder harness, in addition to his seatbelt, his injuries would have been less severe, and he might have survived.

This accident offers another example of the need for the installation and use of shoulder harnesses by cockpit crewmembers. Even though the crash forces were generally in excess of the design standards of the existing restraint system, they were within the limits of human tolerance. This is not an unusual condition, since crash dynamics produce localized decelerations and deformed structure in relatively unpredictable patterns. The Board has previously supported the installation and use of shoulder harnesses and continues to do so. (See Attachment 9.)

Section 121.321 of the Federal Aviation Regulations requires the installation and use of shoulder harnesses for air carrier aircraft certificated after January 1, 1958. In this case, the aircraft was manufactured under a type certificate issued prior to 1958, but the date of manufacture was 1967. The Board believes that the regulation was deficient in that it did not require the installation of shoulder harnesses in aircraft of recent manufacture, regardless of the date of certification. This is inconsistent with the intent of the existing regulation, particularly if the aircraft involved has a normal potential service life.

The Board believes that whenever a new or modified version of an existing aircraft is contemplated, the existing safety regulations should be reviewed and applied as appropriate.

The stewardess received injuries caused by the collapse of her seat and by striking her head on the door-actuating mechanism. The loads imposed on the seat exceeded the design limits. However, her head injuries were caused by the fact that the seat installation was too close to the door mechanism.

The occupants of the aircraft, with one exception, were unable to escape from the wreckage because of the lack of light, their injuries, the collapse of the fuselage, and their location in the wreckage. One passenger escaped before the arrival of the rescue units, but he did not recall how he got out of the aircraft. The rescue effort was well executed by all the personnel involved.

The Mohawk procedures required that the cabin emergency light switch be armed during the completion of the origination checklist and disarmed as part of the termination checklist. There was no mention of this switch on the prelanding or pretakeoff checklists. It is possible that the crew turned this switch off during an intermediate stop and did not turn it on at the beginning of the next segment of the flight. The lights were properly mounted, and the batteries were charged.

2.2 Conclusions

a. Findings

1. The aircraft was certificated, equipped, and maintained in accordance with the regulations.

2. The weight and balance were within limits at the time of the accident.

3. The flightcrew was certificated, trained, and qualified for the intended flight in accordance with the regulations.

4. There was no evidence of physical incapacitation of either pilot prior to the accident.

5. There was no evidence of structural failure, fire, or flight control malfunction or failure.

6. Both propellers were at a blade angle of approximately 16° at the time of impact.

7. The left engine was not operating at the time of impact.

8. The right engine was operating at a low power condition at impact.

9. Both altimeters were operating within prescribed tolerances and had been set within 0.03 inches of the current altimeter setting.

10. The cruise pitch lock of the left propeller initially failed to withdraw and allow the propeller blade angle to decrease below 28°. The cause of this failure could not be determined.

11. The captain repeatedly attempted to withdraw the cruise pitch lock, using the procedures prescribed in the operations manual, but such attempts were unsuccessful.

12. The crew's attempts to feather the left propeller were also unsuccessful, which left that engine in a shutdown condition with the propeller windmilling.

13. The cruise pitch lock withdrew during or after the engine shutdown.

14. During postaccident tests, the propeller control unit and the feathering system functioned normally.

15. The Board could not determine why the left propeller could not be feathered.

16. Before the left engine was shut down, a positive climb gradient was always within the performance capability of the aircraft, even with the drag brake extended and zero fuel trim.

17. After the failure of the left propeller to feather, level flight was not possible even with full power (100 percent fuel trim) from the right engine and the drag brake retracted.

18. Subsequent to the time the pilots encountered the cruise pitch lock problem the descent profile of the aircraft was well below the prescribed minimum altitudes for the approach.

19. The nonconformity to the approach altitude restrictions resulted from a lack of altitude awareness, which in turn was caused by the crew's preoccupation with the cruise pitch lock malfunction.

20. The captain attempted both to troubleshoot the pitch lock problem and to fly the aircraft, to the detriment of the latter function.

21. The first officer failed to adhere to prescribed procedures regarding altitude callouts.

22. The accident was partially survivable.

23. The design and location of the stewardess' seat did not afford adequate crashworthiness protection.

24. The first officer, and perhaps the captain, would probably have survived had shoulder harnesses been available and used.

b. Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the inability of the crew to feather the left propeller, in combination with the descent of the aircraft below the prescribed minimum altitudes for the approach. The Board is unable to determine why the left propeller could not be feathered. Contributing causal factors for the nonstandard approach were the captain's preoccupation with a cruise pitch lock malfunction, the first officer's failure to adhere to company altitude awareness procedures, and the captain's failure to delegate any meaningful responsibilities to the copilot which resulted in a lack of effective task sharing during the emergency. Also, the Board was unable to determine why the propeller pitch lock malfunctioned during the descent.

3. RECOMMENDATIONS AND CORRECTIVE ACTION

On March 10, 1972, the Federal Aviation Administration issued an Airworthiness Directive prohibiting the further use of the aft-facing lavatory wall mounted, stewardess crew seat in all F-27 and FH-227 aircraft. This prohibition was to continue in effect until the seat was modified to comply with the provisions of CAR 4b.358. In addition, the FAA initiated a study of stewardess' seats in other air carrier aircraft to ensure that similar hazards did not exist in those installations.

As a result of the investigation of this accident, the Safety Board on July 7, 1972, issued three recommendations (Nos. A-72-99 through 101) directed to the Administrator of the Federal Aviation Administration. Copies of the recommendation letter and the Administrator's response thereto are included in Attachment 8.

In addition, the Board has made a recommendation to the FAA with respect to the installation and use of shoulder harnesses in air carrier operations. (See Attachment 9.)

The Board believes that the cabin emergency lights did not operate because the arming switch in the cockpit was off. Since emergency lighting is desirable in the case of a survivable crash as well as in other emergency conditions, the Board believes that the system should be armed before each takeoff and landing.

Therefore the Safety Board recommends that:

(1) The Federal Aviation Administration take action to ensure that the arming of the emergency cabin lighting be included in checklists used before each takeoff and landing. (Recommendation No. A-73-14)

The evidence in this case indicates that the captain assumed all of the activities associated with flying the aircraft and coping with the malfunction of the left propeller. While his concern with the propeller received most of his attention, the maintenance of the proper altitude and airspeed control received a lesser amount of attention. The Board believes that the tasks of flying the approach and coping with the propeller malfunction should have been divided between the pilots, and each should have concentrated on his particular aspect of the flight. There was no information in the operations manual that the captain could have used to guide him in assigning tasks in a manner that would have made his work easier and more likely to succeed. Therefore, the Board recommends that:

(2) The Federal Aviation Administration bring this accident to the attention of appropriate FAA and air carrier personnel. Established pilot training programs and operations manuals should be revised to include guidance on time and task sharing in abnormal and emergency situations. Emphasis should be placed on the need of preplanning task and time sharing by the crew before an unusual or emergency situation arises. (Recommendation No. A-73-15)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

April 11, 1973

INVESTIGATION AND HEARING

1. Investigation

The Safety Board received notification of the accident at about 2120 eastern standard time on March 3, 1972. An investigation team was immediately dispatched to the scene. Investigative groups were established for Operations, Air Traffic Control, Witnesses, Weather, Human Factors, Structures, Maintenance Records, Powerplants, Systems, Flight Data Recorder, and Cockpit Voice Recorder.

On March 7, 1972, a Performance Analysis group was formed at the Board's Washington Office. This group conducted an analysis of N7818M's performance during the descent from cruise altitude and the final approach phase of flight.

Participants in the field investigation included representatives of: The Federal Aviation Administration, Mohawk Airlines, Inc., Fairchild Hiller Corporation, Rolls-Royce, Ltd., Dowty Rotol, Ltd., Air Line Pilots Association, Professional Air Traffic Controllers Organization, Dallas Airmotive, Inc., and the International Association of Machinists and Aerospace Workers.

2. Public Hearing & Depositions

A public hearing was held in Albany, New York, on April 25, 26, and 27, 1972. Parties represented at the hearing were: The Federal Aviation Administration, Air Line Pilots Association, Dowty Rotol, Ltd., Mohawk Airlines, Inc., Fairchild Industries, Inc., and Airwork Service Division.

The deposition of the Chief, Airframe Branch, Engineering and Manufacturing Division of the Federal Aviation Administration, was taken in Washington, D. C., on May 19, 1972. All parties represented at the public hearing, with the exception of Airwork Service Division, were represented at the depositional proceeding.

3. Preliminary Reports

A preliminary report of the investigation was released by the Safety Board April 14, 1972.

FLIGHTCREW INFORMATION

Captain Robert McAdam

Captain McAdam was 44 years of age. He was employed by Mohawk Airlines, Inc., in August 1961. He held Airline Transport Pilot Certificate No. 1231844 with type ratings in Convair 240/340/440, Fairchild F-27, and Fairchild Hiller FH-227 aircraft. He had commercial pilot privileges with airplane multiengine land and single-engine land ratings. His FAA first-class medical certificate was last issued, without limitations, on October 14, 1971.

Captain McAdam was initially upgraded to captain status on May 13, 1965, and he qualified as an F-27 captain on February 1, 1967. Captain McAdam satisfactorily completed his last proficiency check on the FH-227 on January 31, 1972. He last completed recurrent ground training in the FH-227 on April 10, 1971. He satisfactorily completed his last line check on May 27, 1971.

During his flying career, Captain McAdam had accumulated a total of 12,248 hours of flying time, of which 2,202 hours were flown in F-27 and FH-227 type aircraft. In the 90-day period preceding the date of the accident, Captain McAdam flew 199 hours in the FH-227; in the preceding 30-day period he flew 65 hours in the FH-227.

First Officer William E. Matthews

First Officer Matthews was 38 years of age. He was employed by Mohawk Airlines, Inc., in July 1968. First Officer Matthews held Commercial Pilot Certificate No. 1085543 with airplane multiengine land and instrument ratings, along with a type rating in Lockheed 300 aircraft. His first-class medical certificate was last issued, without limitation, on October 25, 1971.

During his flying career, First Officer Matthews accumulated a total of 9,969 hours of which 2,723 hours were flown in FH-227 aircraft. First Officer Matthews successfully completed his last proficiency check on April 27, 1971. His last recurrent ground training was completed on August 18, 1971. In the 90 days preceding the accident, First Officer Matthews flew 125 hours in the FH-227. In the preceding 30-day period he flew 63 hours in the FH-227.

Stewardess Sandra I. Segar

Mrs. Segar is 24 years of age. She was employed by Mohawk Airlines, Inc., in January 1969. Mrs. Segar completed her initial training on January 23, 1969, and was qualified on CV-440, FH-227, and BAC-111 aircraft.

Mrs. Segar's last recurrent training was satisfactorily completed on December 15, 1971. She received 8 hours of ground school and a score of 97.5 percent on her written examination. She is qualified in both the FH-227 and BAC-111 aircraft.

AIRCRAFT INFORMATION

1. Aircraft Data

The aircraft, an FH-227B, was manufactured by the Fairchild Hiller Corporation on April 25, 1967. The U. S. registration number was N7818M. The aircraft had a total time in service of 10,068:24 hours, and 15,714 landings had been recorded.

N7818M had a certificated maximum takeoff weight of 45,500 pounds and a maximum landing weight of 45,000 pounds. It had a maximum capacity of 44 passengers in the Mohawk Airlines configuration.

The calculated takeoff weight for N7818M was 45,233 pounds. The center of gravity (c.g.) was at 25.6 percent of the mean aerodynamic chord (MAC). Takeoff c.g. limits were from 20 to 35 percent MAC.

The estimated crash weight of the aircraft was 43,343 pounds, with a c.g. at 25.6 percent MAC. The c.g. limits were from 19 to 25 percent MAC at that weight.

2. Engine and Propeller Data

N7818M was powered by two Rolls-Royce Dart 532-7 jet turbine engines, each equipped with a Dowty Rotol R-257/4-30-4/60 propeller. The engines were each rated at 1,990 shaft horsepower with water/methanol injection, and 1,910 maximum to 1,835 minimum shaft horsepower without injection. Engine and propeller specifics are as follows:

Engines

Position	Serial No.	Time Since Overhaul (TSO)
No. 1	14057	1,989:26
No. 2	13994	3,339:20

Propellers

Position	Serial No.	TSO	Total Time
No. 1	DRG 163/66	2,533:03	6,097:40
No. 2	DRG 451/66	3,494:31	9,[illegible]24:57

Propeller Pitch Locks

Position	Serial No.	TSO
No. 1	163/66	2,259:58
No. 2	409/66	3,988:30

The left propeller control unit, serial No. 1314/66 had accumulated 2,491 hours since the last overhaul on September 17, 1970. On October 24, 1970, after 210:17 hours of operation, the unit was returned to the overhaul facility for repair. The fuel valve lever was reported to be binding when the unit was hot. The repair was completed and the unit was returned to service on the left engine on July 2, 1971. No writeups were recorded regarding this unit after that date.

FH-227B Powerplant Information

In the FH-227B installation, each engine is equipped with a constant speed, hydraulically operated, featherable, four-bladed propeller. Control of the powerplant is accomplished manually by a system of cables and push-pull rods between the cockpit engine control quadrant and the engine nacelles. The electrical circuits related to engine and propeller operation are controlled by manually operated switches, cam-operated microswitches, and propeller hub switches.

Four power levers (two for each pilot), two high-pressure fuel valve levers, and two fuel trimmer switches are mounted on the control quadrant. Fuel flow to the engines is controlled by the power levers. They are mechanically linked to the water/methanol control units and initiate electrical functions by activation of microswitches to control the cabin pressurization system spill valves, the landing gear warning horn, and the automatic feathering circuit.

The high-pressure fuel valve levers are mechanically linked to the fuel flow control unit and the propeller control unit on each engine.

When the fuel valve levers are in the closed position, fuel flow is shut off. With the fuel valve lever in the open position, fuel flow to the engine is regulated by the power lever. When the fuel valve lever is moved forward from the open position to the emergency out position, oil pressure in the propeller control unit is rerouted to withdraw the cruise pitch lock and allow the propeller to achieve blade angles of less than 28°. Movement of the fuel valve lever aft of the closed position initiates a feathering function by rerouting propeller control unit oil pressure. Feathering is completed by use of a feathering button which activates an electrically driven feathering pump.

In addition to these mechanical functions, the high-pressure fuel valve lever activates several microswitches one of which arms the automatic feathering circuit when the lever is in the open or emergency-out position.

The fuel trimmer system is used to increase or decrease fuel flow, to compensate for atmospheric conditions, without affecting engine speed. Minimum fuel flow is obtained by setting the trimmer switch to zero percent and maximum flow is obtained at the 100-percent setting.

Oil for engine lubrication and propeller operation is supplied from a common supply tank in each engine. A standpipe in the tank contains a reserve oil supply of approximately 1 gallon for the propeller feathering. Oil pressure warning lights (one for each engine) are located on the pilots' instrument panel. Illumination of the light indicates that the engine oil pressure is below six pounds per square inch (p.s.i.) or that the oil pressure in the related accessory drive gear box is below 38 p.s.i. With the power lever above the 13,000 e.r.p.m. position, a loss of oil pressure will initiate an increase in propeller blade angle.

Constant speed operation of the engine is achieved automatically by hydraulic adjustment of the propeller blade angle in response to variations in airspeed and engine power. Engine oil is pressurized and metered by the propeller control unit to the operating piston to move the latter and change the propeller blade angle.

The propeller control unit maintains a constant engine speed by routing propeller oil pressure to the operating piston in response to the action of a spring-loaded piston valve. During a constant-speed condition, the piston valve is held in a neutral or closed position by the balancing forces of the spring, which tend to force the valve downward, and a set of rotating flyweights, which tend to force the valve upward. When the forces are balanced in this manner, oil is trapped on both sides of the operating piston, which holds the propeller blades in position. If engine r.p.m. tends to decrease, the flyweights exert correspondingly less centrifugal force and the spring forces the piston valve downward, which admits oil to the fine pitch side of the operating piston while simultaneously relieving oil from the coarse pitch side. The resulting movement of the operating piston rotates the propeller blades to a lesser angle, which lightens the propeller load and increases the engine speed. The increased engine speed increases the centrifugal force exerted by the flyweights and moves the piston valve upwards until a balanced position is again achieved.

If the engine tends to overspeed, the piston valve is moved upward, admitting oil pressure to the high-pitch side of the operating piston until the blade angle is increased sufficiently to impose a higher load on the engine, which decreases engine speed to the point where spring pressure will again neutralize the piston valve. Operation of the power lever changes the spring compression which changes the blade angle (and engine speed) until the force generated by the flyweights again balance the spring force.

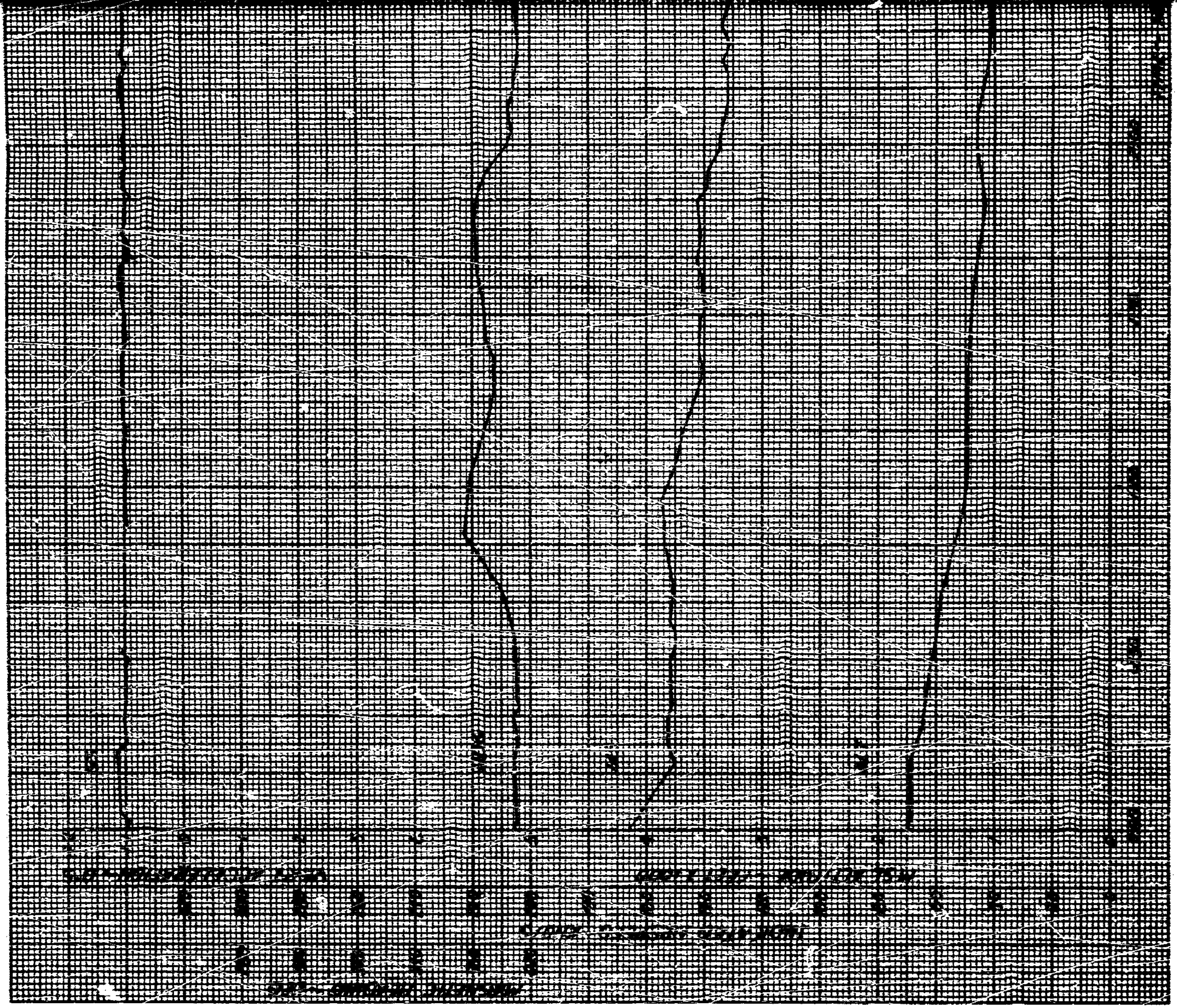
A cruise pitch stop and a flight fine pitch stop are incorporated in the operating cylinder to prevent unwanted low propeller blade angles and overspeeding during flight. When both propellers are operating in the cruising range, the cruise pitch locks are engaged to prevent a reduction in propeller blade angle below 28° until the blade angle of the other propeller is reduced to a propeller hub switch setting of 30° or is moved to within 4° of the feathered position. The cruise pitch locks are normally withdrawn automatically by the actuation of both propeller hub switches. When actuated, relays are energized to complete electrical circuits to the cruise pitch lock withdrawal solenoids. Actuation of the solenoids routes propeller oil to the cruise pitch lock withdrawal cylinders for lock withdrawal. Two amber lights (one for each propeller) are provided on the engine instrument panel. Illumination of a light indicates that the related cruise pitch lock withdrawal solenoid valve has opened and the fine pitch relief valve has pressurized.

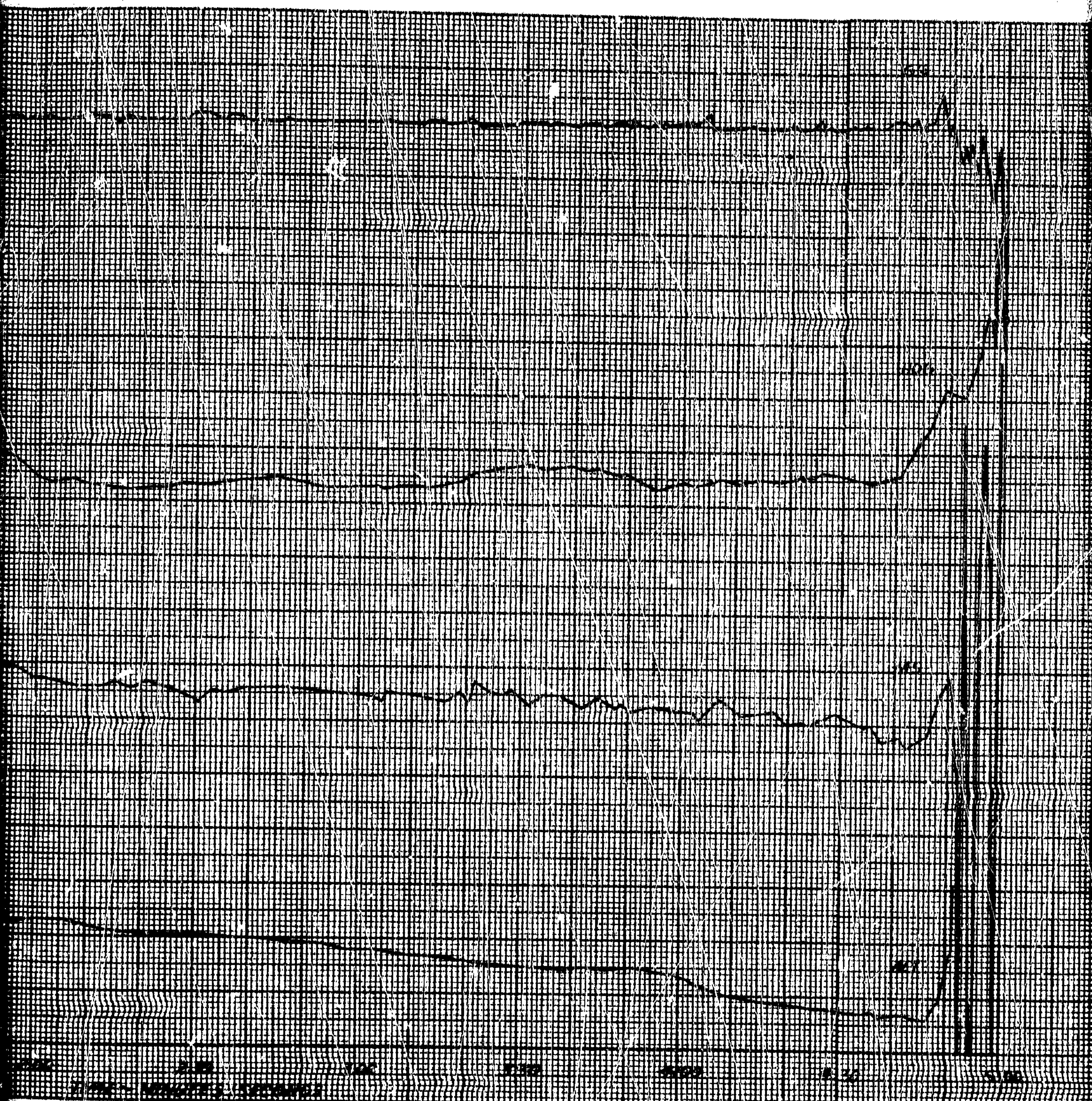
When the fuel valve lever is moved to the Emergency Out position, the cam operated isolation valve in the propeller control unit is positioned to route oil around the solenoids to the fine pitch relief valve and the local withdrawal cylinders and causes the cruise pitch light to illuminate when the fine pitch relief valve is pressurized.

Propeller feathering can be accomplished either automatically or manually. Features common to both methods are: (1) the piston valve in the propeller controller unit is raised to admit oil pressure to the coarse pitch side of the operating piston, (2) the related pressurization spill valve is opened, (3) the related water/methanol valve is closed, and (4) the automatic-feathering feature of the other propeller is disarmed.

Manual feathering is accomplished by placing the h.p., fuel valve lever to the feather position and depressing the feather-pump button. These actions produce the following events: (1) direct propeller oil to the coarse pitch side of the operating piston, (2) shut off the fuel to the engine, and (3) start the feathering pump. The latter event supplies the required feathering pressure when the propeller control unit pump pressure decreases as the engine stops.

Automatic feathering occurs whenever a power lever is advanced above the 13,000 r.p.m. position and the engine torque oil pressure is below 50 p.s.i., provided that the other propeller is not already feathered. These conditions cause the pitch coarsening solenoids to energize, which routes propeller oil to move the propeller control unit servo valve upwards. This movement in turn lifts the piston valve and admits high-pressure oil to the coarse pitch side of the operating piston, moving the latter to the feathered position.





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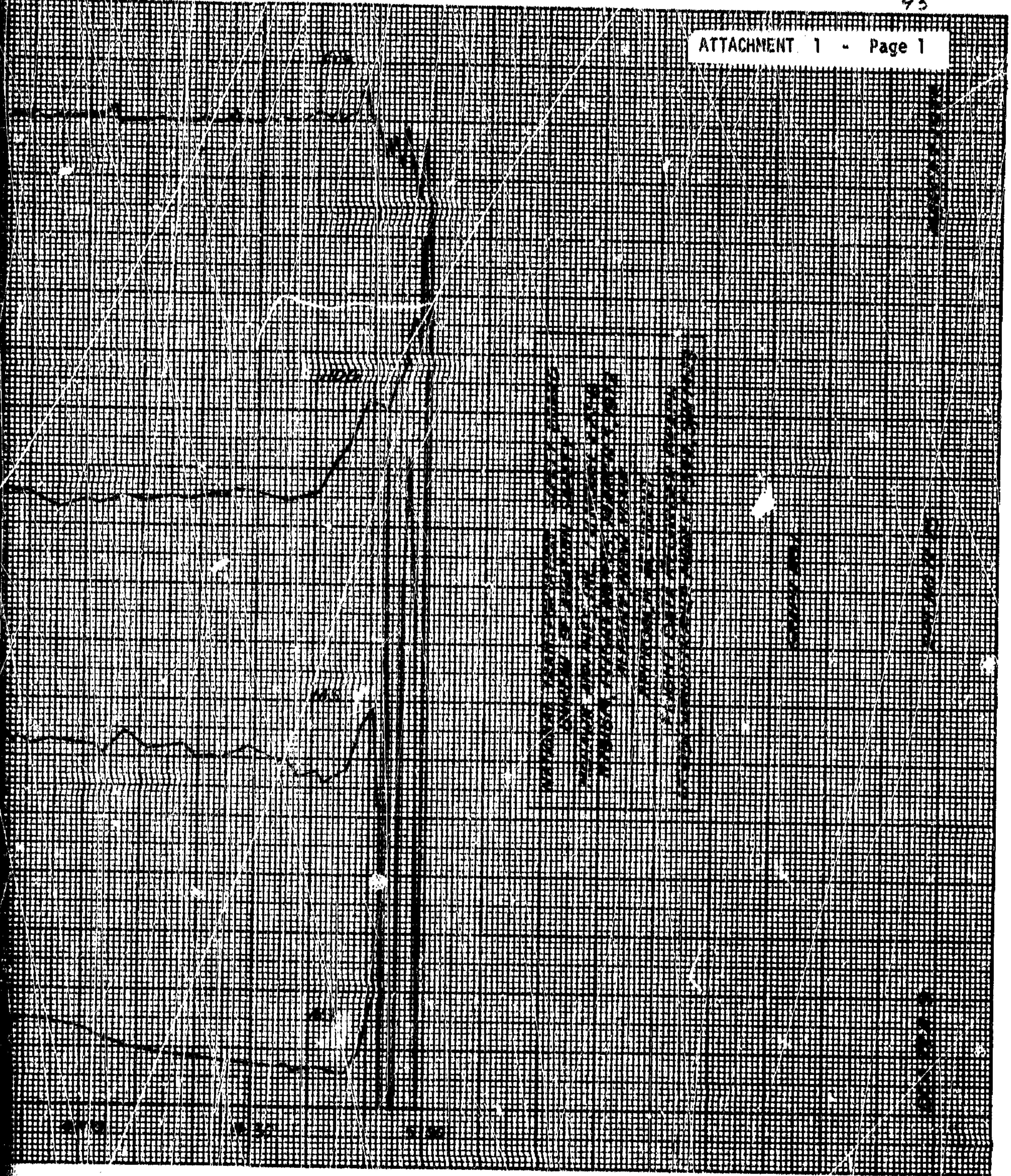
ATTACHMENT 1 - Page 1



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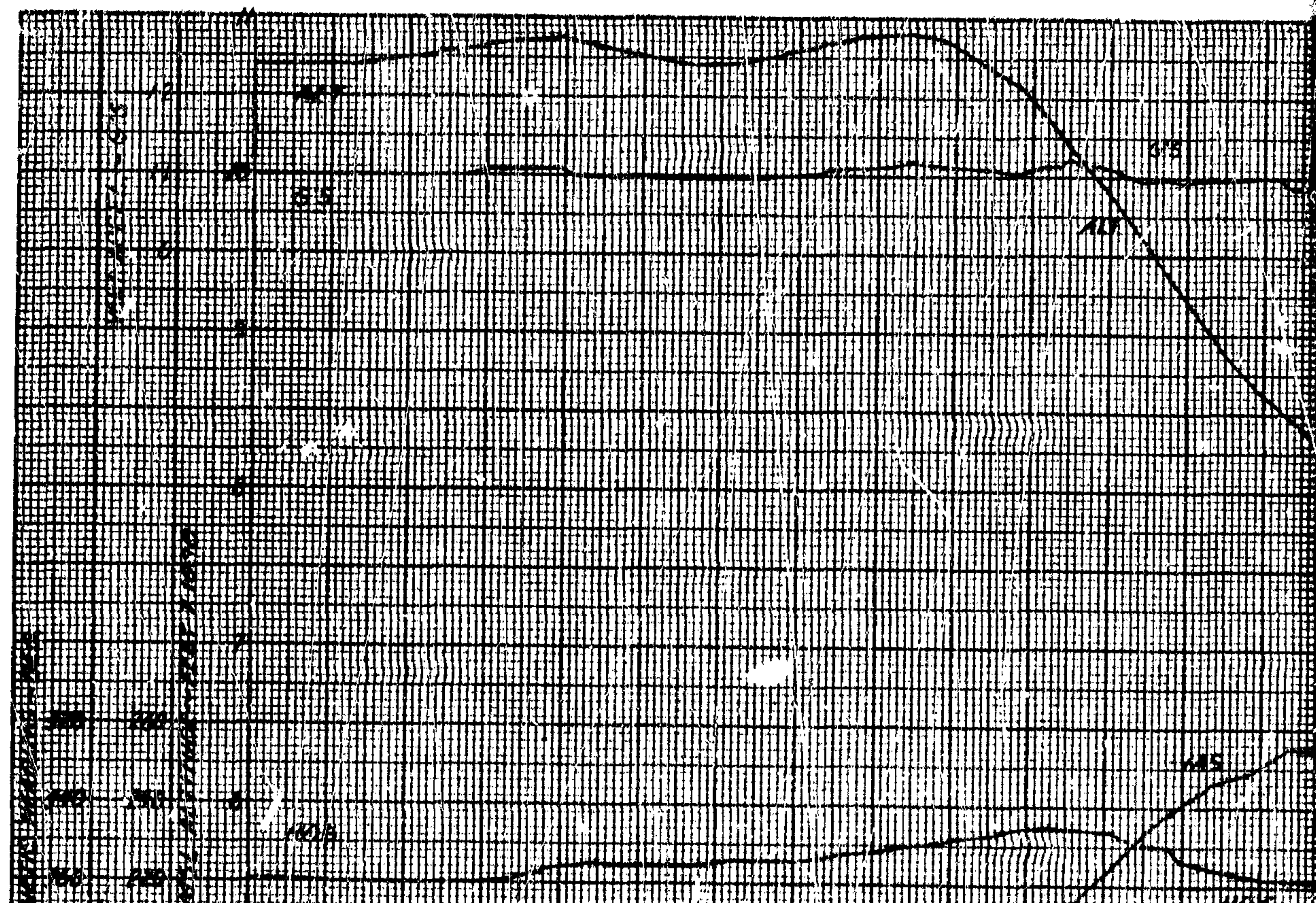

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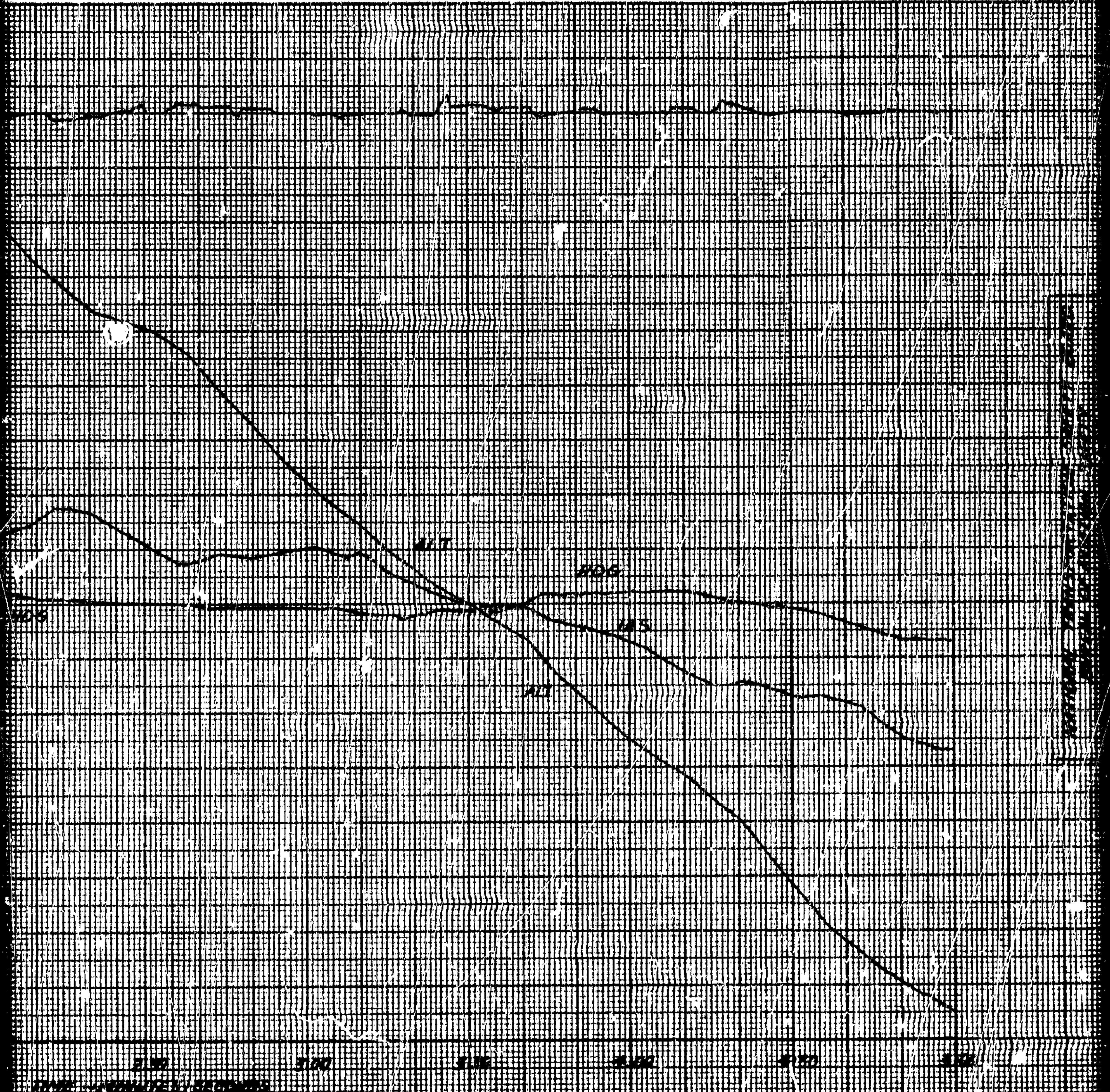

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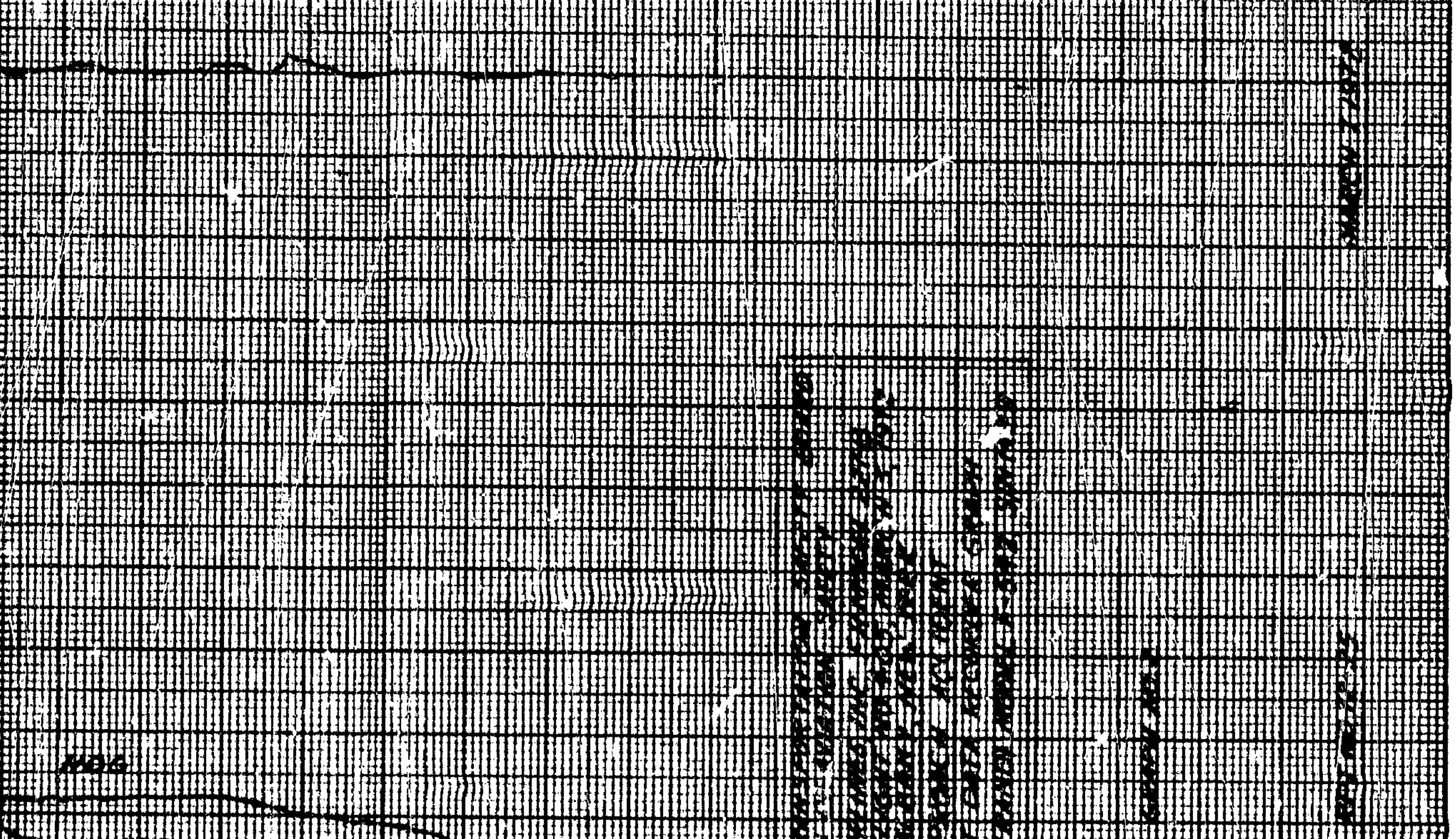

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TRANSCRIPTION OF PERTINENT COMMUNICATIONS FROM COCKPIT VOICE RECORDER--
FAIRCHILD HILLER, FH-227B, N7818M, MOHAWK AIRLINES FLIGHT 405,
ALBANY, NEW YORK, MARCH 3, 1972

LEGEND

CAM	Cockpit area microphone voice or sound source
RDO	Radio transmission from N7818M
-1	Voice identified as Captain
-2	Voice identified as First Officer
-?	Voice unidentified
AR-1	Albany Approach Control Arrival Radar (East)
AR-2	Albany Approach Control Final Vector Controller
*	Unintelligible word
#	Nonpertinent word
%	Break in continuity
( )	Questionable text
(( ))	Editorial insertion

INTRA-COCKPIT		AIR-GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
		2039:16 RDO-2	Approach, Mohawk four zero five, at one one thousand
		AR-1	Four zero five, Albany, ident
		AR-1	Four zero five, Albany, descend and maintain three thousand, vectors to the back course localizer runway one final approach course
		2039:32 RDO-2	Roger, out of eleven for three thousand, the back course ILS approach
2039:33.5 CAM	Sound of click		
2039:35.5 CAM	Sound of click		
		AR-1	What's your airspeed?
		RDO-2	It'll be about, ah, two -- two forty on descent
CAM-1	Two forty		
		AR-1	Two forty
			% % %
		2040:09 AR-1	Okay, four oh five, four sixty-three and five forty-five all copy. You're all

					being vectored for the localizer back course ILS runway one final approach course, the weather is indefinite ceiling one thousand two hundred, sky obscured, visibi--visibility two miles with light snow. The wind is three six zero degrees at one zero, the altimeter three zero zero five, the runway has one-quarter inch of snow over a thin layer hard-packed snow, scattered bare spots, it's been sanded, braking action poor by a DC-9. Four oh five acknowledge
2040:40	CAM	Sound of landing gear warning horn commences			
2040:43	CAM-?	(Your light's blinkin')	2040:43	RDO-2	Mohawk four zero five, roger
					% % %
2040:45	CAM	Sound of landing gear warning horn ceases			
2040:56	CAM-?	(we're) in it			
	CAM-?	Okay			
			2041:13	AR-1	Four of five, you're ten south of Greenbush. Cleared for the back course localizer approach
				RDO-2	Ah, Mohawk four zero five, understand cleared localizer back course approach

INTRA-COCKPIT SOURCE & TIME	INTRA-COCKPIT CONTENT	AIR-GROUND COMMUNICATIONS SOURCE & TIME	AIR-GROUND COMMUNICATIONS CONTENT
CAM-1	'pproach lights on, (dippers (w'ya please?))		
CAM-2	(Okay)		
CAM-1	That's one ninty-one inbound		
CAM-2	Right		
		AR-1	* * * approach one two four point seven
		RDO-2	Is that one two four point seven for four oh five?
		AR-1	That's correct
		2041:40 RDO-2	Roger
		2041:44.5 RDO-2	Albany approach, Mohawk four zero five, ah cleared for the back course ILS approach
		AR-2	Mohawk four zero five, approach, roger, I'll give you, I'll give you the seven and four mile fix
		2041:54 RDO-2	Ah, roger
2042:09.5 CAM-1	Going down to twenty-six, huh?		

CAM-2 All right ((pause)) well, twenty one hundred feet at seven mi--- ah, seven miles, fourteen hundred feet at four miles (approximately 3 seconds after "all right" there are two rapid clicks, the second of which is of higher amplitude and pitch then the first.)

CAM-1 All right

RDO Sound of identification of Albany ILS "I-ALB"

2043:21.0
RDO Sound of popping commences on captain's, first officer's, and observer's audio channels

2043:23.5
CAM-? (What was it?)

2043:26
CAM-1 Pitch light, huh?

CAM-2 Yeah

CAM Click

2043:31
CAM-1 Watch the TGT on that side

CAM-2 Yeah, okay

CAM-2 First time I've ever seen that

CAM Sound of three or four clicks

INTRA-COCKPIT		AIR-GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
CAM	Sound similar to levers being actuated twice		
2043:55 CAM-2	And a little bit right		
CAM-1	Right of course		
CAM-2	Yeah		
CAM-2	And ---		
2044:13.5 CAM-2	We're approaching fourteen hundred feet		
		2044:18 RDO-2	And, ah, four zero five, what is our range, ah, from the field?
		2044:22.5 AR-2	Four zero five, you're eleven miles
		RDO-2	Okay
		RDO	Sound of popping continues
2044:36 CAM-1	I don't know whether it can come out but we'll leave it right there		

CAM-2	What's that?		
CAM-1	Long as I get something out of it we'll leave it right there		
CAM-2	Yeah		
2044:50 CAM-2	You mean it won't go, ah, any further than that		
CAM	Two clicks		
		RDO	Sound of popping
CAM-2	It won't go any further than that right now, Rusty?		
CAM-1	No		
CAM-2	Is that right?		
CAM-2	Ah boy		
2045:12 CAM	Soung of two clicks with dif-fering tones		
2045:16.5 CAM-2	Want me to advise maintenance or, ah, ah, ops, ah I mean Albany?		
CAM-1	Yeah		
CAM-2	What do you want me to tell 'em?		

INTRA-COCKPIT		AIR-GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
2045:23 CAM-1	Tell 'em we have ah, ((pause)) prop hung up on ((short pause)) cruise pitch lock		
CAM-2	Okay		
		2045:32 RDO-2	Albany, ah, Mohawk four oh five
		MOH	Four oh five, gate three
CAM	Three clicks	RDO-2	Okay, ah, would you advise maintenance our left engine is hung up on the locks?
		MOH	Yeah, your left engine, there's somethin the matter with it, okay
		2045:58 RDO-2	Okay, we'll see you on the ground
		MOH	Yeah
		2046:01 AR-2	Four zero five comin' up on the seven mile fix
CAM-2	Four zero five		
CAM-1	* *		
		RDO-2	Four zero five, roger
CAM-1	Tell 'em we'are ah, ((pause)) now ---	MO545	What kind of speed you want for five forty-five now?

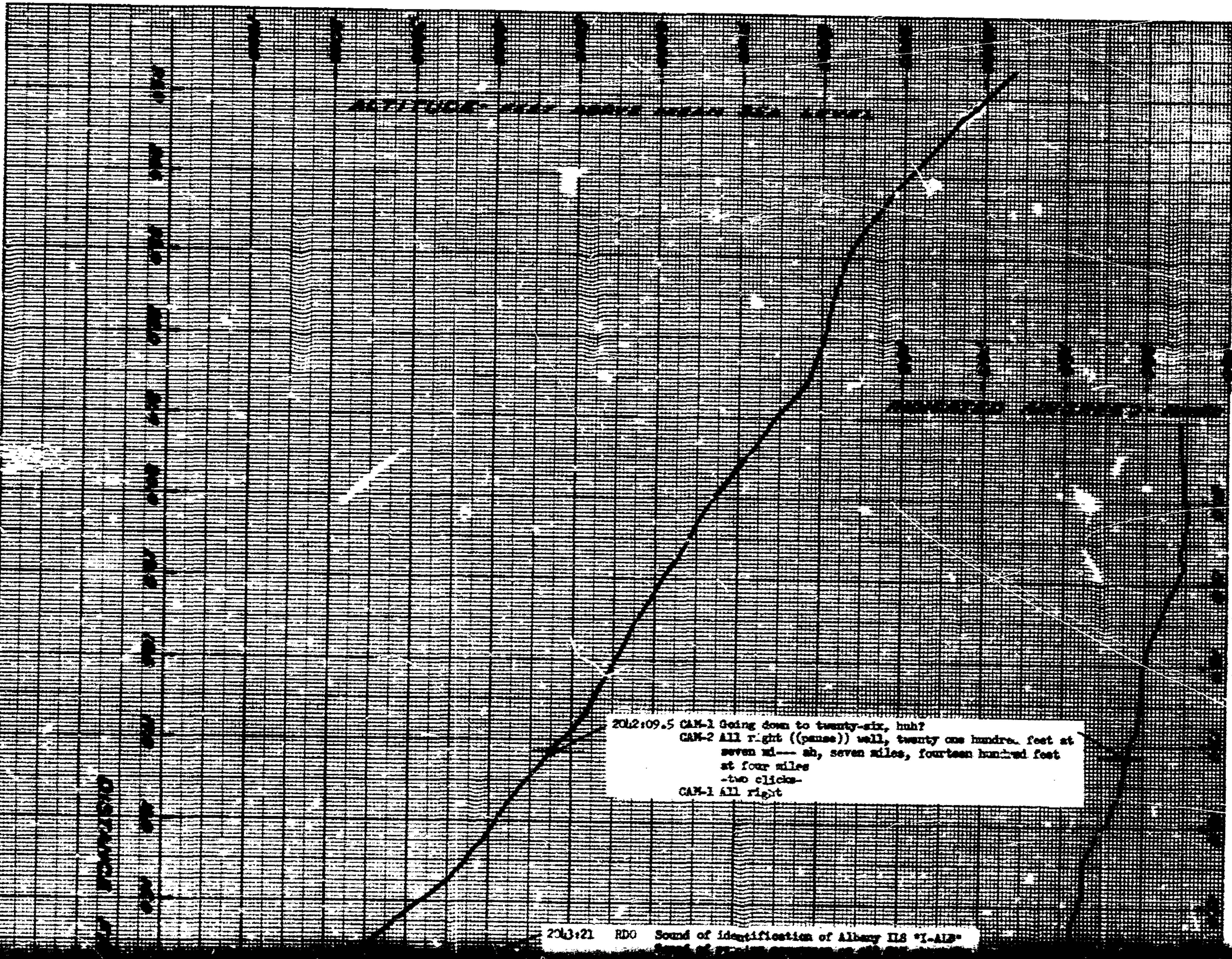
			AR-2	Four oh five, what's your speed?
2046:16	CAM-1	One thirty		
			RDO-2	Ah, we're indicating one thirty
			AR-2	Okay, how about one forty for five forty-five?
			MO545	Okay
			AR-2	* is about three and a half miles ahead of you, five forty-five
			MO545	Okay
2046:38	CAM-1	Better shut it down (checklist)		
	CAM-2	You gotta (shut this), you gotta shut it down?		
2046:43.5	CAM-1	Do you see the runway out there?		
2046:45.5	CAM-2	No, not yet ((pause)) no yet		
2046:55.5	CAM-2	* we're a little bit right	AR-2	Mohawk five forty-five can you get down to one twenty?
			MO545	Negative
			AR-2	Okay
	CAM	Sound of three clicks	MO545	Will be our threshold speed

INTRA-COCKPIT		AIR-GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
CAM	Sound of click		
2047:14 CAM-?	(Aah)	AR-2	* one, ah, one thirty, I suppose
		MO545	'kay
2047:17.5 CAM-1	Tell 'em we got a problem		
CAM-2	Okay		
CAM	Sound of engine spool down begins		
CAM	Sound of two clicks		
2047:20 CAM	Sound of engine spooling down		
		2047:22 RDO-2	Ah, Albany, Mohawk four zero five, ah we're feathering our, ah, left engine, we have a problem there
		2047:29.5 AR-2	Feathering the left, you gonna continue inbound?
CAM	Sound of two clicks. (Stewardess announcement picked up on Track No. 4 starts between words		

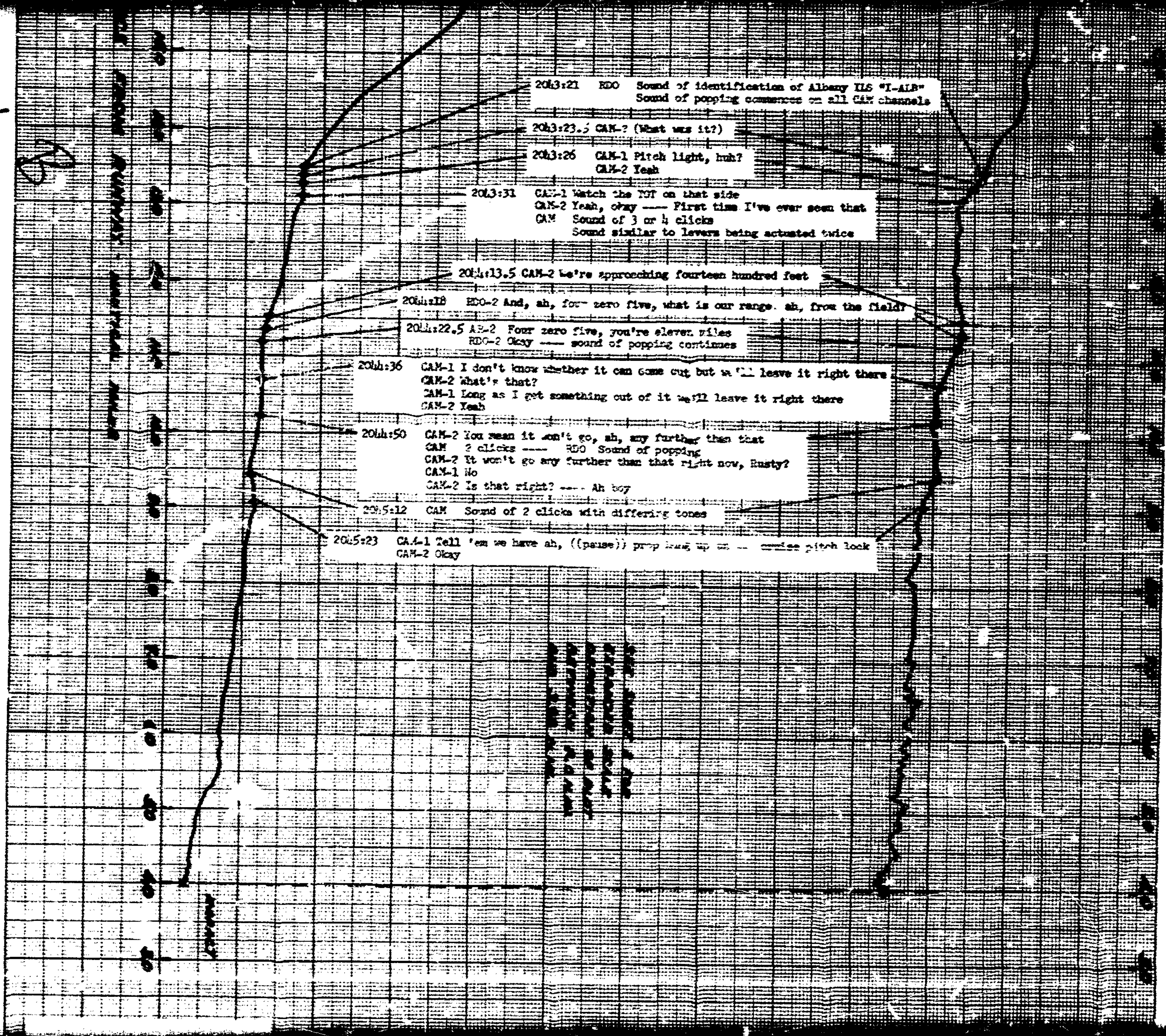
	"gonna" and "continue" as follows: "We're on our final approach, please observe the no smoking sign * * * * * seat backs and trays in vertical and locked position * * *) (Time of announcement is 13.2 seconds from 2047:30.5 to 2047:43.7 e.s.t.)		
		2047:32 RDO-2	Roger, we're continuing inbound
		AR-2	Okay
2047:36 CAM-1	(Give me an inch a the pedal)		
CAM	Sound of two clicks simultaneous with end of preceding sentence		
CAM-2	Huh?		
2047:38 CAM-1	(Didn't) get it to feather! (See if you can)		
CAM-2	Okay		
CAM	Sound of two clicks		
CAM	Sound of two clicks		
2047:51 CAM-1	Tell 'em we're gonna land short, we're in trouble	2047:54.5 RDO-2	Ah, four oh five's gonna land short, we're in trouble
CAM	Sound of two clicks		
		AR-2	Say again?
2047:59.5 CAM-?	(Seck up)!		

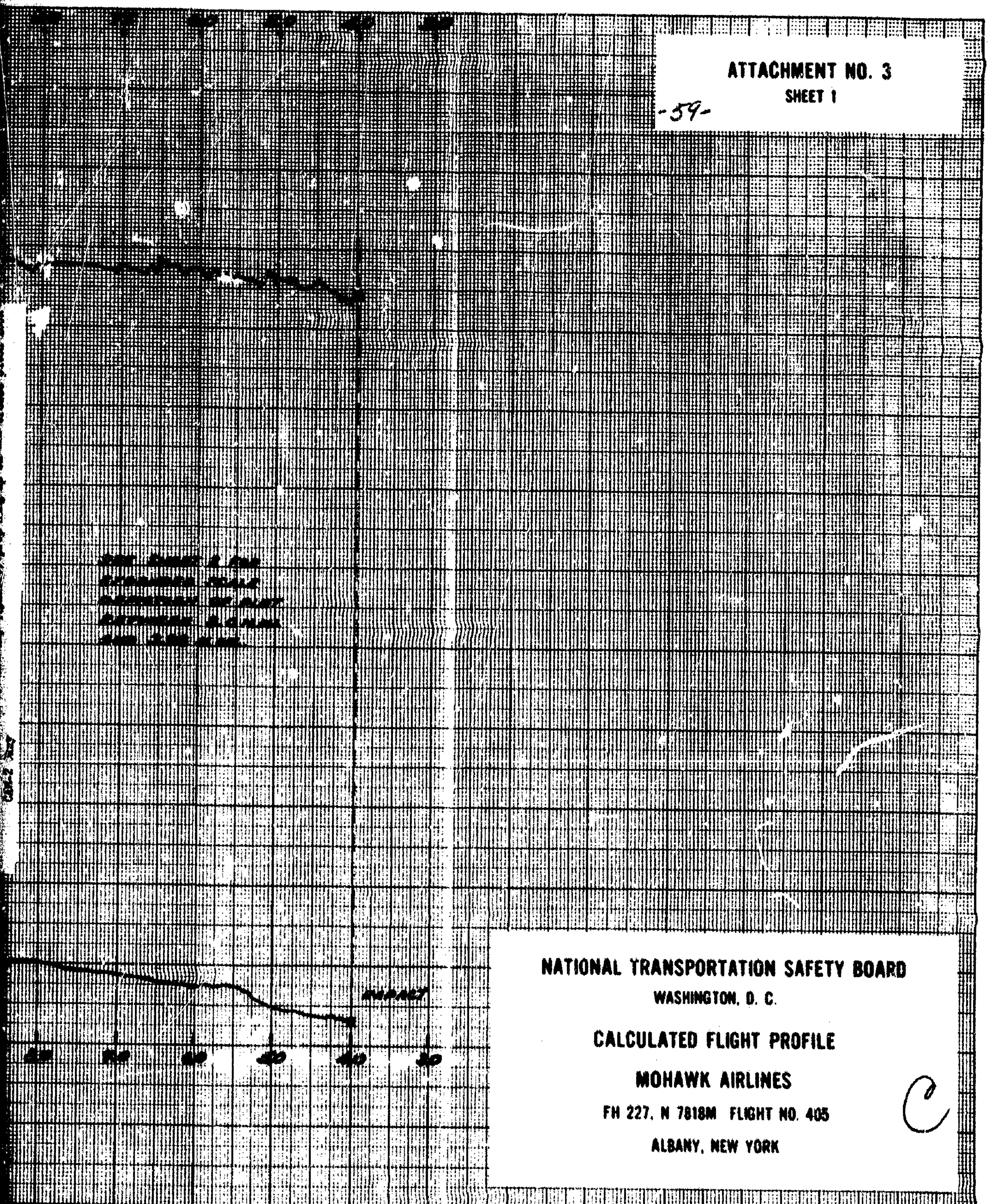
INTRA-COCKPIT		AIR-GROUND COMMUNICATIONS	
SOURCE & TIME	CONTENT	SOURCE & TIME	CONTENT
		2048:01 AR-2	Four oh five, the four mile fix, you want, you want equipment standing by?
CAM	Sound of three clicks over a period of 0.7 second		
2048:02 CAM-?	#		
CAM	Sound of two clicks		
2048:04 CAM-?	(NO CHANCE ! !)		
2048:05.5	I'm a # # # # !		
2048:07	End of recording		

A



ALTITUDE-
2042:09.5 CAM-1 Going down to twenty-six, huh?
CAM-2 All right ((pause)) well, twenty one hundred feet at seven mi--- ah, seven miles, fourteen hundred feet at four miles
-two clicks-
CAM-1 All right
2043:21 RDO Sound of identification of Albany ILS "I-ALB"


2043:21 RDO Sound of identification of Albany ILS "I-ALB"
Sound of popping commences on all CAM channels
2043:23.5 CAM-? (What was it?)
2043:26 CAM-1 Pitch light, huh?
CAM-2 Yeah
2043:31 CAM-1 Watch the TOT on that side
CAM-2 Yeah, okay ---- First time I've ever seen that
CAM Sound of 3 or 4 clicks
Sound similar to levers being actuated twice
2044:13.5 CAM-2 We're approaching fourteen hundred feet
2044:18 RDO-2 And, ah, four zero five, what is our range. ah, from the field?
2044:22.5 AR-2 Four zero five, you're eleven miles
RDO-2 Okay ---- sound of popping continues
2044:36 CAM-1 I don't know whether it can come out but we'll leave it right there
CAM-2 What's that?
CAM-1 Long as I get something out of it we'll leave it right there
CAM-2 Yeah
2044:50 CAM-2 You mean it won't go, ah, any further than that
CAM 2 clicks ---- RDO Sound of popping
CAM-2 It won't go any further than that right now, Rusty?
CAM-1 No
CAM-2 Is that right? ---- Ah boy
2045:12 CAM Sound of 2 clicks with differing tones
2045:23 CAM-1 Tell 'em we have ah, ((pause)) prop hung up on -- cruise pitch lock
CAM-2 Okay
B



ATTACHMENT NO. 3
SHEET 1

-59-

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D. C.

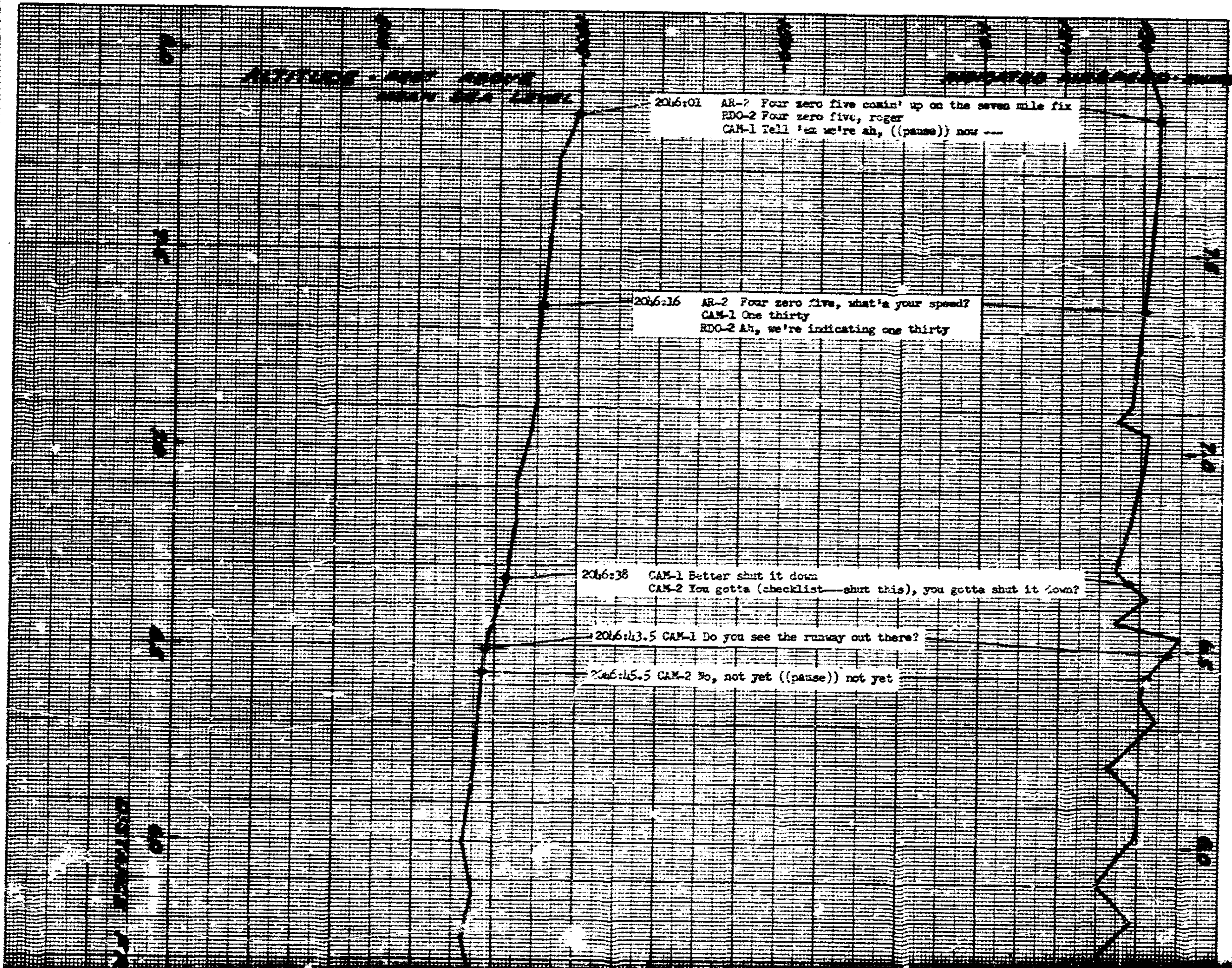
CALCULATED FLIGHT PROFILE

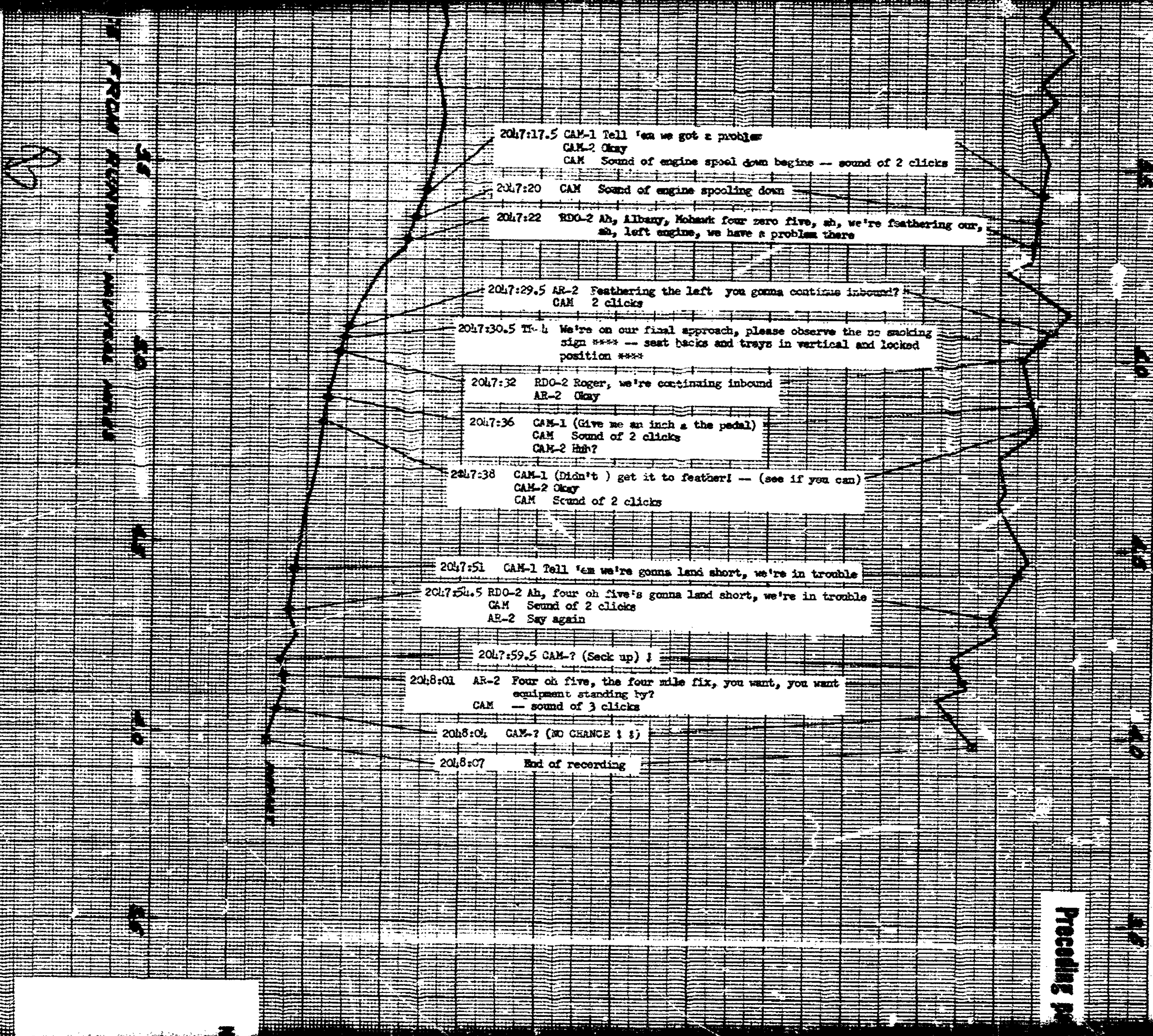
MOHAWK AIRLINES

FH 227, N 7818M FLIGHT NO. 405

ALBANY, NEW YORK

C


ALTITUDE - FEET ABOVE MEAN SEA LEVEL
INDICATED AIRSPEED - KNOTS
2016:01 AR-? Four zero five comin' up on the seven mile fix
RDO-2 Four zero five, roger
CAM-1 Tell 'em we're ah, ((pause)) now ---
2016:16 AR-2 Four zero five, what's your speed?
CAM-1 One thirty
RDO-2 Ah, we're indicating one thirty
2016:38 CAM-1 Better shut it down
CAM-2 You gotta (checklist---shut this), you gotta shut it down?
2016:43.5 CAM-1 Do you see the runway out there?
2016:45.5 CAM-2 No, not yet ((pause)) not yet


2047:17.5 CAM-1 Tell 'em we got a problem
CAM-2 Okay
CAM Sound of engine spool down begins -- sound of 2 clicks
2047:20 CAM Sound of engine spooling down
2047:22 RDO-2 Ah, Albany, Mohawk four zero five, ah, we're feathering our, ah, left engine, we have a problem there
2047:29.5 AR-2 Feathering the left you gonna continue inbound?
CAM 2 clicks
2047:30.5 TR-4 We're on our final approach, please observe the no smoking sign **** -- seat backs and trays in vertical and locked position ****
2047:32 RDO-2 Roger, we're continuing inbound
AR-2 Okay
2047:36 CAM-1 (Give me an inch a the pedal)
CAM Sound of 2 clicks
CAM-2 Huh?
2047:38 CAM-1 (Didn't) get it to feather! -- (see if you can)
CAM-2 Okay
CAM Sound of 2 clicks
2047:51 CAM-1 Tell 'em we're gonna land short, we're in trouble
2047:54.5 RDO-2 Ah, four oh five's gonna land short, we're in trouble
CAM Sound of 2 clicks
AR-2 Say again
2047:59.5 CAM-? (Suck up) !
2048:01 AR-2 Four oh five, the four mile fix, you want, you want equipment standing by?
CAM -- sound of 3 clicks
2048:04 CAM-? (NO CHANCE ! !)
2048:07 End of recording
FROM RUNWAY- NAUTICAL MILES
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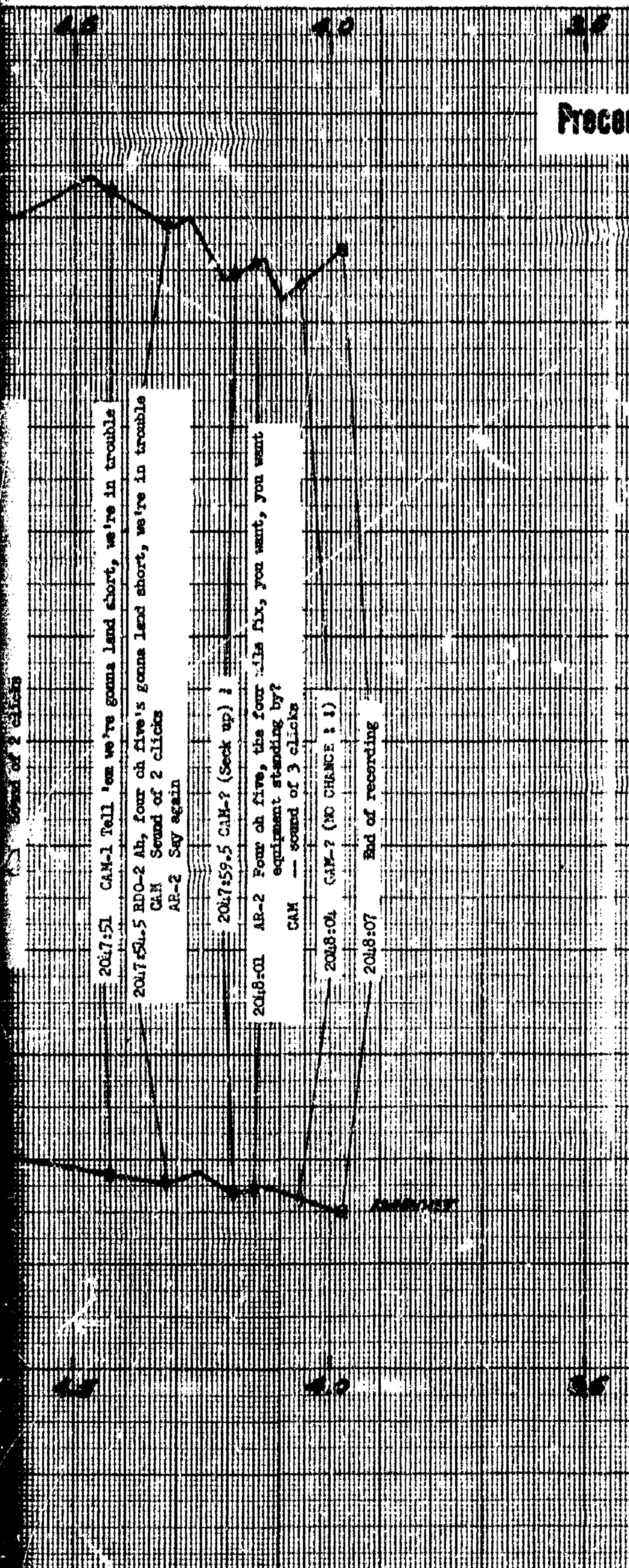
ATTACHMENT NO. 3

-61- SHEET 2



NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D. C.

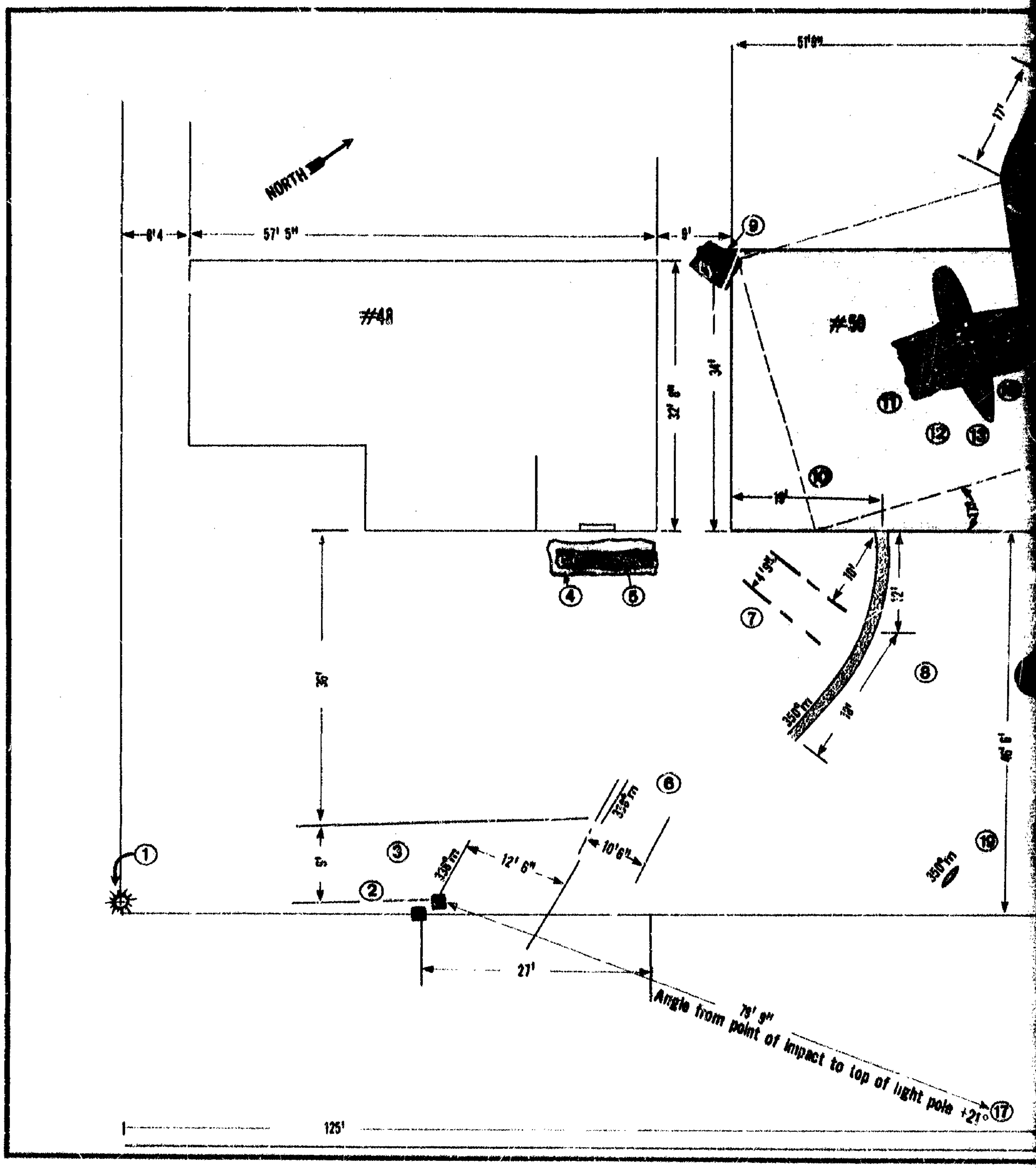
CALCULATED FLIGHT PROFILE

MOHAWK AIRLINES

FH 227, N 7818M FLIGHT NO. 405

ALBANY, NEW YORK

C

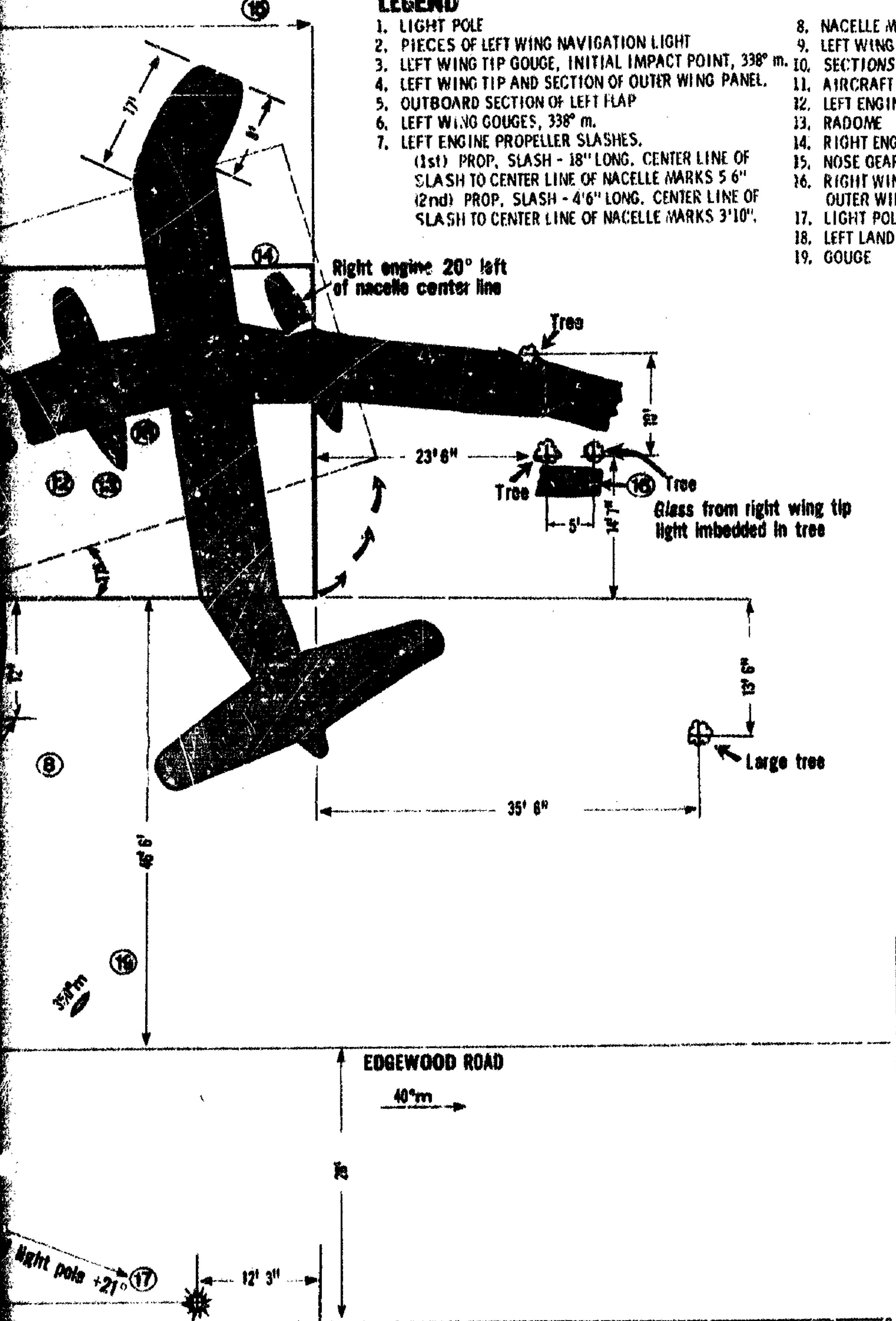


NORTH
#48
#50
57' 5"
8'
51'6"
17'
32' 6"
34'
18'
12'
46' 6"
12' 6"
10'6"
27'
79' 9"
Angle from point of impact to top of light pole +21°
125'

LEGEND

1. LIGHT POLE
2. PIECES OF LEFT WING NAVIGATION LIGHT
3. LEFT WING TIP GOUGE, INITIAL IMPACT POINT, 338° m.
4. LEFT WING TIP AND SECTION OF OUTER WING PANEL.
5. OUTBOARD SECTION OF LEFT FLAP
6. LEFT WING GOUGES, 338° m.
7. LEFT ENGINE PROPELLER SLASHES.
   (1st) PROP. SLASH - 18" LONG. CENTER LINE OF SLASH TO CENTER LINE OF NACELLE MARKS 5 6"
   (2nd) PROP. SLASH - 4'6" LONG. CENTER LINE OF SLASH TO CENTER LINE OF NACELLE MARKS 3'10".
8. NACELLE MARKS, 350° M
9. LEFT WING SECTION
10. SECTIONS OF LEFT WING AND LEFT FLAP.
11. AIRCRAFT NOSE STRUCTURE
12. LEFT ENGINE PROPELLER
13. RADOME
14. RIGHT ENGINE PROPELLER
15. NOSE GEAR ASSEMBLY
16. RIGHT WING TIP AND SECTION OF OUTER WING PANEL.
17. LIGHT POLE
18. LEFT LANDING GEAR
19. GOUGE

Preceding pa



PHOTO

PHOTO

NATIONAL TRANSPORTATION
Washington, D.C.

WRECKAGE DISTRIBUTIO

MOHAWK AIRLINES, INC

FAIRCHILD HILLER FH-227, N

Approx 3.5 nautical miles

Albany Municipal Airpo

Albany New York, March 3,

B

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OLE
OF LEFT WING NAVIGATION LIGHT
NG TIP GOUGE, INITIAL IMPACT POINT, 338° m.
NG TIP AND SECTION OF OUTER WING PANEL.
RD SECTION OF LEFT FLAP
NG GOUGES, 338° m.
GINE PROPELLER SLASHES.
PROP. SLASH - 18" LONG. CENTER LINE OF
TO CENTER LINE OF NACELLE MARKS 5'6"
PROP. SLASH - 4'6" LONG. CENTER LINE OF
TO CENTER LINE OF NACELLE MARKS 3'10".

8. NACELLE MARKS, 350° M
9. LEFT WING SECTION
10. SECTIONS OF LEFT WING AND LEFT FLAP.
11. AIRCRAFT NOSE STRUCTURE
12. LEFT ENGINE PROPELLER
13. RADOME
14. RIGHT ENGINE PROPELLER
15. NOSE GEAR ASSEMBLY
16. RIGHT WING TIP AND SECTION OF OUTER WING PANEL.
17. LIGHT POLE
18. LEFT LANDING GEAR
19. GOUGE

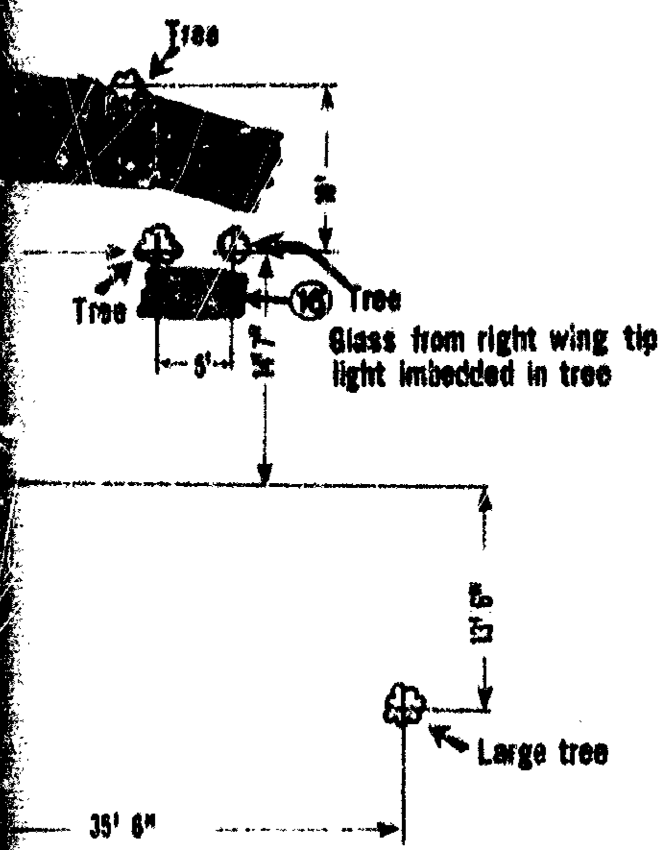

PHOTO A

PHOTO B

OAD

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C.

WRECKAGE DISTRIBUTION CHART

MOHAWK AIRLINES, INC.

FAIRCHILD HILLER FH-227, N7818M

Approx 3.5 nautical miles south of

Albany Municipal Airport

Albany New York, March 3, 1972

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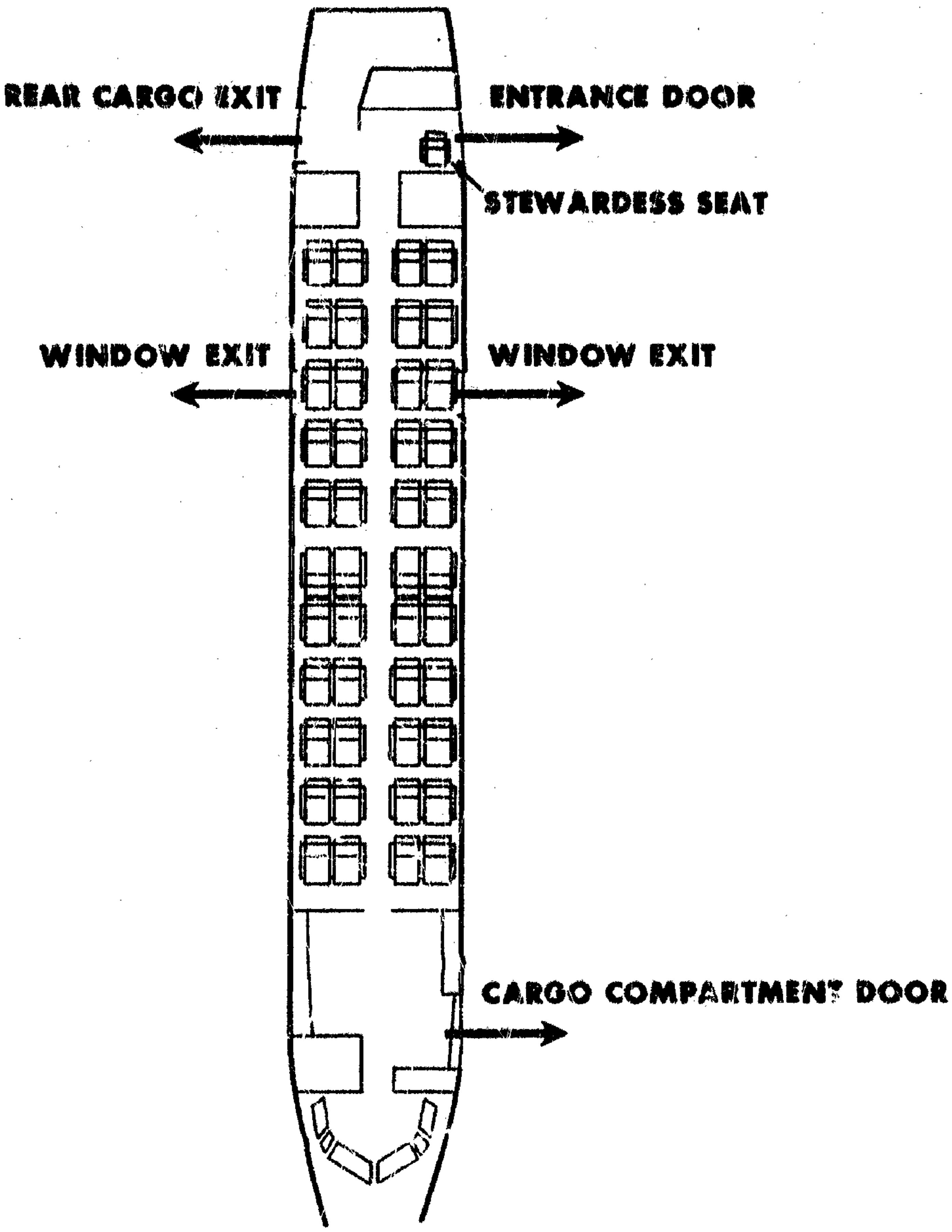
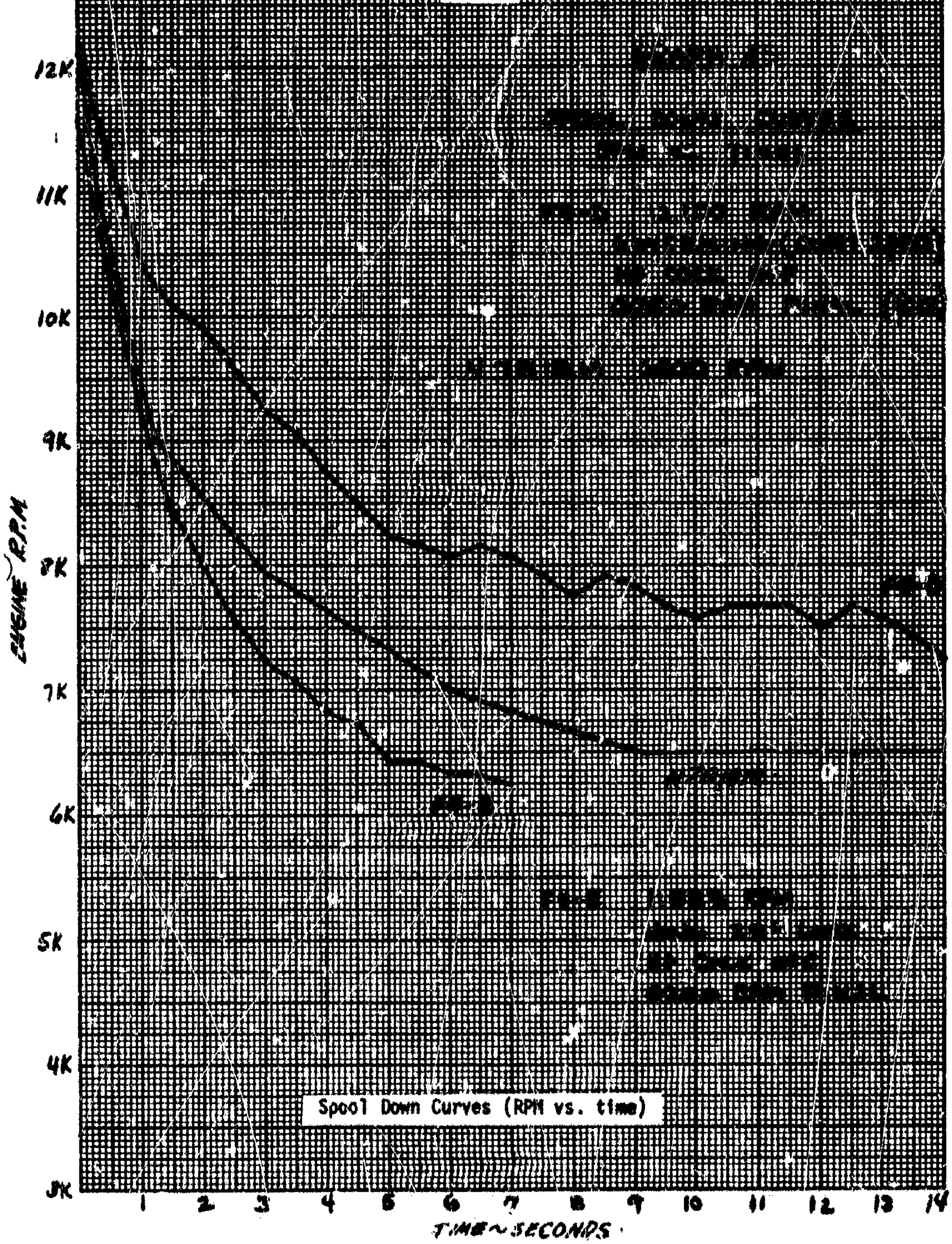


NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

FH-227 SEATING DIAGRAM
MOHAWK AIRLINES
FH 227, N 7818M FLIGHT NO. 405
ALBANY, NEW YORK

ATTACHMENT 6



Spool Down Curves (RPM vs. time)

AIRCRAFT PERFORMANCE CAPABILITY

1. A. Left propeller powered to 12,000 RPM and constrained on 28° CPL

   B. Normal right engine operation (nominal power)

   C. Altitude = 750 feet, temperature = ISA-25° C

   D. Landing gear and flaps retracted

	Right Engine Speed-Rotations Per Minute	Total Gradient Available at 125 KT EAS-Percent	Rate of Climb at 125 KT EAS-Feet Per Minute	Maximum Speed In Straight and Level Unaccelerated Flight-Knots Equivalent Airspeed
0% FUEL TRIM	11,000	+0.23	28	130
	12,000	+1.61	195	146
	13,000	+3.00	363	156
	14,200	+4.44	537	166
	15,000	+5.35	647	171

2. A. Left propeller feathered or windmilling

   B. Normal right engine operation, minimum dry power - 15,000 RPM

   C. Altitude = 750 feet, temperature ISA-25° C

	Left Propeller Configuration	Total Gradient Available at 125 KT EAS-Percent	Rate of Climb Descent at 125 KT EAS-feet Per minute	Incremental Altitude Required to Travel 4 NM* - Feet
0% FUEL TRIM	a. Feathered	-0.98	-119	238
	b. Windmilling at 28° C PL	-2.56	-310	620
	c. Windmilling at 16° C PL	-4.64	-561	1122
100% FUEL	a. Feathered	+2.77	+335	N.A.
	b. Windmilling at 28° C PL	+1.27	+154	N.A.
	c. Windmilling at 16° C PL	-0.98	-119	238

* Approximate distance of impact site from airport.

The performance capability of the airplane with the flaps up and the drag brake down, for conditions otherwise similar to those above, is as follows:

3. A. Left propeller powered to 12,000 RPM and constrained on 28° CPL

   B. Normal right engine operation (nominal power).

	Right Engine Speed - Rotations Per Minute	Total Gradient Available at 125 KT EAS-Percent	Rate of Climb/ Descent at 125 KT EAS-Feet Per Minute	Maximum Speed in Straight and Level Unaccelerated Flight-Knots Equivalent Airspeed
0% FUEL TRIM	11,000	-1.9%	-230	---
	12,000	-0.58	- 70	115
	13,000	+0.69	+ 83	132
	14,200	+2.19	+265	143
	15,000	+3.00	+363	148

4. A. Left propeller feathered or windmilling

   B. Normal right engine operation, minimum dry power - 15,000 RPM

	Left Propeller Configuration	Total Gradient Available at 125 KT EAS-Percent	Rate of Climb/ Descent at 125 KT EAS-Feet Per Minute	Incremental Altitude Required to Travel 4 Nautical Miles - Feet
0% FUEL TRIM	a. Feathered	-3.02	-365	730
	b. Windmilling at 28° C PL	-4.60	-556	1,112
	c. Windmilling at 16° C PL	-6.75	-815	1,630
100% FUEL TRIM	a. Feathered	+0.63	+ 76	N.A.
	b. Windmilling at 28° C PL	-0.92	-111	222
	c. Windmilling at 16° C PL	-3.12	-377	754

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

ISSUED: July 7, 1972

Adopted by the NATIONAL TRANSPORTATION SAFETY BOARD
at its office in Washington, D. C.
on the 23rd day of June 1972

FORWARDED TO:
Honorable John H. Shaffer
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATIONS A-72-99 thru 101

During the National Transportation Safety Board's Public Hearing regarding the Mohawk Airlines Accident at Albany, New York, an area of disagreement developed as to the proper emergency procedures to be followed upon encountering a cruise pitch lock withdrawal malfunction. Pilots operating the FH-227B aircraft stated that they disagreed with the published procedures contained in the Mohawk Airlines Operations Manual.

The Mohawk Airlines emergency procedure now in effect describes several methods to eliminate the cruise pitch lock malfunction. The procedure goes on to state, "If the lock cannot be withdrawn, the affected engine should be shut down and the propeller feathered to avoid the danger of overheating the engine when the aircraft reduces speed for the landing." The emergency procedures contained in the Ozark Air Line Operations Manual do not follow the Mohawk presentation verbatim, but are similar.

Three Mohawk Airlines pilots (a line captain and two FAA designated check airmen) testified that they disagreed with the latter portion of the procedure. They stated, in part, that if the engine was producing thrust they would prefer to continue using it to touchdown, even though the propeller was "hung" on the cruise pitch lock. This preference coincides with the recommended procedure contained in the Rolls Royce Service Bulletin No. 61-10a, dated May 15, 1970.

The Safety Board believes that the area of disagreement brought out by the testimony and the data set forth in the Rolls Royce Bulletin 61-10a constitute sufficient grounds to request a reevaluation of the present emergency procedure.

Honorable John H. Shaffer

The explanation in the emergency procedures section of the Mohawk Operations Manual is misleading. It creates the impression that the main hazard associated with a propeller "hung" on the cruise pitch lock is potential damage to, or destruction of, the affected engine. No mention is made of the difficulties associated with continued flight following such a malfunction. For instance, the hazards involved in attempting a missed approach from low indicated airspeed with the propeller "hung" on the cruise pitch lock are not described. The Operational Manual should be revised to place emphasis on the operational problems inherent in attempting to land, or execute a missed approach without shutting down the engine and feathering the affected propeller.

The Safety Board, therefore, recommends that the Federal Aviation Administration:

1. Review and evaluate the present cruise pitch lock emergency procedure. The review should include an evaluation of the recommended procedures set forth by the Rolls Royce Company in their Service Bulletin No. 61-10a to ascertain if these procedures are preferable to those now in effect.

2. Require that the language in the Mohawk Airlines Operations Manual and other FH-227 air carrier Operations Manuals be revised to clearly identify the potential hazards associated with continued operation, attempted landings, and missed approaches with a propeller "hung" on the cruise pitch lock.

3. Require that all carriers operating FH-227B aircraft revise their recurrent ground training curricula to include instruction on the performance characteristics of the FH-227B when operating the aircraft with a cruise pitch lock malfunction. Emphasis should be placed upon flight conditions involving a windmilling propeller on the cruise pitch or flight fine locks and the minimum control speed problems associated with such conditions.

Members of our Bureau of Aviation Safety will be available for consultation in the above matter if desired.

These recommendations will be released to the public on the issue date shown above. No public dissemination of the contents of this document should be made prior to that date.

Reed, Chairman; McAdams, Thayer, Burgess and Haley, Members, concurred in the above recommendations.

John H. Reed

By: John H. Reed
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590

OFFICE OF
THE ADMINISTRATOR

7 JUL 1972

Honorable John H. Reed
Chairman, National Transportation
Safety Board
Department of Transportation
Washington, D. C. 20591

Dear Mr. Chairman:

This is to acknowledge receipt of Safety Recommendations A-72-99 thru 101.

We are evaluating these recommendations and will advise you of the results as soon as possible.

Sincerely,

J. H. Shaffer
Administrator

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590

OFFICE OF
THE ADMINISTRATOR

14 MAR 1973

Honorable John H. Reed
Chairman, National Transportation Safety Board
Department of Transportation
Washington, D. C. 20591

Dear Mr. Chairman:

This is in response to your letter of 16 February 1973 which requested the status of our reevaluation of FH-227 cruise pitch lock emergency procedures.

1. We have reviewed and evaluated the present cruise pitch lock emergency procedure including Rolls Royce Service Bulletin No. 61-10a. The Approved Flight Manual procedures are considered satisfactory. These procedures are not mandatory, however, and do not prohibit an operator from developing and training personnel in alternate, equivalent procedures.

2. We agree that operators should be aware of the potential hazards associated with operating an engine with the propeller "hung" on the cruise pitch lock. While we do not object to inclusion of such information in certificate holder's operations manuals, we favor modification of initial and recurrent training programs to include it. This will apprise crews that the airplane can be successfully handled in this configuration in various maneuvers including missed approaches, without damage to the engine.

3. We plan to insert operations bulletins in FAA Handbooks 8430.1A and 8430.6A. Principal Operations Inspectors will be directed to revise operators initial and recurrent training programs which we believe will satisfy the intent of recommendations 2 and 3.

Sincerely,

J. H. Shaffer
Administrator

NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C. 20591

OFFICE OF
THE CHAIRMAN

January 29, 1973

Honorable John H. Shaffer
Administrator
Federal Aviation Administration
Washington, D. C. 20591

Dear Mr. Shaffer:

This is in response to your letter of November 7, 1972, concerning your progress toward rulemaking action on general aviation crashworthiness standards. Your planned issuance of proposed rulemaking to require the installation of shoulder harnesses on small airplanes is most encouraging. The National Transportation Safety Board has learned informally that the forthcoming NPRM would also amend 14 CFR 91 to require that crewmembers wear shoulder harnesses. We recognize the importance of these positive steps to improve pilot protection in small aircraft.

Additionally, in a related area, we believe that your recent rulemaking regarding the requirements for crewmembers of transport-category aircraft operating under 14 CFR 121 to wear their shoulder harnesses for takeoff and landing also represents a significant advance in crew protection.

However, it also focuses attention on several inconsistencies which exist in the regulations on the subject of shoulder harnesses and which the Board hopes will be resolved by the forthcoming proposals.

First, under Part 121 operations, the degree of protection afforded crewmembers flying aircraft certificated before January 1, 1958, is less than that provided in more recently certificated aircraft, where shoulder harnesses are required to be installed. Federal Aviation Administration statistics show that as many as 269 of the 2,797 registered multiengine air carrier airplanes still in service were certificated prior to January 1, 1958. One of the airplanes in this category, a Mohawk FH-227, crashed at Albany, New York, on March 3, 1972, killing 14 passengers and the two crewmembers on the flight deck. This aircraft, although manufactured in 1967, was type certificated prior to 1958 and thus exempted from the shoulder harness requirement. Our investigation disclosed that the captain and the copilot might have survived the accident had both crewmembers worn shoulder harnesses. Expert medical testimony corroborated our findings.

The Safety Board believes that pilots should be afforded similar protection, regardless of the type of equipment they fly. Moreover, the protection afforded by shoulder harnesses could prove vitally important in enabling crewmembers to assist in passenger evacuation following a survivable crash.

This lesser protection extends also to the crewmembers of aircraft operated under 14 CFR 135, since no requirement exists for shoulder harnesses, either in Part 23 or Part 135. It seems reasonable to require comparable standards for both Part 121 and Part 135 operations, since both crews are exposed to similar hazards during takeoff and landing while engaging in commercial passenger-carrying operations, and both have similar responsibilities for assisting in passenger evacuations.

Our preliminary information from your staff indicated that the provisions of the forthcoming proposal would be most beneficial for general aviation operations. The Board believes, however, that similar regulatory amendments should also be promulgated to encompass all air commerce segments.

Accordingly, we urge you to ensure that the forthcoming changes to Parts 23 and 91 regarding the equipping and wearing of shoulder harnesses by crewmembers are sufficiently broad in scope to apply to air taxi operations, as well as corporate/executive aircraft operations.

Moreover, the Board believes that Part 121 should be similarly amended to require that all transport category aircraft be equipped with shoulder harnesses after a reasonable date, to allow operators to retrofit equipment which was type certificated prior to January 1, 1958.

The Safety Board looks forward to the issuance of your forthcoming NPRM on this subject because of our great concern for this matter and the far-reaching potential for improved crew safety which could result.

Sincerely yours,

Original signed by
John H. Reed

John H. Reed
Chairman