Lgth 2625

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: NOV 14 1996

In reply refer to: A-96-121 through -123

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On May 28, 1996, Martinair flight 631, a Boeing 767-300ER (B767), Netherlands registration PH-MCH, made an emergency landing at Logan International Airport in Boston, Massachusetts, after experiencing numerous electrical power system disruptions. The flight was en route from Amsterdam to Orlando, Florida. Nearing Kennebunk, Maine, all four primary electronic flight instrument displays went blank and the navigation system failed, prompting the crew to declare an emergency. The airplane sustained minor damage during the landing rollout, and none of the 201 people on board was injured.

The Safety Board is conducting the investigation of this incident in accordance with the provisions of Annex 13 to the Convention on International Civil Aviation, and the Netherlands Aviation Safety Board has assigned an accredited representative. Although the investigation is continuing, the Safety Board has identified several safety issues that it believes the Federal Aviation Administration (FAA) should address.

During the flight, the crew received indications of momentary disruptions of portions of the electrical power system. These indications included Engine Indication and Crew Alerting System (EICAS) messages indicating loss of the direct current (DC) power to the navigation system, and blanking of the clock and transponder code displays. In cruise flight, the crew observed movement of the flap/slat position indicator needles to positions indicating an asymmetric slat deployment, although the flap/slat handle was retracted. Later, while preparing for the emergency landing, the flap/slat handle was placed to the "Flaps 1" position, and again the crew observed an indication of asymmetric slat deployment. A visual check confirmed that the slats were deployed symmetrically; however, the flightcrew elected not to move the flap/slat handle any further to eliminate any doubt about deployment asymmetry. After consulting the flight manual, the flightcrew determined that there was adequate runway length (10,005 feet) on runway 4R at Boston to perform a no-flaps landing.

Upon touchdown, however, several of the systems that assist the wheel brakes in stopping the airplane, such as the anti-skid system, thrust reversers, and ground spoilers,

were inoperative. In addition, the engines remained in flight idle and did not reduce thrust to the normal ground idle setting. As a result, the landing rollout was much longer than expected. The flightcrew applied heavy manual wheel braking and managed to stop the airplane approximately 1,500 feet from the end of the runway. All eight main landing gear tires deflated as a result of the heavy braking, and the airplane sustained minor damage from a brake fire that was quickly extinguished by airport firefighters.

The investigation has revealed that the flightcrew's ability to stop the airplane was hindered because a portion of the air/ground logic circuitry was prevented from changing from "air" mode to "ground" mode upon touchdown. (In the "air" mode, operation of the thrust reversers and ground spoilers is prohibited, and the engines will not reduce to ground idle thrust.) Although this malfunction may have occurred because of the intermittent disruptions of electrical power during the flight, the Board has yet to determine this.

According to the Boeing Commercial Airplane Group, the EICAS system on the B767 (as well as the B757) is not designed to provide pilots with an advance warning that a malfunction has occurred that will prevent the air/ground logic circuitry from changing to "ground" upon touchdown. Therefore, the flightcrew was unaware that the systems that assist in stopping the airplane would be inoperative. Had he known, the captain stated that a greater flap setting or a longer runway would have been considered to increase the margin of safety for landing. In addition, examination of the landing data available to the flightcrew revealed that no information was available that would have allowed the captain to compute the distance required for a landing with these systems inoperative.

The Safety Board believes that it is critical to flight safety to alert B757/767 pilots when a malfunction has occurred that will prevent certain braking systems from operating. In addition, pilots must be provided with the flight manual information necessary to plan and safely execute a landing under these circumstances. Therefore, the Safety Board believes that the FAA should require that Boeing modify the crew alerting system of the B757/767 to include a "caution" alert to notify pilots when such a malfunction has occurred, and modify the Operations Manual to include the necessary procedures and data for pilots to safely execute a landing under these circumstances. Because a similar situation may exist on other transport-category airplanes, the Safety Board believes that the FAA should review the design of other transport-category airplanes to determine if there are features to alert pilots of inoperative braking systems before touchdown. If not, similar corrective actions should be taken.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Require that the Boeing Commercial Airplane Group modify the crew alerting system of the Boeing 757/767 to include a "caution" alert to notify

pilots when a malfunction in the air/ground logic circuitry has occurred that will render certain braking systems inoperative upon touchdown. The alert should also specify which systems (thrust reversers, ground spoilers, anti-skid, etc.) will not function properly on landing. (A-96-121)

Require that the Boeing Commercial Airplane Group modify its Boeing 757/767 Operations Manual to include a detailed emergency procedure and the necessary data for flightcrews to execute a landing when certain braking systems (such as anti-skid, ground spoilers, thrust reversers, and ground idle) will be inoperative. (A-96-122)

Review the design of transport-category airplanes other than the Boeing 757/767 to determine if there are features that notify pilots when a malfunction in the air/ground logic circuitry has occurred that will render certain braking systems inoperative upon touchdown. If not, incorporate the appropriate modifications. (A-96-123)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA and BLACK concurred in these recommendations.

By: Jim Hall
Chairman

National T. ortation Safety Board
Washington, D.C. 20594

Brief of Accident

Adopted 01/11/1994

LAX92FA092
FILE NO. 429 01/13/92 TEMPLE BAR, AZ AIRCRAFT REG. NO. N22592 TIME (LOCAL) - 15:50 MST

MAKE/MODEL - CESSNA T210L
ENGINE MAKE/MODEL - CONTINENTAL TSIO-520-H
NUMBER OF ENGINES - 1
OPERATING CERTIFICATES - On-demand air taxi
NAME OF CARRIER - AIR VEGAS
TYPE OF FLIGHT OPERATION - Non-scheduled
- Domestic
- Passenger

AIRCRAFT DAMAGE - Destroyed

	FATAL	SERIOUS	MINOR/NONE
CREW	0	1	0
PASS	2	2	0

REGULATION FLIGHT CONDUCTED UNDER - 14 CFR 135

LAST DEPARTURE POINT - GRAND CANYON, AZ
DESTINATION - LAS VEGAS, NV

AIRPORT PROXIMITY - On airport
AIRPORT NAME - TEMPLE BAR
RUNWAY IDENTIFICATION - 18
RUNWAY LENGTH/WIDTH (Feet) - 3500/ 50
RUNWAY SURFACE - Asphalt
RUNWAY SURFACE CONDITION - Dry

CONDITION OF LIGHT - Daylight

WEATHER INFO SOURCE - Witness

BASIC WEATHER - Visual (VMC)
LOWEST CEILING - None
VISIBILITY - 0020.000 SM
WIND DIR/SPEED - Unk/Nr
TEMPERATURE (F) - Unk/Nr
OBSTR TO VISION - None
PRECIPITATION - None

PILOT-IN-COMMAND AGE - 24

CERTIFICATES/RATINGS
Commercial
Single-engine land, Multiengine land
INSTRUMENT RATINGS
Airplane

FLIGHT TIME (Hours)

TOTAL ALL AIRCRAFT - 2039
LAST 90 DAYS - 125
TOTAL MAKE/MODEL - 74
TOTAL INSTRUMENT TIME - Unk/Nr

THE PLT SAID THAT DRG DSCNT FM 10,500 FT, THE MANIFOLD PRESSURE DROPPED TO 18 INCHES. HE DECIDED TO LND AT A NRBY ARPT. WHILE DIAGNOSING THE PROBLEM, HE TURNED ON THE BOOST PUMP & THE ENG LOST MORE PWR. THE COCKPIT BGN TO FILL WITH SMOKE. THE PLT SECURED THE ENG & TURNED THE ELEC SYS OFF. HE BGN A PWR-OFF DSCNT OVR THE ARPT & MANUALLY EXTENDED THE LNDG GEAR. HE THOUGHT HE WAS TOO HIGH, SO HE TURNED THE BATTERY "ON" TO LOWER THE FLAPS. WITH ELEC PWR RESTORED, THE LNDG GEAR RETURNED TO THE "UP" PSN. THE PLT AGAIN LOWERED THE LNDG GEAR. UNABLE TO REACH THE RWY, HE TRIED TO RE-START THE ENG ON FINAL APCH. BUT DID NOT HAVE ENOUGH TIME. SUBSEQUENTLY, THE ACFT IMPACTED AN UP SLOPE ABOUT 300 FT SHORT OF THE RWY & CRASHED. AN EXAM OF THE TURBOCHARGER REVEALED THE TURBINE SHAFT FAILED DUE TO MULTIPLE FATIGUE CRACKS. ABOUT 125 FLT HRS BEFORE THE FAILURE, THE TURBINE SHAFT HAD BEEN REWORKED (GROUND & CHROMIUM PLATED), BUT NOT IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS. TURBOCHARGER MALFUNCTION WAS NOT ADDRESSED IN THE POH.

LANS 2
FILE 429 01/13/92 TEMPLE BAR, AZ AIRCRAFT REG. NO. N22592 TIME (LOCAL) - 15:50 MST

Occurrence# 1 LOSS OF ENGINE POWER(PARTIAL) - MECH FAILURE/MALF
Phase of Operation CRUISE

Findings
1. - EXHAUST SYSTEM, TURBOCHARGER - FATIGUE
2. - MAINTENANCE, OVERHAUL - INADEQUATE - OTHER MAINTENANCE PERSONNEL

Occurrence# 2 LOSS OF ENGINE POWER(TOTAL) - NON-MECHANICAL
Phase of Operation DESCENT - EMERGENCY

Findings
3. - EMERGENCY PROCEDURE - INITIATED - PILOT IN COMMAND
4. - AIRCRAFT MANUALS, PROCEDURE INFORMATION - INADEQUATE
5. - IN-FLIGHT PLANNING/DECISION - IMPROPER - PILOT IN COMMAND
6. - INFORMATION INSUFFICIENT - MANUFACTURER

Occurrence# 3 FORCED LANDING
Phase of Operation DESCENT - EMERGENCY

Occurrence# 4 IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation MANEUVERING - TURN TO LANDING AREA (EMERGENCY)

Findings
7. - TERRAIN CONDITION - ROUGH/UNEVEN

The National Transportation Safety Board determines that the Probable Cause(s) of this Accident was: FATIGUE FAILURE OF THE TURBOCHARGER'S TURBINE SHAFT DUE TO INADEQUATE MAINTENANCE, AND THE PILOT'S IMPROPER IN-FLIGHT PLANNING/DECISION AFTER EXPERIENCING A TURBOCHARGER FAILURE. A FACTOR RELATED TO THE ACCIDENT WAS: THE LACK OF INFORMATION IN THE PILOT'OPERATING HANDBOOK CONCERNING TURBOCHARGER FAILURE OR MALFUNCTION.

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

Adopted 09/24/1995

FTW95FA082
FILE NO. 380 01/05/95 HURLEY, NM AIRCRAFT REG. NO. N3LP TIME (LOCAL) - 18:35 MST

MAKE/MODEL - BEECH A60
ENGINE MAKE/MODEL - LYCOMING TIO-541-E1C4
NUMBER OF ENGINES - 2
OPERATING CERTIFICATES - None
TYPE OF FLIGHT OPERATION - Business
REGULATION FLIGHT CONDUCTED UNDER - 14 CFR 91

AIRCRAFT DAMAGE - Destroyed

	FATAL	SERIOUS	MINOR/NONE
CREW	1	0	0
PASS	2	0	0

LAST DEPARTURE POINT - Same as Accident
DESTINATION - Local

AIRPORT PROXIMITY - Off airport/airstrip

CONDITION OF LIGHT - Daylight

WEATHER INFO SOURCE - Weather observation facility

BASIC WEATHER - Visual (VMC)
LOWEST CEILING - 3300 FT Broken
VISIBILITY - 0010.000 SM
WIND DIR/SPEED - 300 /012 KTS
TEMPERATURE (F) - 36
OBSTR TO VISION - None
PRECIPITATION - None

PILOT-IN-COMMAND AGE - 36

CERTIFICATES/RATINGS
Airline transport
Single-engine land, Multiengine land
INSTRUMENT RATINGS
Airplane

FLIGHT TIME (Hours)

TOTAL ALL AIRCRAFT - 2746
LAST 90 DAYS - Unk/Nr
TOTAL MAKE/MODEL - 209
TOTAL INSTRUMENT TIME - 157

DURING CLIMB TO CRUISE THE PILOT REPORTED A POWER LOSS ON ONE ENGINE AND RECEIVED VECTORS FOR A RETURN TO THE DEPARTURE AIRPORT. THE PILOT WAS SUBSEQUENTLY CLEARED FOR THE VOR-A APPROACH AND REPORTED INTERCEPTING THE INBOUND RADIAL. THE IMPACT SITE WAS RIGHT OF THE INBOUND RADIAL AND SHORT OF THE EXTENDED RUNWAY CENTERLINE. WEATHER AT THE AIRPORT WAS VFR. POST IMPACT FIRE DAMAGED THE AIRPLANE. THE LEFT ENGINE PROPELLER WAS IN THE FEATHER POSITION. VISUAL AND METALLURGICAL EXAMINATION CONFIRMED THE TURBOCHARGER SHAFT SEPARATED DUE TO FATIGUE. THE SHAFT CONTAINED CHROMIUM. THE AIRCRAFT OVERHAUL MANUAL STATES THAT "CHROME PLATING...RESTORATION OF THE SHAFT...ARE NOT PERMITTED." METALLOGRAPHICS REVEALED A MICROSTRUCTURE OF GREY IRON (AUTOMOTIVE APPLICATION) IN THE CENTER HOUSING. THE TURBOCHARGER WAS OVERHAULED AND INSTALLED ON THE LEFT ENGINE IN OCTOBER 1989.

Occurrence# 1 LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation CLIMB - TO CRUISE

Findings
1. - 1 ENGINE
2. - EXHAUST SYSTEM,TURBOCHARGER - FATIGUE
3. - MAINTENANCE,MAJOR REPAIR - IMPROPER - OTHER MAINTENANCE PERSONNEL

Occurrence# 2 LOSS OF CONTROL - IN FLIGHT
Phase of Operation CIRCLING (IFR)

Findings
4. - AIRSPEED(VS) - NOT MAINTAINED - PILOT IN COMMAND
5. - STALL - INADVERTENT - PILOT IN COMMAND

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

The National Transportation Safety Board determines that the Probable Cause(s) of this Accident was:
THE PILOT'S FAILURE TO MAINTAIN AIRSPEED DURING A SINGLE ENGINE APPROACH RESULTING IN AN INADVERTENT STALL. FACTORS WERE A FATIGUE SEPARATION OF A SHAFT IN THE LEFT ENGINE TURBOCHARGER DUE TO IMPROPER REPAIR BY MAINTENANCE PERSONNEL, AND THE RESULTANT LOSS OF POWER TO THE LEFT ENGINE.

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

Adopted 11/30/1995

FTW95LA119
FILE NO. 777 02/22/95 SANTA ROSA, NM AIRCRAFT REG. NO. N100BL TIME (LOCAL) - 20:30 MST

MAKE/MODEL - BEECH 60
ENGINE MAKE/MODEL - LYCOMING TIO-541-E1A4
AIRCRAFT DAMAGE - Substantial
NUMBER OF ENGINES - 2

OPERATING CERTIFICATES - None
TYPE OF FLIGHT OPERATION - Business
REGULATION FLIGHT CONDUCTED UNDER - 14 CFR 91

	FATAL	SERIOUS	MINOR/NONE
CREW	0	0	1
PASS	0	0	2

LAST DEPARTURE POINT - SANTA FE, NM
DESTINATION - DALLAS, TX

AIRPORT PROXIMITY - Off airport/airstrip

CONDITION OF LIGHT - Night (dark)

WEATHER INFO SOURCE- Pilot

BASIC WEATHER - Visual (VMC)
LOWEST CEILING - None
VISIBILITY - 0100.000 SM
WIND DIR/SPEED - Calm
TEMPERATURE (F) - 54
OBSTR TO VISION - None
PRECIPITATION - None

PILOT-IN-COMMAND AGE - 65

CERTIFICATES/RATINGS
Airline transport
Single-engine land, Multiengine land, Single-engine sea
INSTRUMENT RATINGS
Airplane

FLIGHT TIME (Hours)

TOTAL ALL AIRCRAFT - 34000
LAST 90 DAYS - 40
TOTAL MAKE/MODEL - 25
TOTAL INSTRUMENT TIME - 18300

WHILE THE AIRPLANE WAS CLIMBING THROUGH FL230 IN DARK NIGHT VMC CONDITIONS, THE RIGHT ENGINE LOST POWER. SECONDS AFTER THE PILOT INITIATED AN EMERGENCY DESCENT, THE LEFT ENGINE LOST POWER. HE THEN ATTEMPTED SEVERAL UNSUCCESSFUL RESTARTS ON BOTH ENGINES UNTIL REACHING 15,000 MSL, AT WHICH TIME HE FEATHERED THE RIGHT ENGINE PROPELLER. CONTINUED ATTEMPTS TO RESTART THE LEFT ENGINE USING VARIOUS COMBINATIONS OF CROSS-FEED, MIXTURE, AND THROTTLE WERE NOT SUCCESSFUL. THE PILOT THEN EXECUTED A FORCED LANDING TO ROUGH TERRAIN WITH THE AIRPLANE COMING TO REST 1/3 MILES WEST OF AN AIRPORT. THE AIRPLANE WAS STRUCTURALLY DAMAGED DURING THE EMERGENCY LANDING. EXAMINATION OF THE RIGHT ENGINE REVEALED THAT THE #5 CONNECTING ROD FAILED DUE TO OIL STARVATION, AND PENETRATED THE CRANKCASE. ADDITIONALLY, THE TURBOCHARGER TURBINE WHEEL WAS FOUND SEPARATED FROM ITS SHAFT. EXAMINATION OF THE LEFT ENGINE ALSO REVEALED A FAILED TURBOCHARGER TURBINE WHEEL SHAFT. TEARDOWN OF BOTH TURBOCHARGER ASSEMBLIES REVEALED EVIDENCE OF EXCESSIVELY HIGH TURBINE INLET TEMPERATURES AND BOTH TURBOCHARGERS HAD UNAPPROVED PARTS INSTALLED.

Occurrence# 1 LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation CLIMB - TO CRUISE

Findings
1. - 1 ENGINE
2. - EXHAUST SYSTEM,TURBOCHARGER - FAILURE,TOTAL
3. - EXHAUST SYSTEM,TURBOCHARGER - UNAPPROVED PART
4. - FLUID,OIL - LEAK
5. - FLUID,OIL - STARVATION
6. - ENGINE ASSEMBLY,CONNECTING ROD - FAILURE,TOTAL
7. - ENGINE ASSEMBLY,CRANKCASE - PENETRATED

Occurrence# 2 LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation DESCENT - EMERGENCY

Findings
8. - ALL ENGINES
9. - EXHAUST SYSTEM,TURBOCHARGER - FAILURE,TOTAL
10. - EXHAUST SYSTEM,TURBOCHARGER - UNAPPROVED PART

Occurrence# 3 FORCED LANDING
Phase of Operation DESCENT - EMERGENCY

Occurrence# 4 ON GROUND/WATER ENCOUNTER WITH TERRAIN/WATER
Phase of Operation EMERGENCY DESCENT/LANDING

Findings
11. - TERRAIN CONDITION - ROUGH/UNEVEN
12. - TERRAIN CONDITION - NONE SUITABLE
13. - LIGHT CONDITION - DARK NIGHT.

The National Transportation Safety Board determines that the Probable Cause(s) of this Accident was:
THE FAILURE OF THE RIGHT ENGINE'S TURBOCHARGER RESULTING IN OIL STARVATION AND SUBSEQUENT FAILURE OF THE #5 CONNECTING ROD WHICH PENETRATED THE CRANKCASE, AND THE FAILURE OF THE LEFT ENGINE'S TURBOCHARGER RESULTING IN THE LOSS OF POWER ON BOTH ENGINES. FACTORS WERE THE LACK OF SUITABLE TERRAIN FOR THE FORCED LANDING, DARK NIGHT LIGHT CONDITIONS, AND UNAPPROVED TURBOCHARGER PARTS.

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

Adopted 04/18/1996

CHI96LA060
FILE NO. 1749 12/20/95 INDIANAPOLIS, IN AIRCRAFT REG. NO. N5083C TIME (LOCAL) - 20:30 EST

MAKE/MODEL - CESSNA T210N
ENGINE MAKE/MODEL - CONTINENTAL TSIO-520-R
NUMBER OF ENGINES - 1
OPERATING CERTIFICATES - On-demand air taxi
NAME OF CARRIER - PROMPT AIR INC
TYPE OF FLIGHT OPERATION - Non-scheduled
- Domestic
- Cargo

REGULATION FLIGHT CONDUCTED UNDER - 14 CFR 135

AIRCRAFT DAMAGE - Substantial

	FATAL	SERIOUS	MINOR/NONE
CREW	0	0	1
PASS	0	0	0

LAST DEPARTURE POINT - Same as Accident
DESTINATION - CHICAGO, IL

AIRPORT PROXIMITY - Off airport/airstrip

CONDITION OF LIGHT - Night (dark)

WEATHER INFO SOURCE - Weather observation facility

BASIC WEATHER - Visual (VMC)
LOWEST CEILING - None
VISIBILITY - 0015.000 SM
WIND DIR/SPEED - 010 /016 KTS
TEMPERATURE (F) - 24
OBSTR TO VISION - None
PRECIPITATION - None

PILOT-IN-COMMAND AGE - 27

CERTIFICATES/RATINGS
Commercial
Single-engine land, Multiengine land
INSTRUMENT RATINGS
Airplane

FLIGHT TIME (Hours)

TOTAL ALL AIRCRAFT	- 1253
LAST 90 DAYS	- 124
TOTAL MAKE/MODEL	- 24
TOTAL INSTRUMENT TIME	- 116

The pilot reported an engine power surge, followed by a loud bang from the engine area, and a total loss of engine power. A piece of the snap ring from the turbocharger was found jammed between the oil scavenge pump gears and the oil scavenge pump case. This caused the oil pump to fail, resulting in no oil pressure and a total loss of engine power. The center section of the turbocharger had been rebuilt using automotive parts. The airplane's propeller, fuselage bulkheads and lower fuselage skin were bent during the emergency landing.

CHI 60
FILE No. 1749 12/20/95 INDIANAPOLIS, IN AIRCRAFT REG. NO. N5083C TIME (LOCAL) - 20:30 EST

Occurrence# 1 LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation CLIMB

Findings
1. - EXHAUST SYSTEM, TURBOCHARGER - FAILURE
2. - EXHAUST SYSTEM, TURBOCHARGER - UNAPPROVED PART
3. - MAINTENANCE, REBUILD/REMANUFACTURE - NOT APPROVED - UNKNOWN
4. - LUBRICATING SYSTEM, OIL PRESSURE PUMP - FOREIGN OBJECT DAMAGE

Occurrence# 2 FORCED LANDING
Phase of Operation EMERGENCY DESCENT/LANDING

Occurrence# 3 IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation EMERGENCY LANDING

The National Transportation Safety Board determines that the Probable Cause(s) of this Accident was:
the failure of the turbocharger, caused by a unapproved rebuild of the turbocharger which contained automotive parts. Debris from the failed turbocharger damaged the oil pump resulting in lack of engine lubrication.