SA-415 FILE NO. A-0002

AIRCRAFT ACCIDENT REPORT

COMPANIA DOMINICANA de AVIACION
DOUGLAS DC-4, CARVAIR ATL. 98, HI-168
NEAR MIAMI INTERNATIONAL AIRPORT
MIAMI, FLORIDA
JUNE 23,1969
ADOPTED: AUGUST 12, 1970

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20591
REPORT NUMBER: NTSB-AAR-70-17

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SYNOPSIS

Dominicana Airlines, Flight 401, a DC-4, Carvair ATL. 98, Dominican Republic registry HI-168, operating as a cargo flight from Miami, Florida, to Santo Domingo, Dominican Republic, crashed shortly after takeoff from Miami International Airport on June 23, 1969, about 1542 e.d.t. The aircraft was destroyed by impact and the ensuing ground fire. Several buildings in the area of the accident site were also damaged.

The four occupants of the aircraft, three crewmembers and one non-revenue Dominican Republic military pilot, as well as six persons on the ground, were fatally injured.

Immediately after the aircraft passed over the end of Runway 12 following takeoff, the FAA local controller, in the tower, advised the flight that heavy white smoke was being emitted from the No. 2 engine and that they were cleared for landing on any runway. The flight acknowledged this communication and advised the tower that they were returning to the airport for landing.

Witnesses reported black puffs of smoke coming from the vicinity of the No. 4 engine prior to the emission of white smoke from the No. 2 engine; the aircraft continued climbing on runway heading for a short distance, attaining an altitude of approximately 300 feet; the propeller of the No. 4 engine was feathered shortly after takeoff; white smoke from the No. 2 engine intensified; a left turn back toward the airport was initiated and altitude was lost, as the turn continued. Ultimately, the aircraft crashed into buildings located approximately 1 mile from the approach end of Runway 27.

The Safety Board determines that the probable cause of this accident was the confused action on the part of the crew while attempting to cope with the catastrophic failure of an engine during takeoff.

The Safety Board has recommended that the FAA initiate a study, in full coordination with the Civil Aeronautics Board and the Department of State, to determine the feasibility of formulating a policy which would permit reciprocity in surveillance and inspection, by the parties to a bilateral air route agreement. Such a policy should assure acceptable adherence to the safety standards established pursuant to the bilateral agreement.

1. INVESTIGATION

1.1 History of the Flight

Dominicana Airlines (CDA) Flight 401, a Douglas DC-4, Carvair ATL. 98 of Dominican Republic Registry (HI-168) was operating as a cargo flight from Miami International Airport, Miami, Florida, to Santo Domingo, Dominican Republic, when it crashed shortly after take-off on June 23, 1969, at approximately 1542 e.d.t. 1/

The aircraft, HI-168, arrived at the Miami International Airport at 1800 on June 16, 1969, after a nonrevenue flight from Santo Domingo. The copilot of the trip stated that the flight was routine and that no aircraft discrepancies were experienced or reported. This crew returned to Santo Domingo the same day on another company aircraft, leaving HI-168 in Miami for a scheduled cargo flight departure on June 22.

Early on the morning of June 22, the aircraft was loaded with 15,368 pounds of cargo and was serviced for a scheduled departure at 1700. The captain and flight engineer, who had flown the aircraft to Miami on June 16, returned to Miami on the afternoon of the 22nd, along with another company copilot scheduled for this trip. The scheduled departure on the 22nd was cancelled by the captain because of the possibility of its arrival in Santo Domingo after 2000, which is contrary to established company policy. Prior to departing the ramp area, the flight engineer determined the amount of fuel on board through use of a "dip-stick." The captain then requested the tanks be "topped off," and the refueling truck was requested to be at the aircraft at 0900 the next day. Flight 401 was then rescheduled to depart in the morning of June 23.

In the morning of June 23 three air conditioners were placed aboard the aircraft, bringing the total cargo load to 15,758 pounds. The aircraft was serviced with the 202 gallons of additional fuel requested by the captain.

Records of the fueling company, which supplied aviation gasoline to the aircraft prior to the departure, indicate the aircraft was defueled on June 17. This was done so that the aircraft could be weighed for weight and balance purposes, following removal of some galley equipment, prior to the flight to Miami on June 16. After the weighing of the aircraft, the fuel (926 gallons) was returned to the aircraft. In addition, the fueling company records indicate that on June 21, 934 gallons were placed in the fuel tanks. On June 23, 151 gallons were added to the No. 4 main tank and 51 gallons to the No. 1 main tank.

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

About 1316 on June 23, Flight 401 departed the northwest cargo area; however, shortly thereafter, it returned to the ramp due to a reported high oil pressure (135 p.s.i.) 2/ indication on the No. 4 engine.

Two mechanics 3/ were contracted by Dominicana to perform the required maintenance on the No. 4 engine and the oil pressure relief valve was adjusted. According to the crew, the oil pressure indication in the cockpit was then within satisfactory limits.

At approximately 1530, Flight 401 was cleared to taxi from the northwest cargo area to Runway 9 left (L) and thence to Runway 12 for departure. At 1539, the flight was cleared to taxi into position and hold, on Runway 12. At 1541:05, Dominicana 401 was cleared for takeoff. The takeoff was begun and, at 1542:30, the local controller in the tower cab observed smoke coming from the aircraft and advised the flight: "Dominican 401 heavy white smoke, Number Two Engine, you're cleared to land any runway." The flight replied: "Four zero one."

At 1544:15, Dominicana 401 advised the tower, "Four zero one is gonna land on niner right." The local controller replied: "You're cleared to land four zero one straight in." At this time, the aircraft was east of the airport, heading toward Runway 27 right. This was the last radio communication between the tower and Dominicana 401. 4/

The local controller, handling the flight, observed the flight during the takeoff run and stated that shortly after the aircraft lifted off, as it was crossing the intersection of Runways 12 and 9R, the No. 4 engine propeller was in the feathered position. As the aircraft was passing the end of Runway 12, two puffs of black smoke, followed immediately by heavy white smoke, came from the No. 2 engine. At this point, the controller advised the flight of the smoke from No. 2 engine and cleared it for landing on any runway. The aircraft proceeded on runway heading, climbing to an altitude of approximately 300 feet, turned eastward, then northward, and finally turned back toward the airport. From the time the aircraft entered the first turn, it began a steady, slow descent that continued until impact with the buildings.

2/ The normal operating oil pressure range is between 40 to 80 p.s.i. The recommended and placarded operating oil pressure is 85 ± 5 p.s.i. at 60° C. oil temperature and 2,000 r.p.m.

3/ The required maintenance on the oil pressure relief valve was performed by two Columbian certificated mechanics employed by Aero Conder, Inc., of Miami, Florida.

4/ All radio communication from Dominicana 401 to the tower, as identified by CDA officials, were made by the copilot.

Another tower controller observed Dominicana 401 as it became airborne and, at that time, he noted nothing unusual about the aircraft or the engines. However, as the aircraft approached the airport boundary, puffs of light colored smoke were observed "spitting" from the No. 2 engine. As the aircraft proceeded over the airport boundary, the smoke changed to a steady, light-colored stream which continued throughout the remainder of the flight. At no other time was the aircraft's altitude more than 300 feet. As the aircraft turned to the east and then northward, it began to lose altitude. The loss of altitude continued as the aircraft made a gradual turn westward back toward the airport and finally disappeared from view, east-northeast of the airport. Flames and two large columns of black smoke were observed in the vicinity where Dominicana 401 had disappeared.

The ground controller in the tower observed black puffs of smoke coming from the right side of the aircraft when the aircraft was just becoming airborne and had reached an altitude of 10 to 15 feet above the intersection of Runways 35 and 12. Thereafter, when the aircraft reached a point one-half and three-quarters of a mile off the end of the runway, the No. 2 engine "started smoking real bad."

The cab controller in the tower testified that puffs of black smoke were coming from the No. 4 engine during the takeoff.

The captain of a commercial airliner, which had just landed on Runway 9L and was taxiing toward the tower, observed Dominicana 401 just after it became airborne near the intersection of Runways 12 and 9R. Puffs of black smoke were emanating from one of the engines on the right side of the aircraft. Seconds later, heavy "white-yellow" smoke streamed from the No. 2 engine, at which point the aircraft went out of his view behind the terminal building.

Another airline pilot, approximately one-quarter of a mile southeast of the departure end of Runway 12, observed Dominicana 401 as it was crossing the airport boundary at an altitude of approximately 100 feet and flying directly toward, his position. All four engines were turning and heavy white smoke was emanating from the No. 2 engine. As the aircraft passed overhead in this condition, proceeding southeast away from his position, he observed the No. 4 propeller come to the feathered position. Immediately following, the smoke from the No. 2 engine subsided momentarily to a few puffs, and then the No. 2 propeller appeared to windmill to a stop. The aircraft continued to climb to an altitude of between 300 and 350 feet and then commenced a turn to the left. The aircraft then began to lose altitude and finally disappeared from his view.

Another witness, who was located approximately 2 miles east-southeast of the airport, observed Dominicana 401 as it passed directly over his position, proceeding eastward. At this point, the aircraft was at an altitude of approximately 125 feet, the landing gear and flaps were up, the No. 4 propeller was in the feathered position, and the No. 2 engine was windmilling and emitting heavy black smoke. The other two engines (Nos. 1 and 3) sounded as if they were at or near maximum power. After the flight passed his position, a column of heavy white smoke replaced the black smoke that had been previously observed. The aircraft then commenced a shallow turn to the left and disappeared from his line of sight.

Witnesses in the vicinity of the impact site observed the aircraft just prior to the accident. The consensus was that the No. 4 propeller was feathered and that heavy white smoke was trailing from the No. 2 engine at this point. The aircraft was also observed to be in an extremely nose-high attitude, with the landing gear and flaps in the up position.

The descent continued until the aircraft finally struck power lines and the tops of buildings located on the south side of 36th Street, just east of N. W. 33rd Avenue. The aircraft continued across N. W. 33rd Avenue and struck a single-story business structure where it came to rest. Fire broke out immediately and consumed most of the aircraft and the building. The impact site was approximately 1 mile east of Miami International Airport.

The accident occurred at 1542 during daylight conditions.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	4	0	6
Nonfatal	0	0	12
None	0	0	

All occupants of the aircraft, three crewmembers and a nonrevenue Dominican Republic military pilot, received fatal injuries in the crash. Six persons on the ground also were fatally injured as a result of the aircraft impact, debris from the aircraft and/or building structures, or fire.

In addition, 12 other persons on the ground received nonfatal injuries resulting from flying debris and/or fire.

Post-mortem examination of the flight crewmembers revealed no evidence to indicate any pre-existing disease that would have affected the performance of their duties.

X

1.3 Damage to Aircraft

The aircraft was destroyed by impact and resulting fire.

1.4 Other Damage

A series of buildings between N. W. 32nd Avenue and N. W. 35th Avenue on N. W. 36th Street were damaged by impact and fire. A single-story auto body paint and repair shop, which the aircraft impacted, was destroyed by the impact and ensuing fire. Numerous motor vehicles, either parked in this area or proceeding on N. W. 36th Street, were also damaged by debris from the aircraft and/or the buildings, or the fires that resulted from the crash. Electrical powerlines on poles along the N. W. 36th Street and 33rd Avenue were severed.

1.5 Crew Information

All of the crewmembers held appropriate certificates issued by the Dominican Republic, and, in accordance with the bilateral air transport agreement between the United States and the Dominican Republic, as well as provisions of the Chicago Convention of the International Civil Aviation Organization (ICAO) of which both nations are signatories, they were qualified to conduct this flight. (For detailed information, see Appendix B.)

1.6 Aircraft Information

The aircraft was certificated and maintained in accordance with the airworthiness requirements of the Dominican Republic. (For detailed information, see Appendix C.)

HI-168 was originally configured with eight fuel tanks (four main tanks and four auxiliary tanks). The two inboard auxiliary tanks (auxiliary tanks Nos. 2 and 3), which are of fabric construction, were removed by Iberia Airlines prior to delivery of the aircraft to CDA. The cockpit fuel selector valves for these two tanks were blocked off, the fuel gauges were removed from the instrument panel, and the refueling caps were blocked off.

The aircraft "actual takeoff weight" as depicted on the load sheet for the flight was 68,270 pounds. This weight should be adjusted, however, to account for the following changes which occurred after computation of the load sheet:

2,772 lbs.	extra fuel added
160 lbs.	additional crewmember
- 592 lbs.	less cargo
- 300 lbs.	fuel burnoff due to taxiing and warmup
2,040 lbs.	total addition.

The gross weight for takeoff, as recomputed in light of the above, would have been 70,310 pounds. This figure should have appeared on the load sheet.

Following the accident, Board investigators made a further recomputation of weight, allowing 600 pounds of additional fuel burn-off to account for the extra taxiing and runups performed prior to takeoff. Subtracting this 600 pounds from the 70,310 pounds, referred to above, yielded an estimated actual gross takeoff weight of 69,710 pounds. This weight is based on gasoline weighing 6 pounds per U. S. gallon. The maximum allowable gross takeoff weight computed for altitude (sea level) and temperature (89° F.) as specified in the CDA flight manual is 69,200 pounds. CDA dispatching papers do not reflect weight restrictions due to altitude and temperature.

The center of gravity (c.g.) was computed to be at 16 percent of the Mean Aerodynamic Chord (MAC), which was within the specified limits of 14.2 to 28.4 percent MAC.

1.7 Meteorological Information

The surface weather observations recorded by the Weather Bureau at Miami International Airport immediately preceding and following the accident were as follows:

1530 - 3,000 feet scattered clouds, higher light broken clouds, visibility 10 miles, wind 170° at 7 knots. Remarks: Thunderstorm southeast with cumulus build-ups to the west.

1544 - 3,000 feet scattered clouds, higher light broken clouds, visibility 10 miles, pressure 1013.4 millibars, temperature 89° F., dew point 74° F., wind 150° at 7 knots, altimeter setting 29.92 inches.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

There were no reported communication difficulties between Dominicana 401 and the Miami Tower. The only communications made during the flight were those between the copilot and the FAA local controller which are reported in Section 1.1 History of the Flight.

1.10 Aerodrome and Ground Facilities

Runway 12, which was utilized by the flight for takeoff, is 9,604 feet long and 150 feet wide.

1.11 Flight Recorders

No flight data or voice recorders were installed in this aircraft nor were they required.

1.12 Wreckage

Examination at the crash site indicated that the aircraft first contacted high-tension powerlines and a light pole before it damaged a number of buildings along the wreckage path. The aircraft finally struck, and stopped within, an automotive paint and body shop. The total wreckage area was approximately 740 feet in length and 180 feet in width. The damage sustained by the buildings in the vicinity of the first contact area indicated that the aircraft was on a heading at that time of approximately 260° magnetic.

No parts of the aircraft were found outside of the above area and the examination revealed no evidence of *any* in-flight separation of the aircraft structure or components. The aircraft was destroyed by impact and ensuing ground fire.

Examination of the remaining portions of the flight control system showed no evidence of *any* failure or malfunction prior to impact. Because of the extensive impact and fire damage, no reliable trim settings could be obtained for any of the control surfaces.

All wing flap actuators were recovered and found in the full retracted position, which corresponds to a flap-up configuration.

Examination of the nose gear and main landing gear hydraulic actuating cylinders indicated that all three landing gears were in the retracted position at impact.

There was no evidence of any failure of hydraulic and electrical system components prior to impact.

All four engines were recovered in the wreckage area. The Nos. 1, 2, and 3 engines had separated from the aircraft during the impact sequence, while the No. 4 engine was still attached to the wing but only by the fluid lines and cables.

Partial disassembly and examination of the Nos. 1 and 3 engines revealed no evidence of any failure, malfunction, or operating distress prior to impact.

A complete disassembly and examination of the Nos. 2 and 4 engines was conducted by the Board at an engine overhaul facility in Miami, Florida.

(4) [Inspection of the internal components of the No. 4 engine disclosed no indications of *any* internal operating distress or rotational damage.] A film of lubrication was observed on all cylinder walls. The crankshaft and its three bearings were in good condition and adequately lubricated. All spark plugs were in serviceable condition and exhibited evidence of the capability of proper firing. Extensive ground fire damage to both magnetos precluded functional testing; however, examination of the distributor electrodes showed them to be intact, with no signs of arcing or burning.

The No. 4 engine carburetor assembly was badly burned and was partially separated from the mount pad. The carburetor was disassembled. The magnesium throttle body section, except for the throttle shaft, was completely burned away. The cable-operated throttle valve was found in the full closed position and the idle valve was frozen in the idle position. The cable-operated manual mixture control valve was set in the "auto-rich'' position. The poppet valve diaphragm was completely charred. The fuel strainer and carburetor inlet air scoop were examined. There was no evidence of any blockage that would have precluded operation. The automatic mixture control housing was completely burned away.

The No. 4 engine oil pressure relief valve was found securely in place on the rear accessory section. Seven threads of the oil pressure relief valve adjusting screw were visible above the adjusting screw plain nut. The relief valve assembly was subsequently removed and functionally tested at the CDA maintenance facility in Santo Domingo. (See Section 1.15 Tests and Research.)

Examination of the No. 2 engine revealed that the Nos. 6 and 8 cylinders had separated from the crankcase, breaking all of the cylinder hold down studs in an apparent tension failure mode. The No. 6 cylinder, containing the remains of its piston with a section of the master rod attached, was found removed from the main wreckage area but within the impacted building. The No. 8 cylinder and parts of the Nos. 8 and 14 pistons were found, detached, between the Nos. 1 and 2 engines. The engine cowling was recovered generally intact in the main wreckage area. There was no evidence of any cylinder penetration.

The front row master rod and all front row cylinder link rods were broken into small pieces by rotational forces. The cylinder skirts were extensively damaged by the broken rods. The rear row of cylinders was generally intact and the cylinders were all attached to their respective crankcase bases. The Nos. 5 and 7 cylinders were damaged during impact. Both cylinder heads were torn from these barrels, and the barrels were cracked and bent over the case, thus wedging the Nos. 5 and 7 pistons against the cylinder barrels.

The front row cylinder barrel bores were battered and scraped in a longitudinal direction. The rear row cylinder barrel bores were generally in good condition, with the exception of Nos. 5 and 7 which were damaged on impact, and all evidenced a film of lubrication.

All of the front row pistons were extensively broken and damaged and evidenced pounding and gouging on their bottom sections. Sections of the Nos. 8 and 14 pistons below the piston pinhole were completely ground and pounded away. These piston rings were extensively broken, with the remaining pieces of rings wedged into the ring grooves.

The rear row of pistons was not damaged and appeared to be in good condition except for intake valve pounding marks in the heads of some of these pistons. The piston rings all moved freely within their respective grooves and evidenced a film of lubrication.

The front row master rod "I" section was broken and ground off. The link rods were broken and ground off, with only a small portion of each link rod remaining attached to the master rod assembly. Pronounced rotational damage was evident throughout this entire area. The master rod attaching bolts were severely damaged at the bolt head and nut ends, with one bolt completely broken away. The master rod assembly was free to rotate on the crankshaft journal and did not exhibit any excessive sldeplay.

Examination of both the front and rear row master rod bearings shared no evidence of bearing overtemperature, seizing, or galling. These bearings were determined to be in serviceable condition.

The crankcase front section and the forward portion of the crankcase center section were extensively battered, with some small pieces of broken rod sections still remaining in the front section. The rear of the center crankcase section and the rear crankcase section were not internally damaged.

The three crankcase bearings were examined. There was no evidence of pounding, galling, or overheat, and all appeared to be adequately lubricated.

The crankshaft was found to be intact with the front, rear, and master rod journals undamaged. The front crank cheek and counterweight were pounded and battered. Examination of the rear counterweight and counterweight bushings showed no evidence of any overspeed condition.

Examination of the spark plugs, cams and rollers, left magneto, and propeller governor indicated no evidence of preimpact failure, malfunction, or operating distress. The right magneto was not recovered.

The propeller assemblies for all four engines were recovered in the wreckage area. Eased upon disassembly and examination of the blade spider shim plates, the following blade angle settings existed at impact: No. 1 propeller, 28°; No. 2 propeller, 25°; No. 3 propeller, 25°; No. 4 propeller, 93". A blade angle setting of 24° corresponds to the full low pitch stop and a setting of 93" corresponds to the full feathered position.

Two of three fuel dump valves, found in the remains of the right wing, were in the closed position. No other fuel dump valves were recovered. No fuel dump chute positions could be determined due to the impact and ground fire damage sustained by these units.

The upper center panel containing switches for engine ignition, feathering, generator, starter, main and auxiliary fuel boost pump, and battery, together with associated indicating lights, were not recovered.

The cockpit pedestal containing the mechanical controls for regulating throttle, mixture, carburetor air, propeller r.p.m., landing gear and wing flaps was damaged by impact and ground fire to the extent that no useful information could be obtained from these components.

1.13 Fire

The aircraft fuselage struck, and came to rest in, an auto body repair shop. The impact demolished the building and the aircraft. Fire broke out immediately and was fed by aviation fuel contained in the left wing tanks and a large quantity of auto body paint and thinners which were stored in the building. Another building in the area was set afire by fuel from the right wing, which had separated from the aircraft on impact.

The tower controller alerted the Airport Fire Station at the time of the advisory to Flight 401 concerning the smoking No. 2 engine. Fire equipment then proceeded to positions adjacent to Runway 27 right. Following the crash, these vehicles proceeded from their stations to the east gate and then east along 36th Street to the accident site. This equipment arrived at the site approximately 4 minutes after the accident occurred.

The Miami, Hialeah, and Metro Dade County Fire Departments also responded to the accident.

1.14 Survival Aspects

The accident was of a survivable nature for the cockpit occupants. This classification is given because of the absence of significant impact injuries to three of the four aircraft occupants and the fact that these

three victims died as a result of smoke inhalation and burns. The fourth victim died as a result of traumatic injuries received in the crash. The six persons on the ground died as a result of falling debris and/or burns.

1.15 Tests and Research

Laboratory analysis was performed on fuel samples from the tank farm which was utilized for the predeparture fueling of HI-168 prior to its departure. The properties of the fuel, thus ascertained, are considered normal for grade 100/130 aviation fuel.

Other aircraft were fueled from the same fuel supply tank with no undesirable results reported.

No. 2 Engine

Segments of the failed No. 2 engine were sent to the Pratt & Whitney Aircraft Facility, Hartford, Connecticut, for metallurgical examination and testing. These included the No. 6 cylinder containing the piston to which a 2-inch broken section of master rod was attached, the No. 8 cylinder, remains of the front row master rod assembly with the remains of the link rods attached, the front and center crankcase section which encompassed the mount base of the Nos. 6 and 8 cylinders, and several front and rear row pistons.

During the laboratory examination, one small area of fatigue was discovered on the No. 6 master rod, approximately 1-1/2 inches below the piston pinhole. However, because of the extensive pounding and damage that these internal operating components received during the failure and breakup sequence, the relationship between this fatigue and the initial cause of the engine disintegration could not be positively determined.

Oil Pressure Relief Valve No. 4 Engine

The oil pressure relief valve from the No. 4 engine was functionally tested in the "as found" condition at the CDA maintenance facility at Santo Domingo, Dominican Republic. The valve was installed and operated in two different engines of another Carvair ATL. 98 (HI-172). The following results were obtained:

1. Oil pressure relief valve installed in No. 2 engine (TSO 1,173 hours) of HI-172.

   (a) at 800 r.p.m., oil pressure 25 p.s.i.
   (b) at 1,000 r.p.m., oil pressure 35 p.s.i.
   (c) at 2,000 r.p.m., oil pressure 55 p.s.i.
   (d) at 1,500 r.p.m., oil pressure 45 p.s.i., propeller control levers then moved to the high-pitch position and, when governing action took place, oil pressure declined to, and remained steady at, 35 p.s.i.

2. Oil pressure relief valve installed in the No. 4 engine HI-172 (TSO 20 hours).

   (a) at 1,000 r.p.m., oil pressure 30 p.s.i.
   (b) at 2,000 r.p.m., oil pressure 60 p.s.i.
   (c) the same test was performed as in 1.(d) above and the same results were obtained.

   All tests were performed at an oil temperature of 60° C.

Propeller Feathering/Unfeathering System

Examination of the propeller assemblies for all four engines revealed no discrepancies that would prevent normal operation. Functional testing and/or examination of the recovered components comprising the feathering/unfeathering systems of all four engines displayed no evidence of any malfunctions that would impair normal capabilities of this operation.

Emergency Procedures

The CDA Flight Manual for the Carvair ATL. 98 outlines the following procedure to be followed in the event of an engine failure on takeoff:

Engine Failure

If the decision is made to abandon the takeoff immediately close all four throttles and apply maximum wheel braking until it is certain that adequate stopping distance is available, keeping straight by use of nosewheel steering.

If the decision is made to continue the takeoff, maintain directional control by means of coarse use of rudder and aileron (if an outer engine has failed full corrective rudder and considerable aileron will be necessary), holding the nosewheel in contact with the ground by firm forward pressure on the control column until rotation is initiated at V_2 - 5 (m.p.h. or knots) by a firm rearward movement of the control column. The propeller of the failed engine should be feathered at the earliest opportunity after the failure has been confirmed.

When airborne, continue application of corrective rudder assisted as necessary by ailerons. Select landing gear up and climb, maintaining speed at V_2 and the flaps at TAKE-OFF until it is evidently safe to change to the en route configuration having regard to the obstacles to be cleared. Reduce power to maximum continuous on the three operative engines, and climb at the one engine inoperative en route climbing speed (147 m.p.h. (128 knots) I.A.S.) until the required minimum safe altitude has been achieved. At some convenient stage carry out the subsequent actions after propeller feathering.

Propeller Feathering Procedure

Immediate Actions

Throttle	- Closed
Feathering Button	- Push. When propeller is feathered the button should kick out automatically.

Subsequent Actions

Mixture	- IDLE **CUT-OFF**
Cowl Flaps	- CLOSED, then OFF
Booster pump	- **OFF**
Tank Selector	- **OFF** (Note: Do not shut tank selector **OFF** if crossfeeding in use.)
Ignition	- OFF
Generator	- OFF
Propeller pitch	- Full "DECREASE R.P.M."
Trim	- Retrim as necessary
Firewall Shut off	- If any evidence of fluid supply line failure ahead of the firewall is noted, pull the fire extinguisher selector lever (firewall shut-off valve) for the failing engine.

The Manager of Operations for CDA testified regarding company operating procedures and of the capabilities of the crew involved in the accident.

He stated that although a flight engineer is not required on the Carvair, CDA often assigns a mechanic to a flight for the purpose of reducing the captain's workload. **His** duties in this capacity would include preflighting the aircraft, checking fuel and cargo, and assisting as necessary with other associated ground duties. During flight operations, he would be seated *in* the **jump** seatbetween the pilot and copilot and would normally be expected to assist with the engine runup procedures. ***If*** a flight engineer were assigned for a flight on a Carvair.,as in this case, he might be expected to perform the function of feathering a propeller in an emergency upon the command of the captain. **If** a flight engineer were not assigned to the flight, the copilot would feather the propeller ***upon*** command from the captain.

Aircraft Performance

The takeoff climb performance charts for this aircraft indicate the following associated conditions:

Temperature: 89° F., International Standard Atmosphere (I.S.A.) + 17° C.

Engines: Operative engines at takeoff, power, 2,700 r.p.m., 50 in. Hg manifold pressure is adjusted to maintain constant power up to full throttle height. Propeller of inoperative engine is feathered.

Carburetor Air: Cold

Cowl Flaps: Trail on operative engines, closed on inoperative engines.

Wing Flaps: Takeoff 15°.

Landing Gear: Retracted.

Aircraft Weight: 69,195 pounds.

Rate of Climb:	1 Engine Inoperative	2 Engines Inoperative
	+ 255 ft./min.	No Chart

The En Route Climb Performance Charts indicate the following:

Engines: Operative engines at maximum continuous power, 2,550 r.p.m., 42 in. Hg manifold pressure, propeller of inoperative engine is feathered.

Carburetor Air: Cold.

Cowl Flaps: Trail on operative engines, closed on inoperative engine.

Wing Flaps: Retracted.

Landing Gear: Retracted.

Speed: 128 knots I.A.S.

Temperature: ISA + 17° C.

Weight: 69,195 pounds.

Rate of Climb:	1 Engine Inoperative	2 Engines Inoperative
	+ 220 ft./min.	- 220 ft./min.

The maximum the aircraft can weigh with two engines inoperative and still maintain level flight is 58,400 pounds.

The maximum fuel dumping capability of the Carvair, utilizing all four fuel dump chutes as specified in the flight manual, is 2,280 pounds/min. (380 gal./min.).

1.16 Treaties and Regulations Governing International Air Carriers

Routes and services of Dominican air carriers into the United States, and U. S. air carriers into the Dominican Republic are provided for by a Bilateral Air Transport Agreement negotiated by the two countries. Such agreements are negotiated by the U. S. Department of State and the foreign government, subject to the approval of the President.

After such an Agreement has been approved by the President, the Civil Aeronautics Board issues a permit to the foreign carrier to operate into the United States. The carrier then applies to the FAA for the issuance of operating specifications which outline primarily the airports and aircraft to be used in the operation on the approved routes.

The Air Transport Agreement between the United States and the Dominican Republic became effective July 19, 1949. Article 4 of this Agreement reads as follows:

> "Certificates of airworthiness, certificates of competency and licenses issued or rendered valid by one contracting party and still in force shall be recognized as valid by the other contracting party for the purpose of operating the routes and services described in the Annex. Each contracting party reserves the right, however, to refuse to recognize, for the purposes of flight above its own territory, certificates of competency and licenses granted to its own nationals by another state."

A foreign air carrier operating permit was issued to Dominican Airlines by the CAB in February 1951. The permit was later amended in January 1955. Provisions of the amended permit included the following:

> "The holder hereof shall conform to the airworthiness and airmen competency requirements prescribed by the Government of the Dominican Republic for Dominican international air service.
>
> This permit, as amended, shall be subject to all applicable provisions of any treaty, convention, or agreement affecting international air transportation now in effect, or that may become effective during the period this permit, as amended, remains in effect, to which the United States and the Dominican Republic shall be parties."

In addition to the bilateral agreement, the other treaty which governs the conduct of international air carrier operations is the Convention of the International Civil Aviation Organization (ICAO), to which both the United States and the Dominican Republic are signatories. 5/

Article 33 of the Convention, "Recognition of Certificates and Licenses", provides for the following:

> "Certificates of airworthiness and certificates of competency and licenses issued or rendered valid by the contracting State in which the aircraft is registered, shall be recognized as valid by the other contracting States, provided that the requirements under which such certificates or licenses were issued or rendered valid are equal to or above the minimum standards which may be established from time to time pursuant to this convention."

Article 37 of this convention provides for the establishment of Annexes by which to secure the highest possible degree of uniformity in regulations, standards, and procedures wherein such uniformity will improve international air carrier operations. Article 38 provides that if a nation finds it impractical to comply in all respects with an international standard or to bring its own regulation, or practices into full accord with such standard, it shall register notification of such difference with ICAO, which in turn will issue immediate notification to all the member States.

The development and implementation of additional international standards by member States are also provided for within the ICAO framework. Such recommendations are submitted to the ICAO Council for adoption and become effective if approved by a two-thirds majority of the council. Again, the member States, according to the terms of the convention, are called upon either to implement the standards, or if they find this impractical, to notify ICAO that a difference exists between the adopted standards and the existing national standards and corresponding practices.

States are also encouraged to notify ICAO of differences between their national practices and any "recommended practices" as set forth in the ICAO annexes. A "standard" in the ICAO sense is mandatory whereas a "recommended practice" is desirable.

At the present time there are 15 Annexes to the convention covering the various standards and recommended practices as described above. It should be noted that the Dominican Republic has not filed any differences between their existing national regulations and those outlined in the ICAO Annexes.

5/ There are presently 116 nations as Contracting States of ICAO.

It should also be mentioned that the Convention and the Annexes become treaty obligations between the Contracting States and that ICAO assumes no authority either in enforcing or maintaining surveillance as to the degree of application of the international standards by member nations.

In addition to the above-cited treaty obligations between the United States and the Dominican Republic, all foreign air carriers are subject to parts 91 and 129 of the Federal Aviation Regulations (FAR's). Part 91 sets forth the "Air Traffic and General Operating Rules." Part 129 governs the operation of foreign carriers into the United States. Primarily, Part 129 requires: that the carrier shall conduct its flights in accordance with the operation specifications issued by the FAA; that current airworthiness and registration certificates of that country be carried aboard the aircraft; that flight crewmembers hold current certificates, issued by that country, showing their ability to perform required duties; that aircraft be equipped with such radio equipment as is necessary to use properly the air navigation facilities and maintain communications with ground stations while operating in the United States; that each pilot be familiar with, and abide by, the U. S. Air Traffic Control regulations and procedures; and that the foreign air carrier establish procedures to assure that its pilots have the necessary knowledge and abilityto operate in accordance with the applicable rules and regulations. This part also includes the general format to be followed by foreign air carriers in making application to the FAA for Operations Specifications.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The No. 2 engine sustained a massive failure. The No. 4 engine oil pressure relief valve tested functionally below the recommended operating limits following the accident. As discussed under Section 1.12, various components of the No. 4 engine were destroyed by impact and ground fire and could not be documented as to operability prior to impact. However, the examinable portions of the No. 4 engine as well as the Nos. 1 and 3 engines and all other structure, systems, and components of the aircraft revealed no evidence of any preimpact failure or malfunction.

A review of the maintenance records indicates that the aircraft had been maintained in accordance with the procedures and regulations prescribed by CDA and the Dominican Government and within the requirements of the applicable ICAO provisions. All required aircraft inspections and overhauls had been performed within specified times.

The captain and first officer were properly certificated in accordance with the requirements of the Dominican Government and the ICAO provisions and, accordingly, were qualified to conduct this flight. A flight engineer

is not required for Carvair operations; however, in this instance, a CDA flight engineer (DC-6 qualified) was assigned to the flight and was seated in the observer seat in the cockpit.

It is concluded that the initial failure of the No. 2 engine occurred immediately after takeoff when it emitted heavy white smoke. Witness observations, as well as the physical evidence found in the engine and on the propeller, indicate that the engine continued to operate, or was at least windmilling from air stream effect, throughout the rest of the flight until impact. This continued operation resulted in almost complete destruction of the internal operating components of the front row cylinders.

The No. 2 engine was completely disassembled in an attempt to isolate the initial mode and mechanism of the failure. The state of physical destruction of the front row link rods, master rod and pistons, however, precluded positive definition of the initial failure. The condition of the internal operating parts in the vicinity of the Nos. 6 and 8 cylinders, as well as the evidence of these cylinders' having separated from the crankcase base prior to impact, does indicate, however, that the failure sequence originated in this vicinity.

Examination of the engine bearings, the components associated with the cams, and the valves, bore no evidence of a sustained overspeed condition that would have contributed to the malfunctions.

Similarly, the master rod bearings for the Nos. 6 and 9 cylinders evidenced no indications of bearing chatter, burning and/or spalling to indicate a distressed bearing condition as the initiating mechanism of the engine failure.

Metallurgical examination of the hold down studs for Nos. 6 and 8 cylinders showed that, in both cases, the studs on the aft side of the cylinder base had failed in tension and those on the forward side had failed in combined tension, bending, and shear. The pattern of failures indicated that the No. 6 cylinder barrel had bent slightly forward and upward, and the No. 8 cylinder barrel had been bent forward and slightly to the left as the studs on the forward sides failed.

None of the studs showed any evidence of fatigue failure.

These findings, in addition to the lack of any significant pounding damage to the base of the crankcase, indicate that the cylinder separations were of a secondary nature rather than an initiating factor, as would be caused by the cylinders' lifting off the crankcase mount base due to a fatigue failure of the hold down studs.

The remains of the "I" section of the broken No. 6 master rod were attached to the piston and exhibited evidence of fatigue over an area encompassing one-eighth of the "I". Examination of the part revealed no apparent manufacturing or metallurgical defect that would cause a master rod failure either through stress or fatigue; however, a slight turned-over section was observed at the master rod facture which would indicate that the rod had been subjected to bending in the direction of failure.

Further, the type and extent of the breakup within the front cylinder crankcase was typical of the damage that would occur as a result of a master rod failure. Therefore, it is considered that the failure of the No. 6 master rod was most probably the initiating factor resulting in the engine disintegration? However, as was stated previously, there was insufficient evidence to support this conclusion positively.

Other possibilities for the initial failure would include a link rod or piston separation which would produce much the same type of damage. However, due to the massive damage, these possibilities cannot be confirmed.

Inasmuch as the failure occurred shortly after liftoff, it is difficult to explain why it was not secured and its propeller feathered within a reasonable time following the malfunction. Conversely, inspection of the examinable portions of the No. 4 engine disclosed only the oil pressure relief valve problem, discussed previously, but no other evidence of a failure or malfunction that would have necessitated its discontinuance, yet the propeller was observed in the feathered position shortly after takeoff. This propeller stayed in the feathered position throughout the remainder of the flight.

The load sheet as originally prepared on June 22 indicated that the flight would be dispatched with 1,600 gallons of fuel, a crew weight of 480 pounds, 16,350 pounds of cargo with a total takeoff weight of 68,270 pounds. Printed information on the load sheet indicated the maximum allowable takeoff weight was 68,600 pounds, which is based on a zero fuel weight of 59,000 pounds.

If the fueling company records are correct, there should have been 1,860 gallons of fuel aboard the aircraft when the crew arrived for the originally scheduled departure on June 22.

We do not know why the captain asked for additional fuel. His aircraft already contained 260 gallons more than the dispatching amount (1,600 gallons) called for on the prepared load sheet. There were no weather problems which would necessitate the carrying of extra fuel. With 1,860 gallons already on board, it does not appear logical that the captain would request additional fuel that would total 462 gallons more than the amount specified on the load sheet.

It appears that No. 1 main tank contained more fuel than No. 4 main tank. The addition of fuel to tanks No. 1 (51 gallons) and No. 4 (151 gallons), as shown on the fueling company records, could have corrected an asymmetrical fuel loading condition. However, if the addition of this fuel brought the No. 1 and 4 tanks to equal levels, then 100 gallons in No. 4 only would have accomplished the same purpose.

The captain did, however, request the extra fuel and did delay the flight when the fueling truck did not show up early in the morning of June 23 as requested. This action seems to indicate an asymmetrical loading, requiring the addition of fuel to the No. 4 (right wing) tank to even the load. It is not known what distribution was given the 1,860 gallons placed in the tanks previously.

It is also possible that the fuel load was 200 gallons under the required 1,600 when it was checked by the crew on June 22. Placing 202 gallons in the tanks might have corrected an imbalance and brought the fuel quantity up to the desired 1,600 gallons. This theory suggests some mishandling on the part of the fueling company and/or their fuel truck operators. The Board has no other evidence or information, except as mentioned above, that would substantiate such a conclusion.

The load sheet, as presented to the crew prior to the flight, indicated the aircraft would weigh 68,270 pounds at takeoff, Assuming that the aircraft was fueled in accordance with the fueling company records, and considering the changes to cargo and the addition of an extra crewmember, the crew should have been able to recalculate the gross takeoff weight as 70,310 pounds. This figure used the weight of gasoline as 6 pounds per U. S. gallon and is 1,110 pounds over the maximum allowable gross takeoff weight of 69,200 pounds, as specified in the CDA manual for the applicable conditions of altitude and temperature. This limitation is based on the requirement for a 2.5 percent second segment climb gradient with one engine inoperative, which under this weight condition should produce a climb rate of 250 feet per minute.

Recalculation of the aircraft gross weight following the accident revealed a gross takeoff weight of 69,710 pounds.

The maximum allowable takeoff weights as sham on the company load sheet do not take temperature and altitude into consideration.. The maximum allowable takeoff weight used for this flight was *68,600* pounds (which is below the CDA manual figure of 69,200 pounds). According to the chief dispatcher of the company handling this flight, this figure can be increased by increasing the fuel quantity on board up to the next higher restrictive takeoff weight as depicted on the load sheet. This is 71,000 pounds, which is the sum of the maximum landing weight of 65,000 pounds and *6,000* pounds of fuel necessary for a trip from Miami to Santo Domingo. However, if the aircraft weight is increased to the next higher restrictive weight, the CDA manual restrictive weight *(69,200* pounds in this instance) will be exceeded.

Climb performance data for the Carvair shows that with two engines inoperative at a gross weight of 69,710 pounds level flight cannot be maintained. Using maximum continuous engine power on the two remaining engines, a descent rate in the order of 170 feet per minute can be expected.

The maximum aircraft weight at which level flight can be maintained with two engines inoperative, and under the conditions that existed, is 58,400 pounds. At the maximum fuel dumping rate of 2,280 pounds per minute approximately 5 minutes would have been required to dump the necessary amount of fuel to achieve this weight. However, this action was probably not considered by the crew because of a possible fire on the No. 2 engine and the dangerous possibility of igniting the dumped fuel.

These performance figures do not take into consideration the drag induced by the windmilling No. 2 propeller and the angle of bank which would have deteriorated performance to a greater extent than shown here.

It must be noted that under either condition of fuel loading, the amount as sham on the load sheet (6,900 pounds) or the amount depicted by the fueling company records (12,372 pounds), the aircraft would not be capable of maintaining level flight. The difference between the two possible fuel weights, though affecting performance slightly, reflects operational and dispatching practices which do not conform to approved standards wherein the optimum level of safety is achieved.

As was stated previously, there was a problem associated with the relief valve which regulates the oil pressure to the No. 4 engine. The flight had returned to the line subsequent to its original departure because of a cockpit indication of high oil pressure in the No. 4 engine. Following an adjustment to the oil pressure relief valve by a mechanic, the crew indicated that the oil pressure reading was acceptable, and the aircraft again departed for the flight. It is assumed that the crew conducted a normal pretakeoff engine runup, which includes a magneto check at 30 inches Hg and approximately 2,200 r.p.m. At this point the oil pressure reading should be checked, and if not within limits (approximately 80 p.s.i.), the flight should be discontinued. Inasmuch as the flight did not return again to the line, it can be assumed that the oil pressure reading was acceptable to the crew and presumably the oil pressure relief valve was operating satisfactorily to this point.

However, functional testing of this valve following the accident revealed oil pressure indications that were consistently below the recommended operating parameters. In all of the tested ranges of 2,000 r.p.m. or higher, the oil pressure remained at or slightly above 50 p.s.i. If the oil pressure falls below the 48 p.s.i. low oil pressure limit, a warning light located beneath the oil pressure instrument in the cockpit is activated.

In view of the test results just described, it is conceivable that the oil pressure dropped to 50 p.s.i. or to some lower value during the takeoff run and that the low oil pressure warning light on the No. 4 engine was activated. Under other circumstances, such a situation need not lead to precipitate action since there are other engine instruments (i.e., oil quantity, oil temperature, and cylinder head temperature) which can be checked to assess further the significance of the low oil pressure indication. 6/ However, in this case, the crew had to delay its takeoff because of oil pressure problems on the No. 4 engine and there is little doubt that the focus of attention was on this engine. If a loss of oil pressure was noted on the takeoff run or if engine roughness was encountered, as possibly evidenced by the puffs of black smoke observed by ground witnesses, the crew would be apprehensive as to the possibility of a malfunction of the No. 4 engine. At this point, the No. 2 engine probably began its failure sequence. The remedial action initiated by the crew promptly compounded the emergency.

It is known that even the most experienced pilots can be affected in their judgment and reasoning when faced with abnormal conditions. The degree to which their performance standard is affected, and the rate of deterioration are dependent on (1) the complexity of the emergency, (2) the immediacy of the threat to life, and (3) their preparedness (including training) to cope with such situations.

Examination of the training records of this captain does not suggest a high degree of proficiency in emergency procedures. In fact, review of his initial training records in both the DC-4 and DC-6 indicates that one of his weaker areas was the knowledge and execution of such procedures. It is noted, however, that only a few of the captain's records were available for review and that these were for 1963-64. Although it was stated by company management that periodic flight proficiency checks are required of its captains every 6 months, these records were not available and, therefore, the Safety Board can base its evaluation in this area only on review of the above-cited records.

Whether or not the captain was highly proficient in emergency procedures and had sufficient confidence in them so that he might have had time for further analysis of the situation, is difficult to evaluate due to the incompleteness of the factual record referred to above. The available facts suggest, however, that this was not the case.

If appropriate international procedures had been in existence providing for reciprocal surveillance and monitoring by parties to a bilateral air route agreement, it would have been possible to document

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6/ The Nos. 2 and 3 engines cannot be seen by the crew through the cockpit windows. A visual check of these engines for signs of an oil leak can only be made from the main cargo compartment windows.

this area more fully. Of greater constructive import from the standpoint of accident prevention, it might have been possible through the coordinated efforts of all parties concerned to correct any inadequacies disclosed during the monitoring process.

In this vein, the value of recurrent training cannot be overemphasized. It requires a pilot to review procedures periodically, and allows management the opportunity to monitor efficiently a pilot's proficiency. It is incumbent upon the airline to insure that these checks are conscientiously conducted, recorded, and systematically reviewed. In this manner, management control can be exercised in the detection and correction of any individual weaknesses, hopefully before such weaknesses are manifested in air carrier operations.

2.2 Conclusions

(a) Findings

1. The aircraft was properly certificated and, as far as can be determined, was airworthy at the time of departure for the flight.

2. The captain and first officer were properly certificated to conduct this flight.

3. Although the Carvair does not require a flight engineer, a qualified DC-6 flight engineer was occupying the crew seat between the captain and first officer.

4. The gross weight of the aircraft, recomputed following the accident, was determined to have been 69,710 pounds, just over the maximum allowable takeoff weight specified in the Carvair flight manual for the applicable conditions of temperature and altitude. The aircraft was loaded within the acceptable c.g. limits.

5. The maximum allowable takeoff weights sham on the company load sheet do not take into account the possible effects of temperature and altitude.

6. The No. 4 engine oil pressure relief valve was adjusted prior to departure because of a reported high oil pressure indication by the crew.

7. Heavy white smoke was seen coming from the No. 2 engine shortly after lift-off. Just prior to the appearance of the white smoke, a few puffs of black smoke were observed coming from the right side of the aircraft, in the vicinity of the No. 4 engine.

8. The No. 4 propeller was feathered shortly after takeoff.

9. The No. 2 propeller was not feathered during the flight.

10. The flight was attempting to return to the airport and land on Runway 27R.

11. Examination of the No. 2 engine revealed that it had experienced a massive failure of the internal operating components of the front row cylinders. Because of the damage to these components, the cause of the failure could not be positively determined.

12. There was a small area of fatigue evidenced on the broken end of the No. 6 master rod from the No. 2 engine.

13. Several components of the No. 4 engine were destroyed by fire and could not be documented as to operability prior to impact. However, the examinable portions of the No. 4 engine, as well as the Nos. 1 and 3 engines and all other structure, systems, and components of the aircraft, revealed no evidence of any preimpact failure or malfunction.

14. Functional testing of the No. 4 engine oil pressure relief valve after the accident shared oil pressure values that were below the recommended operating limits.

15. Aircraft performance data for the Carvair ATL. 98 shows that with two engines inoperative at a gross weight of 69,710 pounds, level flight cannot be maintained and that a descent rate of approximately 170 feet per minute can be expected. With the aircraft in a turn, and the No. 2 engine windmilling, the descent rate would be increased.

16. The aircraft descended into industrial buildings approximately 1 mile from the approach end of Runway 27R at the Miami International Airport.

(b) Probable Cause

The Safety Board determines that the probable cause of this accident was the confused action on the part of the crew while attempting to cope with the catastrophic failure of an engine during takeoff.

X

3. RECOMMENDATIONS

The Board considers the present standards and recommended practices (SARP's) established under the provisions of ICAO to be adequate. Furthermore, such SARP's are subjected to continuing international review in the interest of assuring that required amendments are made in a timely manner.

The record of the investigation of this accident does not show any contravention of the airworthiness requirements imposed by these international standards. However, the matter of compliance with certification, training, and a number of other operational practices required by these standards, could not be verified by review of official records during this investigation.

Under the provisions of Article 38 of the ICAO convention, a member State may indicate full compliance with all existing ICAO standards and practices by simply not registering any differences. No notification to ICAO in this regard implies full compliance with these standards by the member State. However, there is no international surveillance authority or system to insure such compliance.

The Board is of the opinion, therefore, that a program with regard to surveillance and monitoring should be established in the interest of assuring uniform application of ICAO safety standards. To this end. the Safety Board recommends that:

A study be initiated by the FAA, in full coordination with the Civil Aeronautics Board and the Department of State, to determine the feasibility of formulating a policy whereby parties to a bilateral air route agreement would have the right to inspect, on a continuing basis the facilities, services and procedures of all air carriers subject to the agreement.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ OSCAR M. LAUREL
Member

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

John H. Reed, Chairman, was not present and did not participate in the adoption of this report.

August 12, 1970.

INVESTIGATION AND HEARING

1. Investigation

The Board received notification of the accident at approximately 1600 e.d.t., on June 23, 1969, from the Federal Aviation Administration. An investigation team was immediately dispatched to the scene of the accident. Working groups were established for Operations, Witnesses, Weather, Air Traffic Control, Systems, Structures, Powerplants, and Maintenance Records. Parties to the Investigation included: Dominicana Airlines, the Federal Aviation Administration, the Dominican Republic Department of Civil Aviation, and Pratt & Whitney Aircraft.

2. Hearing

A public hearing was held at Miami, Florida, on October 2, 1969.

X

FLIGHT CREW INFORMATION

Captain Jorge E. Bujosa, aged 42, was employed by CDA on June 29, 1947. He possessed U. S. Airline Transport Pilot Certificate No. 1392657, with a type rating in the C-46. He also held Dominican Republic Airline Transport Pilot Certificate No. 1, with type ratings in the DC-3, DC-4, and DC-6B. He was a designated pilot examiner for the Dominican Republic Department of Civil Aviation. His last U. S. first-class medical certificate was issued on December 19, 1968, and contained the notation "must wear corrective lenses while flying."

Captain Bujosa had accumulated a total of approximately 13,736 pilot hours, of which approximately 500 hours were in DC-4 type aircraft. He had flown a total of 175 hours in the 90-day period preceding the accident and had received approximately 18 hours' off duty time prior to this flight.

The only training records available to the Board concerning Captain Bujosa were the ground and flight training records from Flight Safety, Inc., Miami, Florida, which was under contract with CDA to conduct pilot training on a continuous basis during the period 1963-65. The records show that in October 1964, after completing 64 hours of ground training, Captain Bujosa was given an initial instrument and equipment check flight in the DC-4.

He was graded unsatisfactory in the following areas as recorded on the check form for that flight: engine out procedure; engine fire; attitude; application; minimum speed maneuvers; and emergency procedures.

He was rechecked on these items during the same flight and performed them satisfactorily. He received, therefore, an overall satisfactory grade. The following remarks pertaining to this flight were also recorded:

> "Captain Bujosa did not show up for two scheduled training flights and was late for this one which accounts for the low grade in attitude and application. Needs work in emergency and normal procedures. Recommended four hours Dehmal before further flight training."

One of the other records available for review pertained to four DC-6 simulator training flights made by the captain in April 1964 in preparation for his initial DC-6 checkout. After the third such flight, it was noted on the record that all emergency maneuvers were weak because he had not memorized the Phase I procedures. However, on the fourth and last flight, accomplished the following day, he showed much improvement in emergency procedures and he had memorized the Phase I items.

In May 1966, he was given a progress evaluation check in the Dehmal Duplicator. 1/ In regard to this check, the instructor noted ". . . his general aircraft procedure work limited as it is in the Dehmal, was satisfactory." It was also noted that Captain Bujosa's overall performance *in* this check was satisfactory.

First Officer Carlos A. Brador, aged 30, was employed by CDA on August 8, 1964. He possessed a U. S. Commercial Pilot Certificate No. 1581389, and a Dominican Republic Commercial Pilot Certificate No. 103. He held airplane multiengine, land and instrument ratings in conjunction with his U. S. certificate and, in association with his Dominican certificate, he held copilot's ratings in the L-749A, C-46, DC-3, DC-4, and DC-6B. His last U. S. first-class medical certificate was issued on July 23, 1968, with no waivers.

First Officer Brador had accumulated a total of 2,333 flying hours, of which approximately 476 hours were in the DC-4 type aircraft. He had flown approximately 200 hours within the 90-day period preceding the accident and had received approximately 18 hours' off duty time prior to this flight.

His initial DC-4 ground and flight training was accomplished through Flight Safety Inc., Miami, Florida, in January 1965. Review of his initial training check flight record on the DC-4 shows that he received 14 above average grades among which were included: engine out procedure, engine out maneuvers, unfeathering procedures, and engine fire.

According to CDA manager of operations, it is company procedure for copilots to remain in the right seat until they are checked out as captain. It was stated that copilots are allowed to fly the aircraft from the right seat if the captain believes they are qualified to do so.

Flight Engineer Carlos M. Gonzales was hired by CDA on November 20, 1967. He held a Dominican flight engineer's certificate with ratings in the L-749A and DC-6B. In November 1967, he received 6.6 hours of ground school in its DC-6B and 14 hours of training in the DC-6B flight simulator. In January 1968, he received 10 more hours of DC-6B flight engineer training. He then worked part-time for CDA until January 1969, at which time he became a full-time employee.

He had received 18 hours' off duty time prior to this flight.

1/ Ground training device.

APPENDIX C

AIRCRAFT INFORMATION

The aircraft was a C-54D modified to a Carvair by Aviation Traders (Engineering) Ltd., Essex, England, under the United Kingdom Air Registration Board, Airworthiness Approval Notes 6190, 8235, and P256, Type ATL. 98. This modification was completed June 1964, and included the following:

(a) A new fuselage nose section was built onto the basic aircraft, thus lengthening the fuselage, elevating the crew compartment, and providing additional cargo hold headroom;

(b) A hydraulically operated nose door was hinged to the port side to facilitate the loading of cars and bulky cargo from either a ramp, dock, forklift truck or similar device.

(c) A larger span vertical fin was fitted to retain the original flight handling characteristics of the basic airplane.

Prior to the modification, the aircraft had flown a total time of approximately 37,500 hours. Upon completion of this modification, the aircraft time was zeroed and was sold to Iberia Airlines of Spain. It was operated by Iberia under registry EC-AXI for a total of 4,128 hours.

The aircraft was sold to CDA on February 1, 1969, and was assigned a Dominican Republic registration, HI-168, a certificate of airworthiness, and a license on February 25, 1969. Since the time of possession through June 15, 1961, CDA operated the aircraft for 94:48 hours. This brought the time on the aircraft since modification to a total of 4,222 hours as of that date.

The last 200-hour inspection (major inspection) was performed by Iberia Airlines on December 30, 1968. CDA performed a 50-hour inspection on the aircraft on April 19, 1969, at their main base in Santo Domingo.

On June 15, 1969, galley equipment was removed from the aircraft. It was then given a preflight inspection and was test flown. On June 16, 1969, the aircraft was flown to Miami for weighing and recomputation of the weight and balance. It was then scheduled for the subject flight.

The only corrective maintenance performed on the aircraft while it was in Miami was an adjustment to the oil pressure relief valve for high oil pressure just prior to departure.

The current flight logs were not recovered from the aircraft at the accident site.

The aircraft was equipped with four Fratt & Whitney R 2000-3D engines. These engines were last overhauled and zero timed by Talleres Aeronautics de Barajes (TABSA), Madrid, Spain, and had been installed on the aircraft by Iberia Airlines. The following data pertains to the engines:

Position	Serial No.	Date Installed	Time Since Overhaul (TSO)
1	109.052	August 19, 1967	701.39
2	109.161	September 12, 1967	635.04
3	107.770	June 21, 1967	867.51
4	109.050	June 14, 1967	1282.29

The CDA engine overhaul time is 1,700 hours, which is the same as that of Iberia. (The average engine TSO for U. S. certificated air carriers is approximately 1,600 hours. The maximum TSO for any of these carriers is 2,000 hours.)

The propellers installed on the aircraft were three-bladed Hamilton Standard model No. 23E50.

Examination of the maintenance records for the airframe, engines, propellers, and associated systems revealed no information which would indicate the aircraft was not airworthy.