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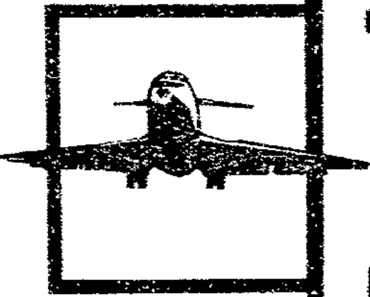

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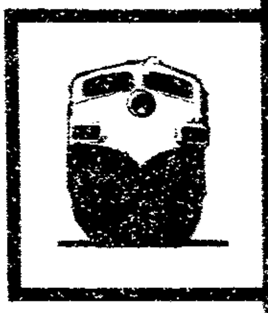

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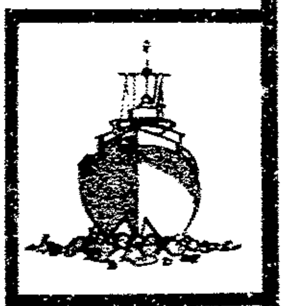
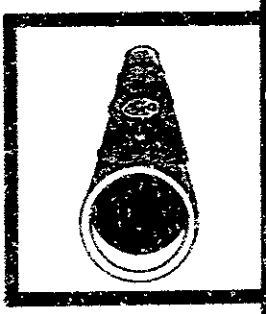


AIRCRAFT ACCIDENT/INCIDENT SUMMARY REPORT

TRAVIS AIR FORCE BASE, CALIFORNIA--APRIL 8, 1987



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16. Abstract

This report is a summary of an aircraft accident investigated by the National Transportation Safety Board. The accident location and date is Travis Air Force Base, California, April 8, 1987.

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Washington, D.C. 20594

AIRCRAFT ACCIDENT/INCIDENT SUMMARY

File No.:	193
Aircraft Operator:	Southern Air Transport, Inc.
Aircraft Type and Registration:	Lockheed L-382G, N517SJ
Location:	Travis Air Force Base, Caiifornia
Date and Time:	April 8,1987,1732 pdt
Occupant injuries:	5 fatal
Aircraft Damage:	Destroyed
Type Occurrence:	Collision with the ground
Phase of Operation:	Landing go-around

Circumstances of the Accident

Southern Air Transport (SAT) flight 517,.a Lockheed L-38PG operating out of Travis Air Force Base (AFB), California, crashed at 1732 pacific daylight time on April 8, 1937, following a practice instrument landing system (ILS) approach to runway 21L at Travis AFB. The flight was conducted in visual meteorological sonditions under the provisions of 14 Code of Federal Regulations Part 91 for the training of two first officer candidates and a flight engineer candidate all of whom had been hired by SAT in the previous 30 days. The captain and the flight engineer check airman aboard the flight had extensive experience in the L-382G airplane and its similar military C-130 version. There were no passengers or cargo aboard the flight. As a result: uf the accident. the airplane was destroyed by ground impact forces ard the effects of a postcrash fire. All five crewmen were fatally injured. Ground damage was limited to an airfield perimeter fence that had been struck by the left wing about 1,000 feet tu the left of the runway and ground scars associated with the impact.

Flight 517 departed Travis AFB about 1157, April *8,* 1987, on ?he first of a series of training flights conducted in N517SJ on that day. The flight proceeded to Sacramento, California, where training was conducted and the airplane was refueled. It returned to Travis AFB, and after a partial crew change the fiight departed at 1445 for a 3-hour local training flight. During the flight, the crew conducted approaches and practice landings at McCiellan AFB near Sacramento. The flight returned to Travis AFB for the completion of the training.

Conversations recorded by the cockpit voice recorder (CVR) indicated that it was the captain's intention to make a full stop landing following the ILS runway 24L approach that preceded the accident. During the practice instrument approach, the airplane was being flown by a first officer candidate who had no previous L-382/C-130 flight experience. At 1729:36, the flight engineer reported that the flaps were full (down) and the before landing checklist war complete. As the first officer operated the flight controls, the captain provided instructional guidance regarding altitude. airplane attitude, airspeed, and power corrections during the approach. Communications among the cockpit crewmembers were routine until moments before touchdown.

At 1731:21, the captain remarked, "Okay, just set the nose down here . . . you're too high to start rounding out. Don't add any power . . . okay, a little bit of rudder. . . okay, let the airplane down, let the nose down." Just before touchdown the captain advised, "All right now, come off on the power. . . just raise the nose a little bit here." As the airplane touched down the captain exclaimed, "Oh, oh, oh. I've got it, I've got it"; he assumed control of the airplane and began a go-around. The CVR recorded sounds similar to engine winddown and a sound associated with a momentary electrical power interruption (to the CVR) as the captain assumed control and the wheels touched down at 1731:40.

At 1731:45, the captain asked, "We lost an engine?" Responses from the flight engineer check airman and the flight engineer candidate were, respectively, "We lost one," and "Two, Skip." (Skip was a nickname of the captain.) At 1731:52, an unidentified crewmember said, "Flaps up." At 1731:57, the captain stated, "Power on." The sound of impact was recorded at 1732:00.

The flight data recorder (FDR) indicated that, the airplane touched down initially at 105 knots indicated airspeed (KIAS). The airplane heading remained within 10° of the runway heading for about 10 seconds after the captain assumed control. Afterward, the airplane heading deviated rapidly to the left as the airplane entered a gradually steepening left bank. The FDR airspeed trace indicated that airspeed also remained essentially stabilized for about 14 seconds, but deteriorated to 88 KIAS while the airplane turned left about 88° during the attempted landing go-around. Based on the heading change rate, it was calculated that the airplane's angle of bank reached about 50° before impact with the fence.

Twenty-five witnesses to the crash were located on and about Travis AFB and in the control tower. They described a normal approach to runway 21L until the airplane pitched upward near the touchdown point and rolled to the left. One of the tower air traffic controllers said he saw a puff of black smoke at the approximate airplane touchdown point on the runway. Since tire scrubbing at touchdown usually produces a grey-white smoke, the Safety Board considered that the tower controller may have observed an indication of a powerplant problem at the point where the go-around was initiated.

Other witnesses said the airplane did not, subsequently, climb higher than 300 feet. The witnesses described a left bank at low altitude which steepened until the airplane collided with the airfield perimeter fence in a nose-low and steep left wing low attitude. An explosion, a ball of fire, and smoke was observed immediately after the crash.

A Travis AFB weather observation taken at 1739, a few minutes after the crash, was: clouds--3,000 feet scattered, 12,000 feet scattered, 25,000 feet thin broken; visibility--40 miles; temperature--71°F; dew point--54°; wind from 220° at 10 knots; and altimeter--30.04 inHg. At 1728:58, when flight 517 was beginning the approach, Travis tower advised, ". . . wind 220 at 10, cleared to land runway 21L. Caution, wake turbulence preceding heavy B52." The captain of flight 517 acknowledged the information and read back the landing clearance. There were no further radio transmissions from the flight. It was determined that the preceding B52 had been 7 miles ahead of flight 517 and had made a touch-and-go landing on runway 21L 3 1/2 minutes before the accident. Consequently, wake vortices from the B52 were not considered to be a factor in the accident.

Emergency Response

Travis AFB control tower personnel initiated crash notifications at 1732. Travis AFB Fire Department firefighting and rescue operations were in progress at the crash site at 1737. The postcrash fire was under control at 1744 and was declared out at 1754, except for small magnesium fires along the wreckage path. Emergency medical personnel responded to the crash with the fire department but found that the crewmembers were deceased. The causes of death were attributed to multiple traumatic injuries. Postmortem examinations revealed no medical or toxicological factors relevant to the accident.

Travis AFB and the Solano County Office of Emergency Services have disaster plans with specific guidelines and checklists to be used in such emergencies. Those plans are practiced annually in joint training exercises and were implemented in response to this crash. The Safety Board found the response to be timely and appropriate to the circumstances of the accident.

The Accident Site

The wreckage path began at the airport perimeter fence, 1,048 feet left of the runway 21L centerline and 5,034 feet down the runway from the approach end. The damaged top rail of the chainlink tence was contoured to the shape of the leading edge of the wing. Airplane debris and several ground scars, beginning 19 feet east of the fence. marked the path of the airplane as it crossed 302 feet of open pasture. Fragments of the left wing, including the navigation light fixture and the fuel jettison pipe, were among the first airplane pieces found along the path. The path was curved, initially oriented to 120° magnetic but changing to 095° before the airplane came to rest. Several well-defined propeller slash marks in the ground were observed along the path. The cockpit area of the airplane was heavily damaged by impact forces and fire. The remainder of the fuselage revealed little fire damage. The left wing, outboard of the number 1 engine nacelle, was fragmented. A large wing section (exclusive of engines), comprising the entire right wing, the center wing section, and a large left wing section was largely intact but exhibited impact and postcrash fire damage. The engines and propellers were separated from the wing sections.

All of the major sections of the airplane and all control surfaces were found along the wreckage path. Examination of the airplane revealed no evidence of preimpact faiiure or malfunction involving the airplane structure or flight control surfaces. There was no evidence of an inflight fire or explosion. The wreckage indicated that the landing gear were fully extended and the flaps were extended about 35 percent with no flap dissymmetry at impact. (According to SAT procedures, the normal position for the flaps during a landing go-around, is 50 percent.) The aileron, rudder, and elevator trim tabs were found in neutral trim positions. The aileron, rudder, and elevator booster assemblies operated when functionally tested after the accident.

All of the crossfeed fuel valves were found closed and all of the engine main tank fuel shutoff valves were open. Refueling records, fuel consumption calculations, and postcrash fuel gage readings indicated that there was a substantial amount of fuel remaining in each of the main tanks at the time of the crash. None of the engine fuel heater/strainer assemblies were obstructed by foreign material. Examination of the fuei system did not reveal any indication of a problem thst would cause a loss of engine power.

Examination of the left horizontal stabilizer and elevator aft of the number 2 engine revealed a discolored area with a definite splash or spray pattern. Laboratory analysis later confirmed the presence of engine oil (the type used by SAT) streaking on the top surface. One of the witnesses reported that he had observed a vapor or mist trail aft of the number 2 engine that was different than the smoke patterns aft of the other engines during the approach to runway 21L. The Safety Board determined that there had been recent, significant leakage of engine oil from the number 2 engine. However, the analysis did not confirm positively that there was significant leakage of engine oil on the accident flight or that leakage from the number 2 engine was limited to engine oil.

The Engines and Propellers

N517SJ was powered by four Allison 501-D22A turboprop engines driving Hamilton Standard 54H60-117 four-blade, full-feathering, reversible-pitch propellers. The engines were serviced with Exxon 2380 turbo oil, and the propellers were serviced with MIL-H-5606E hydraulic fluid.

The Safety Board's examination and testing of the engines, propellers, and related accessories was conducted in stages, beginning at the accident site and then continuing at overhaul and test sites.

All of the propeller components that were not attached to the individual assemblies were found along the wreckage path except for a few small blade sections of the number 3 propeller that were found about 700 feet north-northeast of the remainder of the number 3 propeller. The damage to the propeller and to the right side of the fuselage revealed evidence that the rotating number 3 propeller contacted the fuselage during the impact and breakup of the airplane. The blade roots of all 16 propeller blades were retained within their respective hubs. The propeller blades of engines 1 and 2 showed evidence of less power at impact than did the blades of engines 3 and 4. The propeller disassembly inspections revealed blade shim plate impact marks which were consistent with impact blade angles of 28° to 30° for propeller numbers 1, 2, and 3 and a blade angle of 33° to 35° for propeller number 4. Further examination and testing revealed no evidence of pre-impact malfunction of the propellers.

All of the engines had suffered impact damage, but only the compressor inlet and accessory gearbox section of the number 1 engine power section suffered major fire damage. The accessory gearbox of the number 1 engine was destroyed by fire. The accessory gearbox of the number 2 engine was attached; the accessory gearboxes of the numbers 3 and 4 engines were separated and damaged by impact forces. All of the power section magnetic chip detectors were free of magnetic particles.

The numbers 1, 3, and 4 engine power sections were disassembled to expose the compressor sections, the combustion sections, the turbine sections, the engine bearings, and the compressor air bleed valves. The number 2 power section was disassembled to expose the turbine section; the compressor air bleed valves and engine accessories were removed for further examination. The number 2 power section was subsequently reassembled (substituting serviceable parts where necessary) for a test run.

All of the internal surfaces and components of the numbers 4 and 2 engine compressors were coated with a tar-like residue. A similar but less extensive oil/tar residue coated the internal components of the number 3 and 4 compresses. The number 3 and 4 compressors also had ingested mud or dirt in the impact sequence, &utdirt ingestion was not noted in compressors 1 and 2. Similarly, it was noted that the number 1 and 2 compressor 5th and 10th stage air bleed valve interior anti exterior surfaces were coated with an oil/tar residue that impeded the proper actuation of some of the 5th stage valves. The contact surfaces between the bodies of two of the number 2 compressor fifth stage air bleed valve assemblies and their respective pistons showed a heavy unbroken coating of residue indicating that these valve assernblies were not closing during engine operation. A third fifth stage air bleed valve from the same engine showed evidence of partial closing during engine operation. Attempts to positively identify the adhering residue were inconclusive.

The turbine sections of the numbers 3 an3 4 engines exhibited heavy blade rub and bending or curlin% of blades in the direction opposite turbine rotor rotation. By contrast. the turbine %lades of the number 1 en%ine evidenced light blade rub; turbine blade rub was not observed in the num%er 2 engine. This evidence in combination with the condition ot the propeller blades indicated that the numbers 3 and 4 engines were operating and delivering power to their propellers until impact with the ground. The condition of the engine compressor sections of engine numbers 1 and 2 indicated that while the engines were operating, the engines sustained a power loss, related to oil/tar accumulation in the compressors and air bleed vaives, before impact.

To resolve further the ability of the numbers 1 and 2 engines to produce power, the number 2 engine power section was tested at the Allison Gas Turbine Division (of the General Motors Corporation), Indianapolis, Indiana. The examination of the engine before the test revealed a tar-like substance coating the compressor gas path and on various external engine surfaces in addition to the air bleed valves. Damage to several components required their replacement in order to accomplish the tests. Thus, the 5-4 bleed manifold and seat. two fittings, and one bleed system hose were replaced.

In one test, all of the bleed valves were replaced with functional valves. It was subsequently found that the replacement 5-1 valve did not actuate properly because of a plugged high pressure bleed hose. The tar-coated 5-1 bleed valve operated when tested. The tar-coated 5-4 valve would not open properly but could not be tested because of apparent impact damage. With functional bleed valves installed, the engine produced 88 percent of rated power at the take-off power point (a 12 percent loss), over 20 percent loss in surge line, 9.6 percent loss in airflow, and 5.5 percent loss in compressor efficiency. These test results indicated that the number 2 engine was incapable of delivering normal power at the time of the accident.

A compressor wash using B & B 3100 cleaner (prescribed for the Allison 501-D22A engine) was only slightly effective in restoring power. Walnut shell cleaning resulted in substantially improved engine performance. After such cleaning, the engine exhibited 100 percent of rated power at the take-off power point. restoration of over half of the surge line deterioration, airflow within 2.4 percent of a normal production unit, and the compressor efficiency was within 1.3 percent of normal.

Sound Spectrum Examination

An examination of the sounds recorded by the CVR cockpit area microphone allowed the Safety Board to document engine sound frequencies and to calculate associated engine speed in revolutions per minute (rpm). The sounds documented could not be positively attributed to specific engines using the sound spectrum information alone; but in combination with other information, conclusions specific to some of the engines were substantiated.

The sound spectrum indicated normal operation of all engines in the seconds before touchdown on the runway. After touchdown, during the time when the go-around was being initiated. the sound frequency plot indicated that two engines decelerated about 40 percent rpm while the other engines continued to operate at the engine's normal governed operating speed of 100 percent.

It was noted that the recording speed of the CVR initially slowed during the reduction in engine speed described above and that electrical power to the CVR was interrupted briefly, indicating a transfer of electrical power from the number 2 engine-driven generator (which powers the CVR) to a generator driven by another engine. The recording speed of the CVR returned to normal immediately after ?he electrical power transfer.

The recording speed of the CVR is dependent on the frequency of its input voltage. Therefore, when it was established that the recording speed of the CVR returned to normal after the electrical transfer, it was concluded that the CVR had been transferred to an engine-driven generator still operating at or near 100 percent. Only one electrical power interruption was indicated by the CVR recording. With the electrical power distribution of the airplane, electrical power would have been initially transferred to an electrical bus powered by the number 1 enginedriven generator (following a loss of power from the number 2 engine-driven generator), unless that generator was operating at a speed lower than its generator cutoff speed (90 percent). In the event of a loss of electrical power from the numbers 1 and 2 engine-driven generators, the electrical power to the CVR would have come from an electrical bus powered by the number 3 engine-driven generator. Since there was only one electrical bus transfer and there was other evidence of a loss of power involving the number 1 engine, it was concluded that the power loss involving the number 1 engine preceded or occurred simultaneously with ?Re loss of power from engine number 2, and the number 3 engine-driven generator assumed the electrical load of the CVR. The sound frequency plots showed that at least the number 3 engine and probably number 4 operated in the 100 percent rpm range after the electrical transfer and until the end of the recording.

Aircraft Performance

The landing go-around performance of the accident airplane was examined to determine whether it was consistent with the predicted performance of an L-382 either with a loss of power from the number 2 engine alone or with a loss of power from engines 1 and 2 in combination. The airplane gross weight at impact was about 83,541 pounds. The Safety Board found that the airplane was loaded in accordance with the applicable weight and center of gravity limitations. Stall speeds (1 G) for the L-382 with flaps fully extended and with flaps retracted are 78 knots and 96 knots, respectively. The Airplane Flight Manual contained three-engine air minimum control speed (Vmca) data. In this case, Vmca data, assumes maximum permissible power on all operating engines, the inoperative engine's propeller windmilling, full rudder deflection, 5° of bank away from the inoperative engine, gear down, and flaps at 50 percent. The applicable three-engine Vmca assumes a loss of power from the most critical engine (number 1). With the loss of the number 1 engine and the environmental circumstances of the accident, Vmca would have been about 103 knots. A loss of power from the number 2 engine alone would have been significantly less critical because of the reduced asymmetry of thrust in that condition. Under those circumstances directional control could have been maintained at the airplane's stall speed and Vmca would thus not have been a factor.

The failure of one of the airplane's four engines is not normally considered to be critical from the standpoint of continued safe operation. However, the failure of a second engine would present a substantially more significant problem, particularly when the two inoperative engines were on the same side. The yawing moment caused by the most adverse thrust asymmetry, occurring when the two operating engines are at high power, is significantly higher than the yawing moment with only one engine inoperative. Consequently, the aerodynamic force required for the airplane's rudder to prevent an uncontrollable yaw is greater. That force is a function of airspeed and rudder deflection.

The force required to deflect the rudder against airloads on the L-382 airplane is boosted by hydraulic system pressure. Under normal circumstances for landings, that is with flaps extended beyond the 15 percent (flap handle) position, the independent utility and booster hydraulic systems supply 3,000 pounds per square inch (psi) operating pressure to separate halves of a tandem actuating cylinder that positions the rudder. When either of these hydraulic systems is inoperative. for example, with the complete loss of both engines or engine-driven hydraulic pumps) on one wing, the force available to deflect the rudder is halved. Further, when the wing flap handle is placed in a position less than 15 percent extended, the operating pressure of both systems at the rudder boost actuator is reduced from 3,000 to 1.300 psi. Therefore, under circumstances when both engines on one wing are inoperative <u>and</u> the flap handle is raised, the force available from the rudder boost actuator is reduced to approximately 21 percent of the force available during normal operation.

The combined effect of the yawing moment and the reduced rudder boost actuator force result in a significantly higher Vmca. The airplane manufacturer calculated that the applicable Vmca could be as high as 177 KIAS under conditions wherein the numbers 1 and 2 engines were inoperative (with the utility hydraulic system depressurized). the number 1 propeller was windmilling. the number 2 propeller feathered. and the flap handle was in the retracted position.

The airplane's flaps receive hydraulic pressure from the utility hydraulic system and the utility hydraulic system receives pressure from the number 1 and 2 engine-driven hydraulic pumps. The flaps cannot be extended hydraulically without utility system pressure, but they can be extended manually using an emergency procedure and a handcrank. The handcrank is not located in the cockpit and requires about 650 turns for full travel of the flaps. Since the CVR revealed no conversation regarding use of the manual flap extension/retraction system and little time was available to implement the procedure, the Safety Board concluded that the procedure was not used.

Normally, full flap extension or retraction by the hydraulic system requires 10 to 13 seconds. The flaps are driven to their extended positions by mechanical drive screw assemblies and are held in position by spring-loaded flap brakes; thus, loss of hydraulic pressure would not allow flap positions to be altered by air loads. Since a crewmember called, "Flaps up," and the flap handle was found near the up position and other evidence that indicated that the flaps were in an intermediate position. it was concluded that there was sufficient utility system hydraulic pressure to release the flap brakes.

Crew Decisions

Examination of the cockpit conversation revealed that the captain had been concerned before touchdown that the pitch attitude established by the first officer was incorrect for landing. One second before touchdown, the captain advised his student to start raising the nose. The FDR documented a positive G spike to 1.45 at touchdown followed by a reduction in G loading to a value below 1.0. The captain assumed control, and according to FDR data and CVR conversation, the captain rapidly advanced the throttles and corrected a high nose-up pitch attitude as he initiated the go-around.

The evidence indicates that the number 1 and 2 engines both failed to respond normally, and in fact. decelerated about 40 percent following throttle advancement at the commencement of the go-around. Despite the power loss, it is likely, at 60 percent rpm, that at least one of the two engines was producing sufficient power to maintain hydraulic pressure on the utility system, albeit at some possible reduction in available pressure versus flow rate. Also, at the commencement of the go-around, it is likely that the flap handle remained in an extended position. consistent with the 100 percent flap position selected for landing. Thus. full (3,000 psi) hydraulic pres . e to the rudder booster actuator was probably available initially, and the vawing moment produced by the asymmetry of thrust (with partial thrust from number 1 and 2 engines and full thrust from number 3 and 4 engines) was probably initially controllable with rudder deflection.

However, 13 seconds after the captain assumed control, a crewmember said, "Flaps up." Apparently in response, the flap handle was raised ana flap retraction began. The flaps did not retract completely, but reached the 35 percent extended position which is an indication that utility hydraulic system pressure probably was available in the last seconds of the flight. The action of retracting the flaps produced two adverse effects which probably resulted in an inability of the crew to retain directional control of the airplane: (1) the movement of the flap handle to the retracted position would have reduced rudder boost actuator pressure from 3,000 to 1,300 psi; and (2) the demand for utility system hydraulic flow to the flap system might have resulted in a significaot reduction of pressure in that system. The conseqoence of this action woul have been a reduction in available rudder force, and a sudden decrease in rudder deflection (despite the efforts of the crew). Under these conditions Vmca was significantly higher than the actual air speed and the airplane began an uncontrollable yaw to the left. The immediate increase of aerodynamic drag further aggravated th2 controllability problem to preclude the possibility of recovery in the go-around.

Tie Safety Board does not fault the captain's initial decision to commence the go-around when he became aware that the airplane was not in a position to properly continue the landing. However, soon after the captain advanced the throttles, he should have become aware of the asymmetrical thrust condition. This awareness should have been reinforced by crewmember comments, the sounds of the engines winding down, and the rhanges in engine instrument indications. The captain had substantia! warning that the airplane was experiencing a loss of power from at least one engine, but that information did not become apparent unti! the go-around had been commenced. After the go-around was commenced, it is apparent that the captain either did not recognize promptly that power had been lost from two engines or that the loss of power would potentially render the airplane uncontrollable at the speed a which the go-around was commenced.

In retrospect, it is clear that the best decision a? that time would have been to reland the airplane. However, the captain was able to maintain runway heading for about 10 seconds, and hirdecision to continue may have been influenced initially by the absence of an apparent control problem. Also, the pilot may have been able to control the airplane. depending on the degree of engine power available. were it not for the decision to raise the flap handle to the retracted position, a decision which was contrary to engine inoperative emergency procedures. The Safety Board believes that the loss of directional control began before the command to raise the flaps. but was aggravated by the movement of the flap handle which reduced system hydraulic pressure and rudder effectiveness. The decision to raise the flaps during the go-around was not only incorrect but it contributed to the cause of the accident by rendering the airpiane uncontrollable.

In that the captain continued the go-around until control was lost rather than attempting to reland at the first indication that heading and roll control could not be maintained, the Safety Board also believes that the captain's decision contributed to the consequences of the accident. Apparently. the captain did not recognize that the loss of power experienced by the airplane would render the airplane uncontrollable at the speed at which the go-around was commenced. The Safety Board believes that his continuing the go-around after receiving cues associated with a loss of power from one or more engines must have been influenced by a conviction that the airplane could be flown out of its precarious circumstance.

Engine Maintenance

A detailed inspection of the available airplane maintenance records was conducted to resolve the source of tire turbo-engine oil residues observed on the horizontal surfaces aft of the number 2 engine and the source of the tar-like residues found in the compressor gas path of the number 2 engine and on the air bleed valves of three engines. The maintenance records indicated that the required scheduled maintenance checks ana inspections were accomplished OR time. All applicable airworthiness directives and service instructions had been accomplished. The airplane was manufactured in 1974 and had beer: operated 17,026 hours and 8,146 cycles. All of the engines had been operated in excess of 8,000 hours since overhaul. The most recent engine change (number 1) occurred on March 26, 1987.

However, the engines and propellers had a recent history of oil leaks. The number 2 engine propeller was changed on April 3, 1987, 5 days before the accident Some of the recent reports and actions indicating oil usage or leaks follow:

March 12 - #3 prop oil low; added 1 quart.

March 30 - X2 prop oil light came on; added 1 quart.

> March 31 - Check #2 prop oil and service, oil light on; serviced prop with 1 quart oil.
>
> April 1 - Engine #1 oil low; added 6 quarts. Engine #2 oil low;. added 4 quarts: #3 engine oil low; added 3 quarts. #4 engine oil low; added 4 quarts.
>
> April 3 - X1 prop oil light came on in flight, continued operation for 1.5 hours with prop oil light on. Serviced prop, 1 quart low; serviced engine. 3 quarts low.
>
> April 6 - #1 prop oil Sight came on in flight, flew aircraft with prop low light on 2 hours. Replaced #1 pump housing and valve assembly.

Allison and SAT Maintenance Manuals contained a procedure for nonroutine cleaning of the engines using a liquid cleaner in the event of propeller or engine oil leaks. The SAT procedure required the washing of engine compressors "anytime visible contamination exists, after exposure to prop oil, or compressor contamination is suspected." There was no company procedure for routine compressor cleaning. Although there were several reports and indications of propeller and engine oil leaks involving N517SJ in the 90-day period preceding the accident, there was no record that SAT cleaned the compressors of the engines on N517SJ following any of the incidents

An SAT mechanic who inspected the airplane before the April 8, 1987 flights, reported that he did not observe any visible contamination of the engines that would have required engine cleaning. Also, recent flight engineer logs for the airplane provided a record of normal turbine inlet temperatures, normal engine torque indications, normal fuel flow, and normal rated power indications through April 3, 1987. (flight engineer records were not available beyond April 3.) These records and the April 8 inspection indicated to the Safety Board that any deterioration in the condition of the engines was not readily apparent by external inspection or by the performance of the engines at least until 5 days before the accident. Thus, it was indicated that the accumulation of oil residues within the engine compressors had only begun to degrade engine performance in the last few days before the accident If the SAT mechanic's preflight evaluation of the engines was correct, then there would be reason to conclude that substantial propeller or engine oil leakage occurred during the accident flight. However, the nature of the residues within the engines indicated tong term contamination.

While the maintenance records did not suggest a specific source of an oil leak that might have occurred on the accident flight, the records did indicate that there had been many lost opportunities to remove potentially damaging oil residues from the engines following oil leakage on other recent flights. The Safety Board believes that the failure of SAT maintenance to clean the engine compressors following oil leaks in the months before the accident allowed the accumulation of oil residues in the engines and made the engines susceptible to related performance problems. Consequently, these maintenance omissions are considered to have been a cause of the accident.

The Safety Beard believes that the performance ob the number 2 engine during its testing in Indianapolis was indicative of the performance problems experienced by both the numbers 1 and 2 engines on the accident flight. Because of the components that had to be replaced during the testing, the test results, aithough unacceptable for an in-service engine. probably exceeded the performance of the engine immediately before the accident. Although the examination and testing of the engine did not revea! the exact source of an oil ieak on the accident flight, the testing did show conclusively how accumulated oil residues in the compressors of turbopropeller engines could impede the performance of the engine and propeller in response to rapid throttle movement. The testing did not substantiate whether it was engine oil or propeller oil or a combination of oils that was responsible for the accumulation sf oil residues that impeded engine performance. In that the propellers are designed to provide airflow through the engine inlet, it is concluded that either propeller or engine oil leakage had the potential to cause the degradation of performance indicated in the numbers 1 and 2 engines. Either could have introduced the oil that accumulated within and impeded the performance of the number 1 and 2 engines. The Safety Board believes that the lack of power section response from the number 1 and 2 engines was directly attributable to the accumulated oii residues in the dirty compressors and air bieed valves. This condition rendered the engines unable to respond to or recover from rapid throttle movement and the inability of the power sections to provide the power needed to support normal propeller blade angle mechanical scheduling. As a result, the number 1 and 2 engine rotor speeds decreased causing substantial thrust asymmetry and increased Umca.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was inadequate Southern Air Transport engine maintenance which allowed the accumulation of oil residues in the engine compressor sections until two engines were incapable of responding to rapid demands for increased power. Contributing to the accident was the continuation of the go-around by the captain after power had been lost from two engines and the movement of the flap handle to the flaps retracted position during the go-around.

The attached brief of accident contains the Safety Board's findings.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES L. KOLSTAD
Acting Chairman

/s/ JIM BURNETT
Member

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

/s/ LEMOINE V. DICKINSON, JR.
Member

October 10,1988

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

File No. - 193   4/08/87   TRAVIS AFB,CA   A/C Reg. No. N51791   Time (Lcl) - 1732 PDT

----Basic Information----

Type Operating Certificate-AIR CARRIER - FLAG/DOMESTIC
Type of Operation -INSTRUCTIONAL
Flight Conducted Under -14 CFR 91
Accident Occurred During -DESCENT

Aircraft Damage: DESTROYED
Fire: ON GROUND

Injuries	Fatal	Serious	Minor	None
Crew	5	0	0	0
Pass	0	0	0	0

----Aircraft Information----

Make/Model - LOCKHEED L-382G
Landing Gear - TRICYCLE-RETRACTABLE
Max Gross Wt - 155000
No. of Seats - 5

Eng Make/Model - ALLISON 501-D22A
Number Engines - 4
Engine Type - TURBOPROP
Rated Power - UNK/NR

ELT Installed/Activated - UNK/NR
Stall Warning System - YES

----Environment/Operations Information----

Weather Data
Wx Briefing - COMPANY
Method - IN PERSON
Completeness - FULL
Basic Weather - VMC
Wind Dir/Speed- 220/010 KTS
Visibility - 40.0 SM
Lowest Sky/Clouds - 3000 FT SCATTERED
Lowest Ceiling - NONE
Obstructions to Vision- NONE
Precipitation - NONE
Condition of Light - DAYLIGHT

Itinerary
Last Departure Point
SAME AS ACC/INC
Destination
SAME AS ACC/INC

ATC/Airspace
Type of Flight Plan - IFR
Type of Clearance - IFR
Type Apch/Lndg - ILS-COMPLETE
STRAIGHT-IN
GO AROUND

Airport Proximity
ON AIRPORT

Airport Data
TRAVIS AFB
Runway Ident - 21L
Runway Lth/Wid - 10995/ 300
Runway Surface - ASPHALT
Runway Status - DRY

----Personnel Information----

Pilot-In-Command
Certificate(s)/Rating(s)
ATP
ME LAND

Age - 46
Biennial Flight Review
Current - YES
Months Since - 4
Aircraft Type - L382G

Medical Certificate - VALID MEDICAL-WAIVERS/LIMIT

Flight Time (Hours)
Total - 8600
Make/Model- 8000
Instrument- UNK/NR
Multi-Eng - UNK/NR
Last 24 Hrs - 5
Last 30 Days- 34
Last 90 Days- 99
Rotorcraft - UNK/NR

Instrument Rating(s) - AIRPLANE

----Narrative----

CRASHED IN STEEP LEFT TURN DRG GO-AROUND AFTER BALKED LANDING. INSTRUCTOR TOOK CONTROLS AND INITIATED GO-AROUND AFTER STUDENT LNDD IN IMPROPER ATTITUDE. ENGINES NUMBER 1 & 2 FAILED TO RESPOND WHEN THROTTLES ADVANCED. BOTH ENGINES DECELERATED. AIRSPEED DECREASED DURING GO-AROUND. FLAPS WERE RETRACTED CAUSING REDUCTION IN HYD PRESSURE. INSTRUCTOR UNABLE TO MAINTAIN VMC SPEED, LOST CONTROL. ACFT DESTROYED BY POSTCRASH FIRE. AIRFIELD PERIMETER FENCE DMGD. TEARDOWN AND TESTING REVEALED HEAVY ACCUMULATION OF OIL/TAR RESIDUES ON BLEED VALVES AND THROUGHOUT ENGINES NUMBER 1 & 2 COMPRESSORS, LIMITING ABILITY OF ENGINES TO RESPOND TO THROTTLE MOVEMENT. HISTORY OF RECENT ENGINE AND PROPELLER OIL LEAKS. NO RECORD OF ENGINE WASHES AFTER LEAKS, ALTHOUGH REQUIRED BY MAINTENANCE PROCEDURES. FOR FURTHER INFORMATION, SEE SUMMARY REPORT NTSB/AAR-88/03/SUM.

File No. - 193 4/08/87 TRAVIS AFB,CA A/C Reg. No. N517SJ Time (Lcl) - 1732 PDT

Occurrence #1 LOSS OF POWER(PARTIAL) - MECH FAILURE/MALF
Phase of Operation APPROACH - GO-AROUND (VFR)

Finding(s)
1. COMPRESSOR ASSEMBLY - CONTAMINATION
2. MAINTENANCE - INADEQUATE - COMPANY MAINTENANCE PSNL
3. COMPRESSOR ASSEMBLY - FAILURE,PARTIAL
4. FLUID,OIL - OTHER

Occurrence #2 LOSS OF CONTROL - IN FLIGHT
Phase of Operation APPROACH - GO-AROUND (VFR)

Finding(s)
5. AIRCRAFT PERFORMANCE,TWO OR MORE ENGINES - FAILURE,PARTIAL
6. GO-AROUND - CONTINUED - PILOT IN COMMAND
7. RAISING OF FLAPS - IMPROPER -
8. HYDRAULIC SYSTEM - LOSS,PARTIAL
9. FLT CONTROL SYST,RUDDER CONTROL - MOVEMENT RESTRICTED

Occurrence #3 IN FLIGHT COLLISION WITH TERRAIN
Phase of Operation DESCENT - UNCONTROLLED

Occurrence #4 FIRE
Phase of Operation OTHER

----Probable Cause----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident is/are finding(s) 1,2,3,4

Factor(s) relating to this accident is/are finding(s) 5,6,7

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