PB95-910406
NTSB/AAR-95/06
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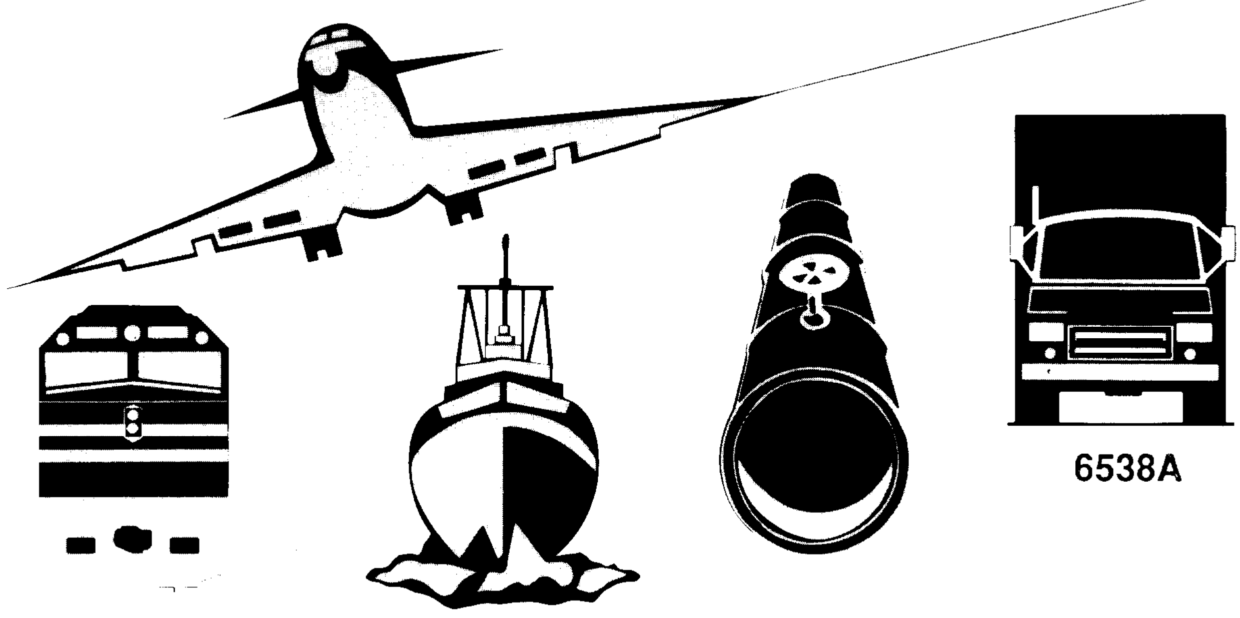
NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

UNCONTROLLED COLLISION WITH TERRAIN
AIR TRANSPORT INTERNATIONAL
DOUGLAS DC-8-63, N782AL
KANSAS CITY INTERNATIONAL AIRPORT
KANSAS CITY, MISSOURI
FEBRUARY 16, 1995



6538A

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Adopted: August 30, 1995
Notation 6538A

Abstract: This report explains the accident involving an Air Transport International DC-8-63, which was destroyed by ground impact and fire during an attempted takeoff at Kansas City International Airport, Kansas City, Missouri, on February 16, 1995. Safety issues in the report include three-engine takeoff training and procedures, flightcrew fatigue, company crew assignment decisionmaking, and Federal Aviation Administration oversight of the company. Safety recommendations concerning these issues were made to the Federal Aviation Administration and Air Transport International.

CONTENTS

EXECUTIVE SUMMARY

On Thursday, February 16, 1995, at 2027 central standard time, a Douglas DC-8-63, N782AL, operated by Air Transport International, was destroyed by ground impact and fire during an attempted takeoff at the Kansas City International Airport, Kansas City, Missouri. The three flight crewmembers were fatally injured. Visual meteorological conditions prevailed, and an instrument flight rules flight plan was filed. The flight was being conducted as a ferry flight under Title 14 Code of Federal Regulations Part 91.

The National Transportation Safety Board determines that the probable causes of this accident were:

(1) the loss of directional control by the pilot in command during the takeoff roll, and his decision to continue the takeoff and initiate a rotation below the computed rotation airspeed, resulting in a premature liftoff, further loss of control and collision with the terrain.

(2) the flightcrew's lack of understanding of the three-engine takeoff procedures, and their decision to modify those procedures.

(3) the failure of the company to ensure that the flightcrew had adequate experience, training, and rest to conduct the nonroutine flight.

Contributing to the accident was the inadequacy of Federal Aviation Administration oversight of Air Transport International and Federal Aviation Administration flight and duty time regulations that permitted a substantially reduced flightcrew rest period when conducting a nonrevenue ferry flight under 14 Code of Federal Regulations Part 91.

Safety issues discussed in the report focused on three-engine takeoff training and procedures, flightcrew fatigue, company crew assignment decisionmaking, and Federal Aviation Administration oversight of the company. Safety recommendations concerning these issues were made to the Federal Aviation Administration and Air Transport International. Also, as a result of the investigation of this accident, on March 30, 1995, the Safety Board issued Urgent Action Safety Recommendations A-95-38 and -39 to the Federal Aviation Administration concerning practices at Air Transport International.

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1. FACTUAL INFORMATION

1.1 History of Flight

On Thursday, February 16, 1995, at 2027 CST[1], a Douglas DC-8-63, N782AL, operated by Air Transport International (ATI), was destroyed by ground impact and fire during an attempted takeoff at the Kansas City International Airport (MCI), Kansas City, Missouri. The three flight crewmembers were fatally injured. Visual meteorological conditions prevailed, and an instrument flight rules (IFR) flight plan was filed. The flight was being conducted as a ferry flight under Title 14 Code of Federal Regulations (CFR) Part 91.[2]

N782AL landed at MCI on February 16, 1995, after a regularly scheduled cargo flight from Denver (DEN), Colorado. The airplane was loaded with new cargo and was prepared for a departure to Toledo, Ohio. During the engine starting sequence, the flightcrew was unable to start the No. 1 engine. Local maintenance personnel examined the engine and determined that a No. 1 engine gearbox drive gear had failed and that repairs could not be accomplished at MCI. ATI management decided to schedule a three-engine ferry of N782AL to Westover Municipal Airport (CEF), Chicopee, Massachusetts, where repairs could be accomplished. The cargo was then offloaded from the airplane.

[1]All times are in central standard time (CST) unless otherwise noted.

[2]Ferry flights are operated under Title 14 CFR Part 91.611, and, under this regulation, do not involve cargo or passengers or produce revenue for the company.

Another DC-8-63, N788AL, was scheduled to be ferried from Dover, Delaware (DOV), to MCI by the captain, first officer and flight engineer, who would later be involved in the accident in N782AL. This flightcrew had completed a regular cargo flight from Germany and were on a off-duty rest break in DOV. AT1 flightcrew scheduling personnel later assigned the captain and his crew to the three-engine ferry operation of N782AL to be conducted from MCI to CEF. The AT1 chief pilot was consulted about this assignment and gave approval for the flight, although flightcrews more experienced in three-engine takeoffs were available at MCI. According to the chief pilot, he telephoned the captain and discussed with him some of the details for the later three-engine ferry flight, including the weather forecast of possible adverse winds during the landing at CEF. Additional discussions occurred concerning a landing curfew at CEF of 2300 eastern standard time and how this would impact the flight. If the captain was unable to arrive before the landing curfew, it was decided to use Bradley International Airport (BDL), Windsor Locks, Connecticut (about 17 nautical miles southwest of CEF), as an alternate.

The captain and his crew departed DOV on the first ferry flight and arrived in MCI at 1739 on the day of the accident. The block-to-block time for the flight was 3.3 hours. AT1 arranged for a qualified airframe and powerplant (A&P) mechanic to fly from DEN to MCI to prepare N782AL for the three-engine ferry. The captain prepared the flight departure papers and discussed fueling requirements with another AT1 captain who had flown N782AL to MCI. Both captains agreed that the fuel load should be 75,000 pounds, to include 30,000 pounds of ballast fuel and 45,000 pounds of usable fuel. The computer flight plan provided to the captain estimated an en route time of 2 hours and 7 minutes for the flight from MCI to CEF. Based on this estimated time, N782AL would have had to take off prior to 1953, in order to arrive at CEF before the curfew. The A&P mechanic, who prepared N782AL for departure, stated that he was present in the cockpit when the captain reviewed the three-engine ferry procedures with the other two crewmembers with the aid of the flight manual.

About 1955, the engine start procedure was initiated. The No. 4 engine would not start on the first attempt because an ignition circuit breaker had inadvertently been left open. The circuit breaker was reset, although some pooled fuel in the cowling did momentarily torch, and a successful engine start was eventually accomplished. All three engines were operating by 2004. Following the fuel torching episode, the captain indicated that he was going to continue the start sequence on that engine until he was reminded by the flight engineer of the starter duty cycle.[3]

At around 2005, the captain stated, "Okay, okay, what we are going to need to do too is, ah, get as much direct as we can that will allow us to fly a little bit better than eight zero if we can." He elaborated on this comment by stating, "yeah, because we got, we got two hours to make it to go over there for flight time...and right now it's past." The next statement by the first officer was "Pushin'."

At 2007:39, the first officer called MCI ground control and requested taxi instructions, indicating that the airplane was "heavy" and that this would be a three-engine departure. Ground control assigned runway 01L via taxiway Bravo. The flightcrew then requested the latest MCI winds, and ground control replied that the wind was from 240 degrees at 4 knots. The flightcrew then requested runway 19R for departure, but due to conflicting inbound traffic, this request could not be approved. During the taxi, the flightcrew of N782AL advised MCI ground control that they would need to hold in position for a "couple of minutes on the runway for a static run-up."

Takeoff data computed by the flightcrew during flight planning (written on the laminated takeoff data card found in the wreckage) included a Vmcg speed [minimum control speed on the ground] of 107 knots, a Vr speed of 123 knots, a V2 speed of 140 knots, a stabilizer trim setting of 5.1 units nose up and a maximum takeoff engine pressure ratio (EPR) setting of 1.9.[4]

Beginning at 2013:28, the CVR recorded the following pretakeoff briefing:

2013:28
CAM-l okay this will be a left seat takeoff, we got number one engine

[3]The engine starter duty cycle limitations for the JT3D turbine engine are 1 minute on, 1 minute off, 1 minute on, 5 minutes off. If the operator is only motoring the engine, the cycle limitation is 2 minutes on, 5 minutes off.

[4]According to the ATI DC-8 three-engine takeoff chart, these speeds would be appropriate for a 220,000 pound, 1,000 foot pressure altitude, 12 degree flap setting, 30 degrees Centigrade takeoff. The temperature at the tune of the accident takeoff was 31 degrees Fahrenheit, or about zero degrees Centigrade. The correct speeds for a zero degrees Centigrade takeoff, under the same conditions, would be Vr - 121 knots, V2 - 141 knots, and Vmcg - 116 knots.

is inoperative, we reviewed the procedures for three engine takeoff and ever and if nobody has any questions --.

2013:50
CAM-2 no questions.

2013:50
CAM-l okay just to review one more time what we're going to do is set max power on number two and number three --.

2013:56
CAM-2 right.

2013:56
CAM-3 right.

2013:57
CAM-l okay and I'll ease in ah number four -.

2014:01
CAM-3 and I'll call increments of point one.

2014:03
CAM-l yeah absolutely and by ah VMCG we'll have max power on number four.

2014:13
CAM-3 right co-pilot er first officer's going to call airspeed-.

2014:16
CAM-2 airspeed alive eighty knots and ten increment to VMCA, then I'll call you rotate--.

2014:21
CAM-l right.

2014:22
CAM-2 positive rate.

2014:23
CAM-l okay and 1'11 ah after rotate I'll call for positive gear ah er positive rate gear up within three seconds **--.**

2014:32
CAM-2 okay.

2014:33
CAM-3 VMCG.

2014:34
CAM-l yes.

2014:34
CAM-2 yes.

2014:35
CAM-l I'll lower, I'll lower, oh pardon me.

2014:38
CAM-3 VMCG is minimum ground control speed.

2014:40
CAM-l right.

2014:41
CAM-2 understood okay.

2014:43
CAM-l at positive rate I'll call gear up I'll lower the nose slightly to gain two ten but still keep about two hundred to four hundred feet a minute climb.

2014:51
CAM-2 right.

2014:52
CAM-l okay then ah when we reach two ten I'll call for max continuous

power.

2014:58
CAM-2 okay.

2014:59
CAM-l okay and then well call ah we'll reduce the flaps like that, we'll climb at V2 all the way up to **three** thousand feet then we'll call for the climb procedures.

2015:09
CAM-2 okay just to verify, I had V2 to four hundred AGL then two ten.

2015:13
CAM-l yeah.

2015:14
CAM-2 okay that's true but we'll take it to three thousand before we okay 1'11 point that --.

2015:18
CAM-3 and we won't start flap retraction until two ten.

2015:20
CAM-2 right.

2015:21
CAM-l right okay.

2015:22
CAM-l okay and ah --.

2015:23
CAM-2 I'm going to tower.

2015:24
CAM-l all right.

2015:27
(sound similar to frequency change).

2015:28
CAM-l and it'll be the royal three departure -- out of here.

2015:30
CAM-2 that radar **vec-** runway heading radar vectors -- you got it? 1'11 read it to you. ah fly assigned heading and altitude for vectors to appropriate route expect filed altitude ten minutes after departure --.

2015:41
CAM-l okay.

2015:42
CAM-2 then it's got some transitions you don't need to worry about not yet **--*.**

2015:44
CAM-l okay.

2015:47
CAM-3 and ah of course we'll all be watching' real close for loss of directional control.

2015:51
CAM-l yeah and also of any other ah problem that we have okay they said that they had a fire bell on number four okay --.

2015:58
CAM-2 yeah.

2015:59
CAM-l ah I talked with the engineer and I talked with the captain both he they both said that it was a false indication to their knowledge. The mechanic said that he fixed it --.

2016: 10
CAM-3 yeah fire loop lain' on the cowling.

2016:11
CAM-2 you will be running all the throttles right -.

2016:13
CAM-l yes.

2016:14
CAM-2 I won't even touch the throttles.

2016:15
CAM-l I ah that is correct you will ah just set them up ah 'til we're ready there.

2016:21
CAM-3 are you ready to go?

2016:22
CAM-2 I'll let him know it's three engine.

At 2018: 15, the flight was cleared into position and to hold on runway 01L. The MCI local controller cleared N782AL for takeoff at 2019:07 and provided instructions to turn right. to 030 degrees after takeoff. The static run-up was performed while in position at the end of the runway, and the takeoff was commenced. At 2020:31, the flightcrew of N782AL stated, "Air Transport 782 we're aborting the takeoff ." The MCI local controller observed the airplane decelerate on the runway and provided instructions to turn right off the runway and contact ground control. In addition, the controller asked if any assistance was needed, to which the flightcrew replied negatively. At 2021:41, the flightcrew contacted MCI ground control and requested clearance to taxi back to runway 01L for another attempted takeoff. This request was approved.

According to the CVR transcript and the sound spectrum analysis, during this first attempted takeoff, the power on the asymmetric engine was advanced so that full power on the asymmetric engine was obtained at around 100 knots, about 7 knots below the stated but incorrect Vmcg speed of 107 knots. The engine pressure ratio **(EPR)** of 1.5 was called 1 second before the airspeed alive (about 50 to 60 knots) call was made; followed by a call of 1.6 EPR, 1 second before the 80 knots call. Then, 90 knots was called, followed 1 second later by the 1.8 EPR (the target takeoff EPR was 1.91). One hundred knots was called 1 second later, followed by the sound of decreasing engine power, indicating the start of the rejected takeoff.

Following the rejected takeoff, the flightcrew discussed the problems they encountered during the takeoff roll. The conversations that follow were excerpted from the CVR recording:

2021:02
CAM-l I couldn't even get **dev-**

2021:03
CAM-3 well how far were we up close to.

2021:05
CAM-2 we we're about ah --.

2021:06
CAM-3 we were at one six, and then power went all the way up to one ah one nine zero as you ran it up, so it went up real fast.

2021:15
CAM-l yeah it jerked up.

2021:17
CAM-2 you brought it up too fast? or it jerked up or what?

2021:19
CAM-l it just came up too fast is what it did.

2021:22
CAM-3 if you want to try it again I can try **addin'** the power if you like.

2021:24
CAM-l okay let's do it that way yeah ah tell em' **--.**

2021:27
CAM-3 ***.**

2021:29
CAM-2 like to go back and do it again?

2021:29
CAM-l yeah tell 'em that we ah we just ah stand-by one let **me-** oh just tell 'em we'd like to taxi back and have another try at it.

2021:39
RDO-2 Kansas City ground Air Transport seven eighty two's clear we'd like to taxi back and depart one **left** again.

202**1:47**
GND Air Transport seven eighty two heavy roger taxi one left.

2021:50
RDO-2 one left Air Transport seven eighty two.

202152
CAM- 1 okay.

2021:55
CAM-3 I'll take off before the line.

202157
CAM-2 yes let's back that one up.

202158
CAM-3 you want the anti-skid off?

202290
CAM-l no ah let's just ah --.

2022:02
CAM-3 to the line?

2022:03
CAM-l yeah all the way down to the line.

2022:06
CAM-3 okay, transponder ignition override back to off.

2022: 10
CAM-3 how much rudder were you stickin' in?

2022: 11
CAM-l I had it all the way in.

2022:13
CAM-3 I was lookin' *.

2022: 14
CAM-l that's why I ah -.

2022: 17
CAM-3 okay when do I have to have max power in on the outboard engine?

2022:21
CAM-l one hundred and seven.

2022:23
CAM-3 by VMCG.

2022:24
CAM-l yeah.

2022:24
CAM-3 okay.

2022:26
CAM-l okay ah we didn't use brakes on that so brake energy ah chart should be okay.

2022:31
CAM-3 no.

2022:36
CAM-l it seemed what happened, it was goin' up smoothly and then all of a sudden -.

2022:40
CAM-2 it kinda ah --.

2022:40
CAM-l it jerked and then yeah.

2022:44
CAM-2 a question to consider Captain is ah when we hit when we get near VMCG or get near Vr or VMCG if we're **usin'** all our rudder authority you might **wanta'** consider abort possibly because once we get higher we'regunnarbeinbein even worse trouble correct.

2023:01
CAM- 1 that's correct absolutely.

2023:07
CAM-3 no actually above VMCG you rudder has more authority it's helping you more.

2023:11
CAM-2 I understand.

2023: 14
CAM-3 if we were to lose ah about the time an outboard engine before VMCG **-.**

2023:18
CAM-2 right.

2023:19
CAM-3 you can't continue the takeoff because you will lose directional control because you other engine is already in.

2023:25
CAM-2 okay yeah you're right you're one hundred percent right.

2023:29
CAM-l okay do me a favor just write down what time we aborted.

2023:32
CAM-3 okay well we aborted at ah about zero?

2023:34
CAM-2 yeah that's about right.

2023:44
CAM- 1 okay.

2023:44
CAM-2 boy it's gettin' tight.

2023:45
CAM-l yeah I know.

2023:48
CAM-2 hay we did our best you know.

2023:51
CAM-l yeah.

The airplane taxied to runway 01L in about 6 rninutes and, at 2024:28, was again cleared for takeoff, with the same instructions to turn right to 030 degrees upon departure. There were no further radio communications with the flight.

On the accident takeoff, the power on No. 4 engine was increased by the flight engineer at a more rapid rate than on the first takeoff. For instance, on the second takeoff, 1.6 EPR was called 1 second before the "airspeed alive" call (50 to 60 knots), whereas on the first takeoff, 1.6 EPR was called 1 second before 80 knots. See figure 7.

Shortly after the first officer called airspeed alive, there was an abrupt turn to the left, followed quickly by a correction to the right. After the first officer called "90 knots," the airplane started to turn left again. Following the 100 knot call, the FDR revealed a pitch change, indicating that the pilot rotated the airplane about 20 knots before the target rotation speed of 123 knots. The left drift continued, and the first officer was heard calling, "we're off the runway." A directional control correction was initiated, and the pitch attitude increased just as the airplane became airborne. The airspeed reached between 120 and 123 knots. This is just about Vmca (minimum control speed air) and is also about the stall speed for that airplane weight. The impact occurred as the airplane rolled to a nearly 90 degree left bank.

The CVR recorded the following sounds and flightcrew words during approximate 4 minutes prior to the accident:

2024:06
CAM-l and you can tell 'em that we'll ah be ready for takeoff again at the end.

2024: 15
CAM-2 tell them now?

2024:20
RDO-2 Kansas City tower Air Transport seven eighty two we'll be ah ready to go at the end of one left.

2024:26
GND roger contact the tower you'll be number one.

2024:27

RDO-2 okay

2024:28
CAM-2 yeah that might **.

2024:32
(Sounds similar to flight switching frequency).

2024:36
RDO-2 Kansas City tower Air Transport seven eighty two be ready to go at the end ah one left ah three engine takeoff.

2024:42
TWR Air Transport seven eighty two heavy tower one left turn right zero three zero cleared for takeoff.

2024:47
RDO-2 okay cleared to go one left after departure zero three zero on the heading Air Transport seven eighty two.

2024:52
CAM-l okay and the checklist.

2024:54
CAM-3 we are to the line.

2024:56
CAM-l okay below the line.

2024:56
CAM-3 transponder?

2024:59
CAM-2 it's on again.

2025:01
CAM-3 ignition override?

2025:02
CAM-2 all engines.

2025:07
CAM-3 exterior lights.

2025:08
CAM-l to go.

2025: 10
CAM-3 ah I'm gunnar need a **minute.**

2025:11
CAM-l yeah.

2025:12
CAM-3 I need to balance fuel out a little bit it's heavy on this side.

2025:15
CAM-l okay.

2025:33
CAM-2 clear left.

2025:43
CAM-3 I'll * I'll let you know when

I have enough there.

2025:46
CAM-1 okay.

2025:54
CAM-1 I'll line up just a little right of the center line here.

2025:58
CAM-2 good idea.

2026:11
CAM-3 okay outboard fuel is balanced.

2026: 12
CAM-1 okay and we're cleared for takeoff, lights are extended and on. checklist is complete?

2026:24
CAM-3 checklist is complete.

2026:24
CAM-1 okay.

2026:25
CAM (sound of increasing engine noise).

2026:33
CAM-1 make sure that ah two and three is is ah -.

2026:37
CAM-3 at max power?

2026:37
CAM-l yeah.

2026:39
CAM-3 okay.

2026:40
CAM-3 I'll set max power.

2026:46
CAM-3 one one.

2026:49
CAM-3 one two.

2026:50
CAM-3 one three.

2026:52
CAM-3 one four.

2026:54
CAM-3 one five.

2026:58
CAM-3 one six.

2026:59
CAM-2 airspeed's alive.

2026:59
CAM-3 one seven.

2027:01
CAM-1 god bless it.

2027:05
CAM-l keep it goin'.

2027:06
CAM (sound of engine noise increasing).

2027:07
CAM-3 keep it **goin'?**

2027:07
CAM-l yeah.

2027:07
CAM-2 eighty knots.

2027:11
CAM-2 ninety knots.

2027:13
CAM-2 one hundred knots.

2027:17
CAM-l okay.

2027:17
CAM (sound of loud crash).

2027:20
CAM-2 we're off the runway.

2027:21
CAM-l go max power.

2027:26
CAM-l max power.

2027:27
CAM-2 get the nose down.

2027:28
CAM-l max power.

2027:29
CAM-2 you got it.

2027:30
CAM-? we're gunnar' go -.

2027:30
CAM (sound of loud crash).

2027:32
end of recording

The MCI local controller later said, ". ..something did not look right as the airplane was lifting **off...the** lights were out of whack...it didn't look right." He thought the airplane became airborne and then observed a **"fireball."** Airport crash/rescue units, already out of the firehouse on a night exercise, responded to the accident scene.

There were several other witnesses to the accident. One was a commercial pilot who observed **N782AL** reject the first takeoff and then taxi back for the second attempt. He was on a ramp near the runway midpoint and observed the second takeoff attempt from the start of the takeoff roll. He said that as the airplane rotated, "...the tail dragged and it left quite a lot of sparks. It looked unusually nose high after rotation." He also said that as the airplane passed by him, he could see something like "fire" emanating from the left side of the airplane, about the location of the No. 2 engine. He stated that the airplane became airborne, but "it mushed into the air." He estimated that the airplane reached an altitude of between 50 and 100 feet. At this point there was no more flame from the left side. He saw the airplane enter a slow roll to the left and reach "nearly a 90 degree bank." It then impacted the ground and exploded. The report of another witness was similar, but he added that he heard the "pop of an engine like a compressor stall." He was located on the airport, and also saw the airplane veer to the left and explode upon impact with the ground.

The **ATI** A&P mechanic who prepared **N782AL** for the three-engine ferry also observed the takeoff and impact. He was at the north end of the runway and had a head-on view of the takeoff. He said the airplane obtained an "unusually

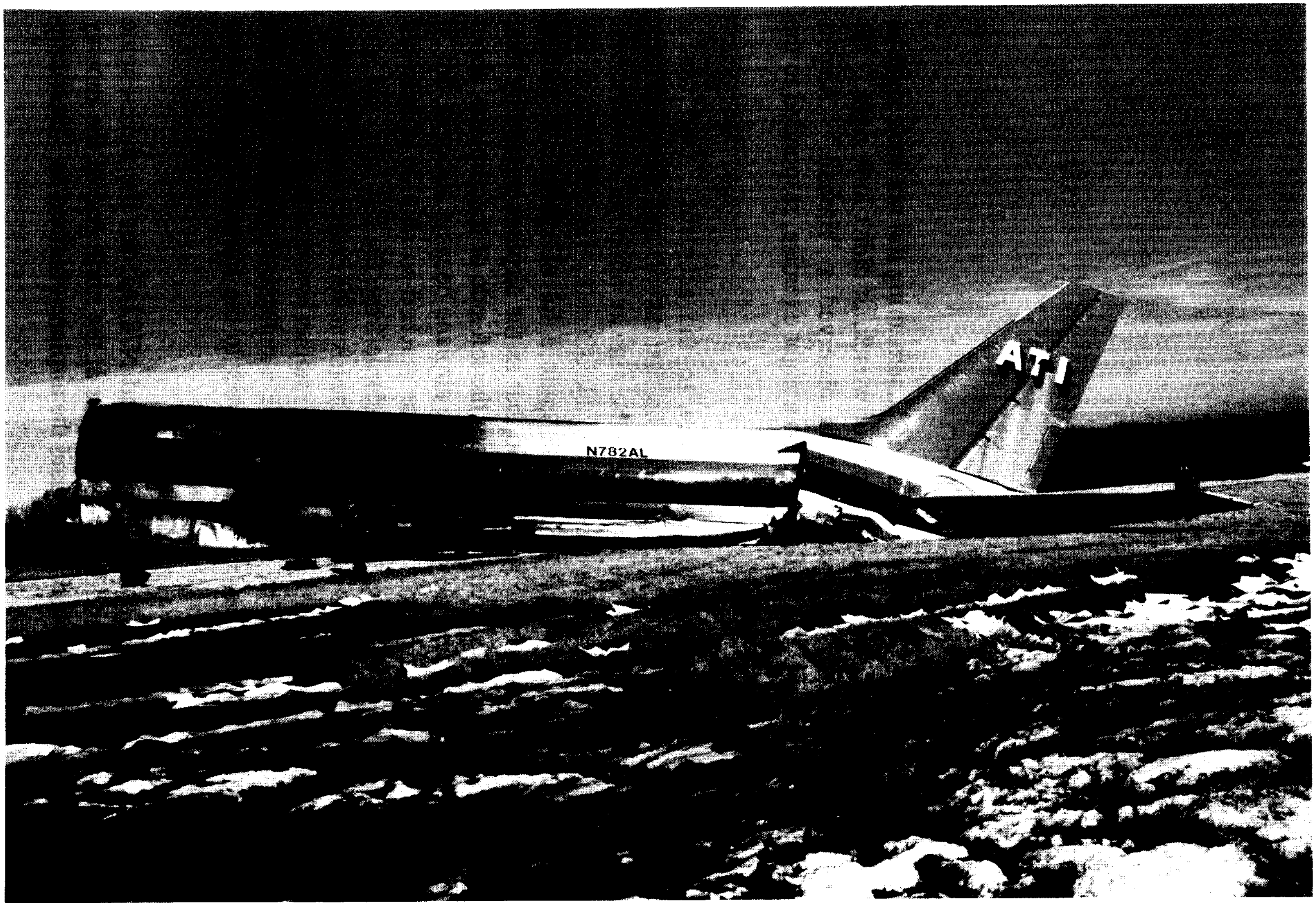

Figure 1.--Ground view of wreckage.

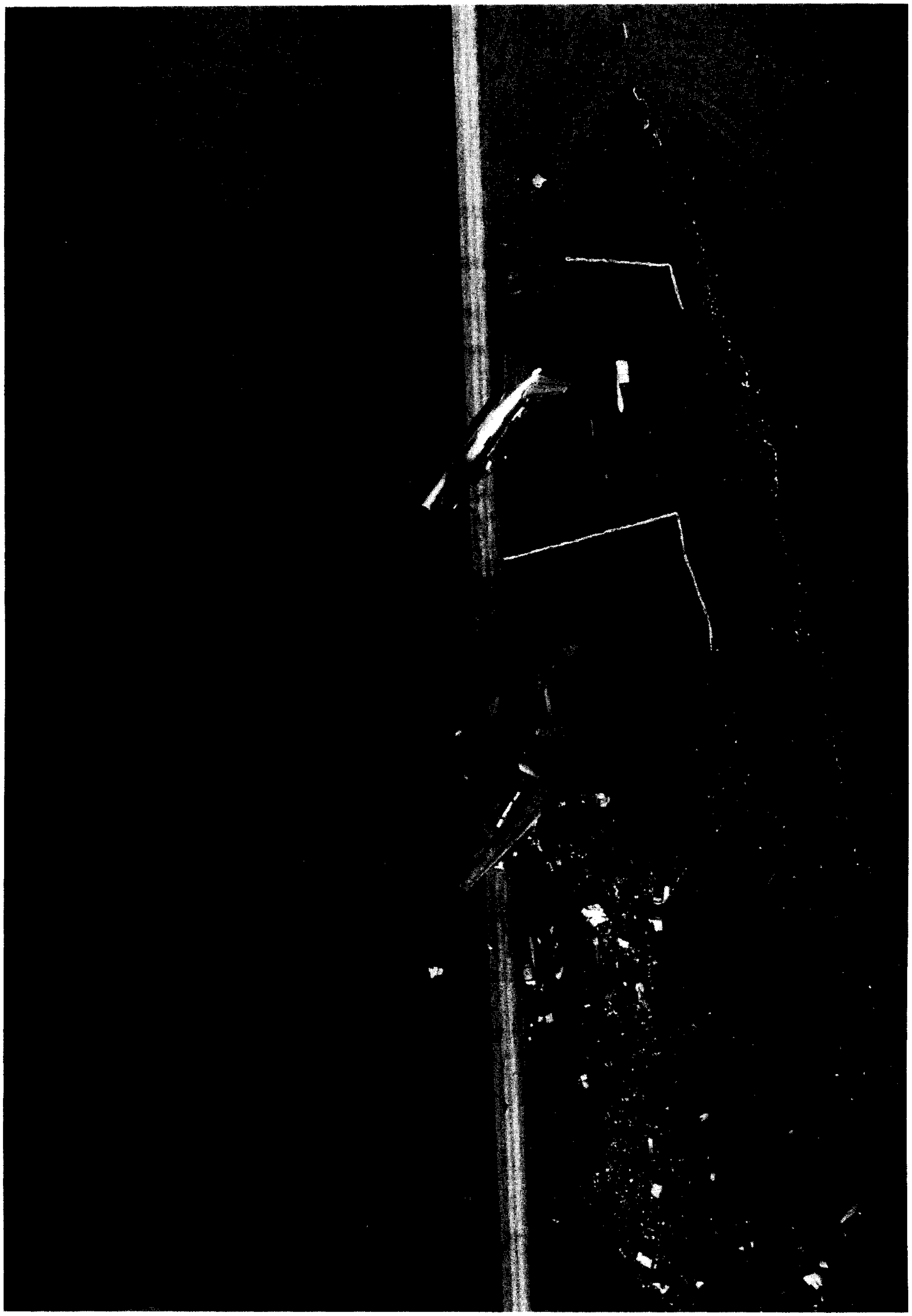

Figure 2.--Aerial view of wreckage.

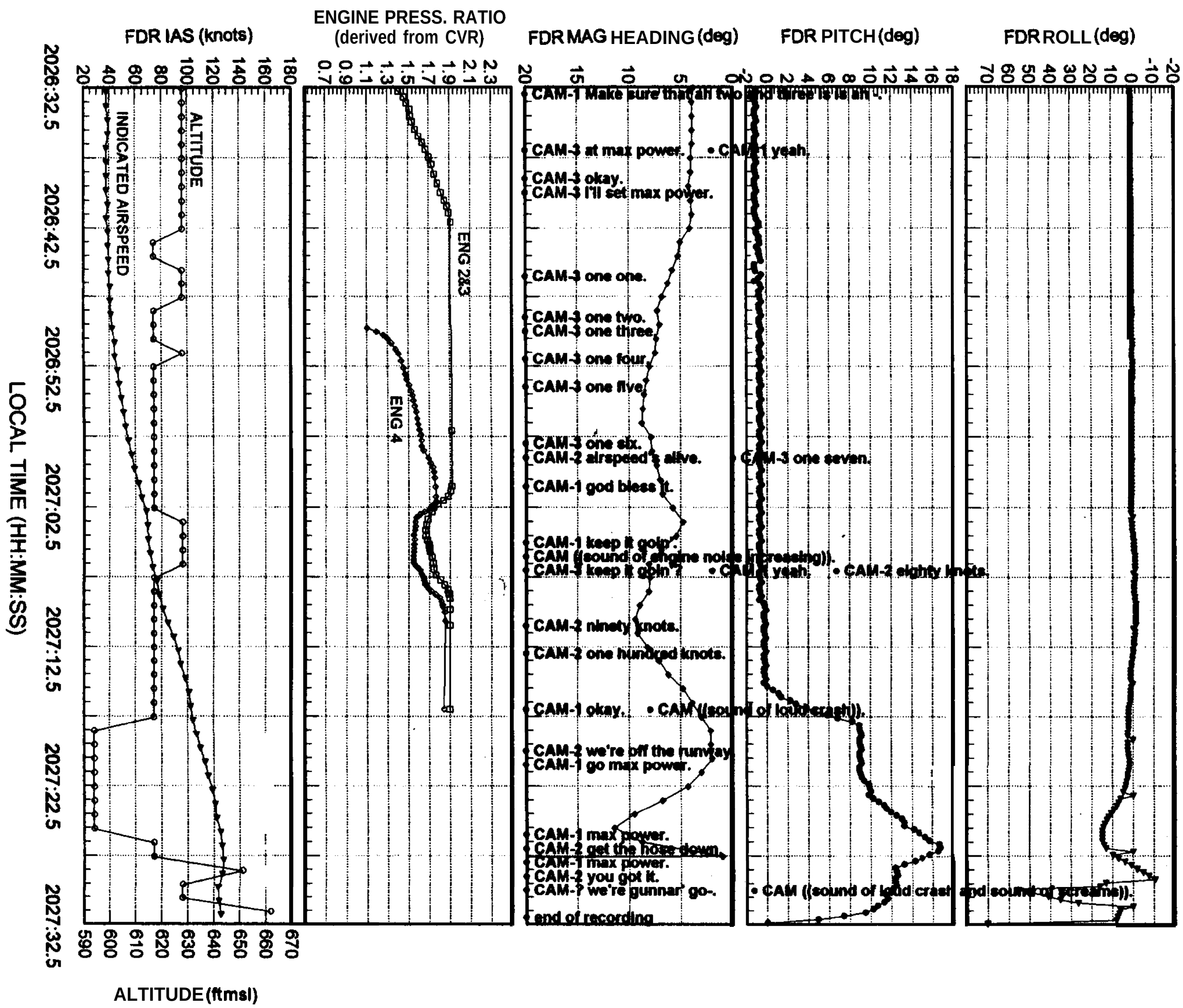

Figure 3.--FDR/CVR presentation.

nose high attitude during rotation," and he observed a "bright yellowish-orange ball of fire from the exhaust of the No. 2 engine." He then saw the airplane enter a "slowly increasing left bank" just before impacting the ground. See figures 1 and 2.

The accident occurred during the hours of darkness at 39'18'50.4" north latitude and 094'43'51.8" west longitude. Field elevation at this location was 978 feet above mean sea level.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others	Total
Fatal	3	0	0	3
Serious	0	0	0	0
Minor/None	4	4	0	0
Total	3	0	0	3

1.3 Damage to Airplane

The airplane was destroyed during the impact sequence and postcrash fire. The hull loss value of the airplane was **$12,000,000.**

1.4 Other Damage

The spilled fuel from the airplane caused environmental damage, which cost $474,000 to clean up.

1.5 Personnel Information

1.5.1 The Captain

The captain, age 48, was born on October 18, 1946. The following are the dates on which he obtained Federal Aviation Administration (FAA) certificates and ratings:

Private Pilot Certificate	September 7, 1970
Instrument Rating	October 4, 1977
Commercial Pilot Certificate (with multi-engine rating)	June 11, 1981

Airline Transport Pilot (ATP) Certificate	August 26, 1985
Type rating in the DC-8	October 21, 1989
Type rating in the DC-6 and DC-7	October 30, 1985
First Class Medical Certificate (must wear and possess corrective lenses for distant and near vision, respectively)	January 11, 1995

On October 13, 1989, an FAA Examiner issued a Notice of Disapproval after the captain (a first officer at that time) failed a DC-8 simulator check. The area graded unsatisfactory was categorized as "other instrument approaches." A recheck was satisfactory on October 21, 1989.

In addition, the captain obtained the following FAA airman certificates:

Mechanic Certificate with A&P Rating	June 1, 1983
Advanced Ground Instructor	November 7, 1983
Flight Engineer (Reciprocating Engine)	January 31, 1984

In the FAA airman records for the captain, there was a Notice of Proposed Certificate Action, dated May 12, 1994. The violation involved a three-engine ferry flight from Belgium to Canada, in which four passengers and 6,250 pounds of company cargo were carried. At the time of the incident, the captain was employed by American International Airways, Inc. (AIA), as a first officer. The operations specification for the airline prohibited carrying any passengers or cargo other than what was essential for the ferry flight. The FAA proposed to suspend his ATP certificate for 45 days. However, after an informal interview with FAA attorneys, the suspension was voided, and action was reduced to a warning letter, which addressed his responsibilities as a first officer to be aware of such limitations and to express these limitations to the pilot-in-command.

The captain's employment records indicated that he flew DC-6 and DC-7 aircraft as a flight engineer and first officer for Trans Air Link, Miami, Florida, from March 1983 until June 1988. He upgraded to captain in these aircraft types in October 1988. He left this company for a position with Rosenbaum Aviation, Inc., in June 1988 and remained with that company until he was furloughed in October 1991. With Rosenbaum, he flew the DC-8 as a first officer until November 1989, when he checked out as a DC-8 captain. No records for training in 1990 could be located, but there was a record of a satisfactory proficiency check accomplished in August 1991.

In February 1992, he was employed by Fiie Airlines, Inc., as a DC-8 captain. He flew with this company until June 1992. In November 1992, he started employment with AIA as a DC-8 first officer. He left this company in January 1994, when he was hired by ATI, as a DC-8 captain.

An examination of the captain's training records while he was employed by AIA revealed that on October 5, 1993, a check airman entered the following comments after a line check:

> Excellent ride. [This individual] would make a great captain.

On October 20, 1993, another check airman entered these comments after a first officer simulator proficiency training session:

> [This individual], at this time, does not exhibit the confidence and command authority necessary to function as a pilot in command. I do not recommend he be considered for upgrade at this time.

Another check airman, on October 21, 1993, stated in the comments section, after a second first officer simulator proficiency training session:

> Good instrument scan and aircraft control. Weak on procedures. All proficiency training maneuvers completed satisfactorily.

His training by ATI consisted of reduced new-hire ground school (48 hours) based on his recent DC-8 experience. This training included basic indoctrination, initial ground school, and two cockpit procedures trainer (CPT) sessions totaling 8 hours. As part of this training, he also received three simulator training periods totaling 12 hours. He shared these sessions with another ATI pilot. The ATI training manual called for a newly hired pilot-in-command to receive 20 hours of initial simulator flight training to be completed in five simulator sessions. These hours could have been reduced if a pilot successfully completed the listed events and an ATI instructor recommended a reduction in training hours. A satisfactory simulator proficiency check (PC) was conducted on February 15, 1994.

The captain's company-optional initial operating experience (IOE) was conducted on 11 flights in the airplane, from February 22 through 26, 1994, and totaled 18.9 hours with 11 landings. An FAA observer was not required because of the captain's previous qualifications. On February 26, 1994, the captain was observed by this second individual for an annual line check, and he was graded satisfactory.

The captain flew with a check airman, in April 1994, to determine his capability to operate internationally. According to a company training supervisor, the check captain did not think that the captain was ready for the international authority; therefore, he did not conduct a line check. It was decided to restrict the captain to domestic routes until he was "more seasoned."

The captain was provided with proficiency training on August 12 and 13, 1994, including two simulator sessions of 4 hours each for a total of 8 hours. Company records showed that the captain then received recurrent training in Denver from February 6 through 11, 1995. Included in the records was documentation of crew resource management (CRM) training, conducted by Hemandez Engineering, Inc., which reflected 16 hours of classroom training, identified as "initial CRM."

The captain was observed on an annual line check on February 14 and 15, 1995, the 2 days prior to the accident, on a round-trip flight to Germany from Dover, Delaware. This was also termed an international line check. All items were rated satisfactory by the check captain. In the comments section, the check captain stated, "Very nice job." The captain was due for a proficiency check in February 1995, with a grace period into March.

The captains training records indicated that he received simulator training in three-engine ferry procedures during training sessions on February 15, 1994, and August 13, 1994. It was noted on the check form, dated February 15, 1994, that Engine Ferry Procedures were graded satisfactory. In addition, pilot logbook entries indicated that the captain was a first officer on three actual three-engine ferry flights in DC-8 airplanes. The last two of these were in November 1993. No record was found that he had performed pilot-in-command duties during a three-engine takeoff.

The following is a summary of the captains flight time:

Total Flight Time	9,711 hours
DC-8 Captain Time	3,129 hours
DC-8 First Officer Time	1,354 hours
Time Last 90 Days (all DC-8)	201 hours
Time Last 60 Days (all DC-8)	120 hours

Time Last 30 Days (all DC-8) **60** hours

1.5.2 The First Officer

The first officer, age 38, was born on August 15, 1956. The following are the dates on which he obtained FAA certificates and ratings:

Private Pilot Certificate	March 22,198 1
Instrument Rating	April 15, 1989
Commercial Pilot Certificate	October 12, 1989
Multi-engine Rating	November 11, 1989
Flight Instructor, Single-engine Land	June 13, 1990
Flight Instructor, Instrument	September 21, 1990
Flight Instructor, Multi-engine	November 9, 1990
Airline Transport Pilot	July 27, 1992
Type Rating in B-737	August 20, 1993
First Class Airman Medical Certificate (with no limitations)	May 19, 1994

On March 20, 1989, a Notice of Disapproval was issued by an FAA Examiner for failed instrument flight check by 'the first officer. The items noted as unsatisfactory were: holding procedures, circling approach, and very high frequency omnidirectional radio range (VOR) approach procedures. A successful recheck was accomplished on April 15, 1989. On July 13, 1992, an FAA Examiner issued a Notice of Disapproval for a failed ATP oral and flight check in a Piper PA-3 l-350. The recheck was successful on July 27, 1992, and the ATP was issued. Another Notice of Disapproval was issued by an FAA Examiner on August 10, 1993, for a failed simulator rating check in a B-737-200. The areas identified as needing reexamination were: **V1** engine cut, single engine missed approach and single engine landing. A successful recheck was conducted on August 20, 1993, and a type rating for the B-737 was issued.

The first officer's employment application indicated that he flew with Sunwest Aviation from November 1990 until January 1994. With this company, he flew as a captain in the Beech 99 and PA-31-350. From February 1993 until August 1994, he flew as a captain with Ameriflight, Inc., operating with the same type aircraft. He was hired by ATI on August 22, 1994.

On August 26, 1994, ATI records indicated that the first officer's initial ground training was completed. He was given four CPT sessions of 4 hours each, totaling 16 hours, and six simulator sessions of 4 hours each, totaling 24 hours, completed on October 6, 1994. His oral examination and proficiency check in the DC-8 were completed on October 7, 1994, and on October 9, 1994, he performed the required aircraft landing certification. He completed his IOE and his line check on October 13, 1994, after 26.6 flight hours. The training record reflected three-engine ferry simulator training on October 5, 1994. He was not type rated in the DC-8.

At the time of the accident, the first officer had a total of 4,261 flying hours, had been flying the line as a DC-8 first officer at ATI for 4 months, and had a total of 171 hours in the DC-8. He was still on probation, which, at ATI, is 1 year in duration.

The following is a summary of the first officer's recent flight time:

Time Last 90 Days (all DC-8)	142 hours
Time Last 60 Days (all DC-8)	71 hours
Time Last 30 Days (all DC-8)	39 hours

1.5.3 The Flight Engineer

The flight engineer, age 48, was born on July 20, 1946. The following is a summary of the dates on which he was issued FAA certificates and ratings:

Mechanic Certificate with A&P Rating	January 28, 1989
Flight Engineer Certificate (Turbojet)	February 18, 1990
Second Class Airman Medical Certificate (corrective lenses required for near vision)	March 15, 1994

The flight engineer retired from the USAF in October 1989 as a Senior Master Sergeant. He had about 23 years military service and had accumulated over 4,000 hours on the Lockheed C-141 as a flight engineer. After his military retirement, he was employed by Hughes Technical Services as a flight engineer instructor in the C-141. He was hired by ATI on July 18, 1994. His ATI training records indicated that he completed five CPT sessions at 4 hours each, for a total of 20 hours; and five simulator sessions at 4 hours each, for a total of 20 hours. He completed a proficiency check ride on August 30, 1994, with all items rated satisfactory. The flight engineer's IOE was completed on September 9, 1994, after 29.2 flying hours. His line check was also completed on that day. There was no FAA observer, and one was not required. The flight engineer's records indicated three-engine simulator training on August 8, 1994.

At the time of the accident, the flight engineer had been flying the line as a DC-8 flight engineer with ATI for 5 months. This was his first experience as a commercial air carrier crewmember, although he had accumulated over 4,000 flight hours as a flight engineer in the USAF, and had acquired additional postmilitary experience as a civilian C-141 flight engineer instructor. He was still on probation at ATI.

The following is a summary of the flight engineer's flight time:

Total Flight Time	4,460 hours
Total Flight Time in a DC-8	218 hours
Total Flight Time Last 90 Days (all DC-8)	135 hours
Total Flight Time Last 60 Days (all DC-8)	116 hours
Total Flight Time Last 30 Days (all DC-8)	57 hours

1.6 Airplane Information

1.6.1 General Maintenance History

Reviews of Airworthiness Directive compliance and pilot reports since December 1994 were performed. No discrepancies relevant to the circumstances of the accident were discovered.

Aircraft inspection records showed that the last "A" Check (every 125 hours) was performed on February 11, 1995. The aircraft had accumulated 12 hours since that inspection, at the time of the accident. The last "B" Check (every 700 hours) was performed on November 14, 1994. The aircraft had accumulated 350 hours since that inspection. The last "C" Check (every 3,000 hours) was performed on February 20, 1994. The aircraft had accumulated 1,521 hours since that inspection. The last "D" Check (every 25,000 hours) was performed on June 24, 1988. The aircraft had accumulated 11,040 hours since then. At the time of the accident, total aircraft time was 77,096 hours and 22,404 cycles.

1.6.2 Powerplants

The airplane was equipped with Pratt & Whitney JT3D-7 axial flow, low bypass, turbofan engines. The engines were rated at 19,000 pounds takeoff thrust at 84 degrees F. They were configured with Stage 2 hush kits manufactured by the Nacelle Corporation.

The operator performs no engine maintenance, other than routine servicing and line maintenance. The Gas Turbine Corporation, East Granby, Connecticut, performs all other engine maintenance and inspection for the operator. A review of the aircraft discrepancy records provided by the operator revealed no history of engine-related discrepancies or deferred maintenance on the engines or engine accessories.

1.6.3 Rudder System Description

The rudder and rudder tab are movable control surfaces that provide directional control. The rudder control system is hydraulically actuated and mechanically controlled from the cockpit rudder pedals. During normal operation, rudder pedal movement is transmitted by cables to the rudder hydraulic power unit, which repositions the rudder while the rudder tab remains faired. If hydraulic pressure drops, or the rudder hydraulic power shutoff control lever is moved to the off position, a power-to-manual reversion mechanism unlocks the rudder tab. Rudder pedal movement then causes the rudder tab to deflect, and aerodynamic forces on the tab cause the rudder to move.

Rudder trim is controlled by a mechanical system that changes the neutral position of the rudder load-feel mechanism. A cable drum on the load-feel mechanism is connected to the rudder trim control knob in the flight compartment. Rotating the trim control knob causes the load-feel mechanism to reposition the rudder and rudder pedals to a new neutral position. Full rudder travel (+/- 32.5" when unrestricted) is available regardless of rudder trim setting.

1.7 Meteorological Information

The Kansas City International Airport automatic terminal information service (ATIS) information Zulu provided the weather conditions at 1950 as: clear skies, visibility 20 miles, temperature 31 degrees F, wind 210 degrees at 4 knots. When the flightcrew of N782AL called for taxi instructions, the winds were reported by the ground controller as 240 degrees at 4 knots. There were no reports of convective weather activity. Other pilots interviewed described the weather as "beautiful...clear...light winds."

1.8 Aids to Navigation

No aids to navigation were used by the flightcrew during the takeoff attempts.

1.9 Communications

No communications difficulties were reported or identified.

1.10 Aerodrome Information

Kansas City International Airport, certificated under 14 CFR Part 139, is 15 miles northwest of the city. The airport elevation is 1,026 feet above mean sea level. Runway 01L/19R, the principal instrument runway, is 10,801 feet long and 150 feet wide. It is not equipped with distance remaining markers, has no significant grade, and was dry at the time of the accident. This runway, used by the accident flight, is equipped with runway centerline, touchdown zone, and edge lighting. At the time of the accident, this lighting was set at step 3. The accident airplane began its takeoff runs at the approach end of runway 01L.

1.11 Flight Recorders

1.11.1 General

The airplane was equipped with a Fairchild Model Al00 cockpit voice recorder (CVR), S/N 2325, and a Sundstrand digital flight data recorder (DFDR), P/N 980-4100-60US, S/N 7768. Both units were mounted in a compartment in the aft fuselage below the cargo bay floor. Both units were found separated from their mounts. Only minor dents in the outer cases were seen. There was no evidence of fire damage. DFDR information is included in figure 3, and a transcript of the CVR recording is included in Appendix B.

Eleven parameters were recorded by the DFDR: time, altitude, airspeed, vertical acceleration, longitudinal acceleration, magnetic heading, pitch attitude, roll attitude, elevator position, engine revolutions per minute (rpm), and microphone keying. The DFDR was upgraded from five parameters to eleven parameters by Aircraft Systems and Manufacturing, Inc. Documentation of this upgrade was found to be incomplete and difficult to interpret. Documentation for elevator position was not sufficient to convert the raw values to engineering units. Engine rpm data was spurious and unusable. All engine data for this accident was derived from the CVR sound spectrum.

1.11.2 Sound Spectrum Analysis

During the acceleration portion of the takeoff, sounds were recorded by the cockpit area microphone (CAM) that could be associated with the spooling up and down of the aircraft's engines. During the rejected takeoff, the sound signatures were identifiable from idle engine through maximum engine speed to the reverser operation at the end of the rejected takeoff. During the accident takeoff, the sound signatures associated with the engines were identifiable from the start of the takeoff until 2027:12 when the background noise in the cockpit increased. From this time, until the end of the recording, the increase in the background noise prevented the identification of any engine signatures. Engine No. 4's acceleration rate during the accident takeoff attempt was derived from this sound spectrum analysis and is included in figure 3. It is also in the analysis section of this report in figure 7. The engine pressure ratio callouts recorded on the CVR were close to those derived from the sound spectrum analysis.

1.12 Wreckage and Impact Information

1.12.1 General Debris Field Description

Two sets of tire marks attributed to the accident airplane's rejected and accident takeoffs were surveyed on the runway. The second set of marks could be followed from the start until the airplane became airborne. Runway marks were further correlated with N782AL's tires after comparison with known dimensions of the airplane's landing gear and tires. Some of the runway marks from N782AL's tires were consistent with skid marks, scuff marks made by a tire that is both rolling and sliding sideways.

Some marks attributed to the rejected takeoff were consistent with skid marks from the nose landing gear (NLG) tires. No other tire marks from the rejected takeoff were observed. The first evidence of tire marks was observed on the runway centerline 590 feet from the threshold of runway 1L. The marks deviated to the left for most of the ground track. The latter portion of the marks deviated back to the right slightly before ending. The last surveyed mark from the rejected takeoff was located 14 feet left of runway centerline and 2,772 feet from the threshold. The tire marks from the rejected takeoff were continuous from beginning to end.

The runway marks attributed to the airplane's second takeoff attempt were consistent with skid marks from the NLG and main landing gear (MLG) tires. Marks in the grass from the right MLG tires were also documented, as were marks on the runway and in the ground adjacent to the runway from the tail skid. The first surveyed tire mark was from the right NLG tire and was located 9 feet right of centerline and 451 feet from the threshold. The tail skid mark began 29 feet left of centerline and 3,779 feet from the threshold. Several pieces of the tail skid casting and fairing were found along the tail skid ground scar. The ground scar ended 144 feet left of centerline and 5,174 feet from the threshold. This was determined to be the takeoff point of the airplane. No additional ground scars or airplane parts were documented until the beginning of the ground scars at the main wreckage site.

The airplane fuselage broke into two large sections and the cockpit. All four engines and pylons and the landing gear assemblies separated from the airplane during the crash sequence. The location of significant ground scars and debris is shown in figures 4 and 5.

Several ground impact scars, containing pieces of left wing, were observed near the main wreckage site. The first of these ground scars began 1,470 feet from the end of the tail skid scar. Fuel was spilled throughout the area of the initial ground scars, and most of the grass in this area was burned. A large trench began approximately 300 feet from the initial ground scar. The trench was generally oriented along a magnetic heading of 350 degrees, although it curved to the west slightly.

A large crater was located beyond the trench. Pieces of cockpit side window, a nose landing gear door, forward fuselage, a main cargo door latch assembly, and pieces of the No. 2 engine were found in and around the crater. A IO-foot section of the left wing tip was located near the crater. This piece had been heavily damaged by fire, and the outboard tip structure was mangled and bent. Also found just beyond the crater were a 19-foot-long piece of outboard left lower skin and most of the main cargo door. Examination of the door revealed that it was latched and locked. Pieces of red lens were found between the initial left wing

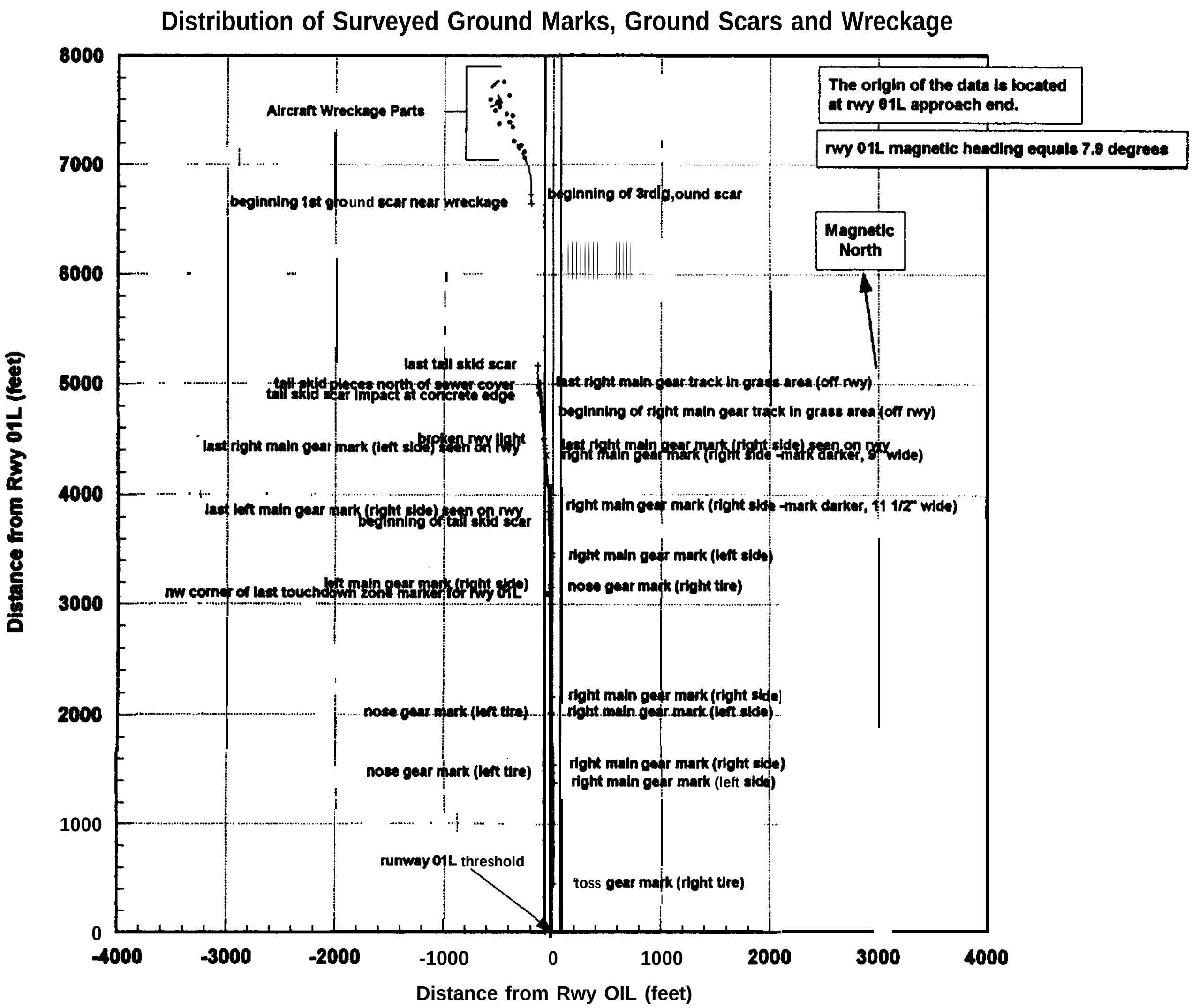

Figure **4.--Ground** scars, ground marks, and wreckage.

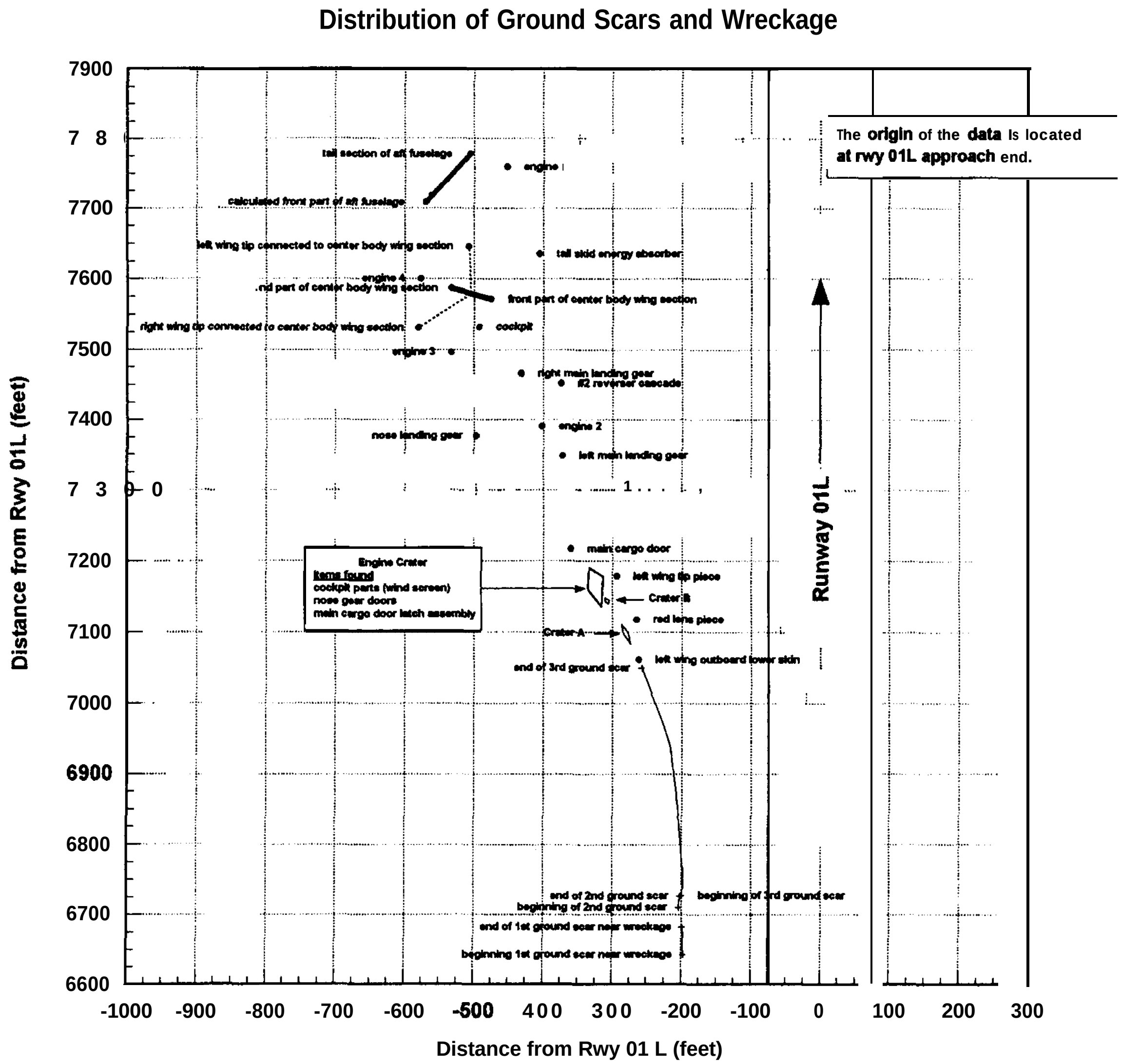

Figure 5.--Ground scars and wreckage.

ground scars and the left wing tip.

1.12.2 Fuselage

The cockpit and forward fuselage suffered severe impact damage. The upper cockpit structure remained recognizable, but the lower cockpit structure, radome, and fuselage were mostly broken into smaller pieces. The upper, forward section of the cockpit was found upside down, and the front windows were shattered.

The forward fuselage remained intact and attached to the wing structure. The left and right sides were sooted, more so on the left side and near the wings, but no soot and only minor deformation were observed on the interior of the fuselage. The forward fuselage section came to rest on a magnetic heading of 125 degrees.

The aft fuselage section remained intact, and with the empennage attached. Some postcrash sooting was observed. The cabin structure remained intact, with no fire penetration. The fuselage belly sustained considerable crushing damage. The section came to rest on a magnetic heading of 240 degrees.

1.12.3 Wings

The full span of the right wing was intact. All right flight control surfaces were found attached to the wing or adjacent to it. The left wing remained attached from the fuselage to just outboard of the No. 1 pylon attachment point. The wing exhibited upward and rearward bending at the break. All left wing flight control surfaces either remained attached or were found adjacent to the wing structure.

1.12.4 Empennage

The empennage exhibited a vertical crack aft of the pressure bulkhead and circumferentially around the fuselage, but it remained attached to the fuselage strllcture. The tail cone was buckled, with the left elevator. jammed into the structure. The rudder was buckled at midspan above the trim tab. The rudder, rudder trim tab, horizontal stabilizer, elevators, and elevator trim tabs remained attached to the mounting hardware. The vertical stabilizer was cracked at the dorsal fairing.

1.12.5 Engines'

1.12.5.1 Engine No. 2

The exterior of the engine case was lightly sooted. It was located in an area that was exposed to a low intensity grass fire. There were no apparent inside-to-outside penetrations of the nose cowl. The thrust reverser assembly and exhaust nozzle were separated from the engine but were intact, with the reverser buckets in the stowed positions.

A borescope examination revealed mud, dirt and grass in the gas path from the inspection hole rearward. Fuel was present in the system and in each examined component from the fuel boost pump to the fuel manifold. The throttle lever position on the fuel control was between 3/4 to full open. The fuel shutoff lever was in the full forward position. Both anti-ice valves were closed. The compressor bleed valve was closed.

1.12.5.2 Engine No. 3

The engine cowling, thrust reverser assembly, and exhaust nozzle remained with the engine. The thrust reverser buckets were in the stowed position. Viewed through the exhaust nozzle, the fourth stage turbine was intact, and there was no visible evidence of foreign object passage through the turbine gas path.

All first and second stage fan blades, except for seven second stage blades from 11 to 2 o'clock, were found broken off adjacent to the blade root above the platform. The seven blades remaining in the disk were deformed in the direction opposite rotation. There was uniform distribution of grass and mud on the fan exit and inlet vanes. Borescope examination aft showed a uniform distribution of mud and grass on the leading edges of all visible vanes back to the high pressure discharge. The fuel pump filter screen contained a small amount of particulate. There was some residual fuel in the inlet filter screen housing. The fuel control inlet filter screens were clean. The fuel control fuel shutoff lever was about 2/3 of the way toward the rear stop. The anti-ice valves were closed. The compressor bleed valve was open.

'According to ATI sources, engine No. 1 experienced a constant speed drive failure previous to the takeoff attempts. It was secured and intentionally not operating at the time of the accident. Its further condition is not considered in this report.

1.12.5.3 Engine No. 4

The No. 4 engine was separated from the pylon, and the pylon was separated from the wing. The thrust reverser assembly and exhaust nozzle were separated from the engine and were located forward of the right wing. The thrust reverser buckets were found in the stowed positions. There was a small amount of vegetation visible in the inlet case forward of the first stage fan, but no visible damage was observed on the first or second stage fans, the inlet guide vanes or first stage vanes. There was no visible damage to the fourth stage turbine. The fourth stage turbine turned freely by hand, and the fan and low pressure compressor turned with it. The blanking plate for the hydraulic pump mount pad, and the pressurization and dump valve were not recovered. All other engine-mounted accessories appeared to be intact.

There was no visible damage to the inlet guide vanes. There was no visible foreign object damage to the fan section. There was evidence of a tip rub on the first stage fan rub strip located from the 7 to 8 o'clock position that covered an arc of six inlet guide vanes. The fuel control fuel cutoff lever was against the forward stop. The fuel control throttle lever was midrange. The pushrod between the fuel control throttle lever and the engine stub shaft crank was bent slightly near the stub shaft end. There was a witness mark on the engine stub shaft throttle crank and a complimentary witness mark in the clevis of the fuel control-to-stub shaft throttle pushrod that mates when the throttle control is in the full forward position. Borescope examination revealed no apparent internal damage. There was no evidence of foreign object travel through the turbine gas path. A fuel sample obtained from the engine was clear and had no visible water. The anti-ice valves were closed and the compressor bleed valve was open.

1.12.6 Fuel Samples

Fuel samples were obtained from the airplane, the vendor service tanks, and the filter of the fuel tanker that serviced the airplane. These samples were analyzed by Cleveland Technical Center, Kansas City, Missouri. The laboratory report resulting from this examination revealed normal levels of contaminants.

1.12.7 Landing Gear

All three landing gear were separated from the fuselage. The left and right main truck brake stacks were compressible and showed no evidence of melting, fusing, or exposure to fire. All brake hydraulic lines were normally attached, and all the brake stacks appeared to have ample brake wear remaining. All of the left and right main tires showed deep tread grooves, and none had evidence of flat spots or unusual wear. The nose gear was found fully extended and locked in the centered position. Both tires had deep tread grooves remaining.

1.12.8 Hydraulic System

A hydraulically powered nose wheel steering system provides directional control of the nose wheel and is actuated by a nose wheel steering wheel or the rudder pedals. The two hydraulic cylinders in this system, one on each side of the nose gear shock strut to provide the steering input to the nose wheels, remained attached to the nosegear and appeared normal. There was no evidence of damage to or leakage from the associated hydraulic lines.

In addition, both anti-skid junction boxes and the brake hydraulic fuses were inspected and appeared normal. Several hydraulic accumulators (general system and standby rudder system) were visually inspected and appeared normal.

1.12.9 Rudder System

The rudder was deflected trailing edge left and was in contact with the tailcone, which was resting on the ground. The rudder trim tab was deflected approximately 4° trailing edge right. The rudder was movable by hand and could be deflected fully left without restriction. The rudder tab moved in a mechanically geared fashion when the rudder was moved. Damage to the tailcone prevented the rudder from being moved by hand to the right. The hydraulic power unit was visually inspected and appeared normal and undamaged. All control cables to the power unit, as well as the load-feel mechanism, remained attached to their respective components; however, they were broken in several locations consistent with the fuselage breaks.

The rudder load feel mechanism measurement revealed that the distance from the cable drum and the housing was 3/8 inch, which, according to Douglas, corresponds to a trim setting of 3.5 degrees aircraft nose right. There was no witness mark that would have indicated the preimpact distance from the cable drum to the housing. The cable was not intact from the rudder trim handle to the rudder load feel mechanism.

1.12.10 Other Flight Control Systems

The stabilizer trim jackscrews were extended to a point where 18 threads were showing on the right jackscrew and 19 threads on the left jackscrew. According to data provided by Douglas, these extensions corresponded to a trim setting of 5.0 degrees aircraft nose up.

Due to impact damage, it was not possible to measure directly the position of the flaps. The hydraulic system was no longer intact, and the fluid had drained from the hydraulic lines, which allowed the actuators to move freely. However, measurements were made of the extension of the flap lockout cylinders. The inboard cylinder was extended 5.25 inches and was bent in that position. The other lockout cylinders contained no witness marks. According to data provided by Douglas, an inboard cylinder extension of 5.25 inches corresponds to a flap position of 12 degrees. The flap actuator cylinders were inspected but showed no evidence of witness marks.

The control columns were found in the cockpit wreckage and remained attached and interconnected in the longitudinal axis. Both sets of rudder pedals were found in numerous pieces in the cockpit wreckage. All spoiler overcenter links were in the down position, although several spoiler panels were damaged and bent upward. All slot doors were open.

All flight control cables were continuous from the tail to the point at which that section had separated from the midfuselage. Cables were again continuous through the midfuselage to the point of cockpit separation. No corrosion was observed on any of the flight control cables.

1.12.11 Cockpit Documentation

The throttles were found in the following positions: No. 1 - Idle, fuel switch **off;** No. 2 **- 1/4** inches from **firewall,** fuel switch on; No. 3 - 1 inch from idle, fuel switch off; No. 4 **-** mid range, fuel switch **-** on. All throttles were movable and connected to the pulleys beneath the throttle quadrant. The flap handle was found in the 23" position. The flap handle operated normally and engaged all detents. There was no evidence of damage or witness marks on the flap handle assembly or detent track. The rudder trim handle was found three units nose left, and aileron trim was found one unit right wing down. Engine instrument readings varied widely between the four engines.

1.13 Medical and Pathological Information

1.13.1 General

According to his family, the captains health was excellent. They stated that he wore contact lenses and always carried glasses. They also said that he did not take prescription medicine, never drank alcohol, and would not have taken any drugs that would have affected his performance. He carried nonprescription medicine in his flight bag in the event of a cold or headache, but he did not have a cold before the accident. The captains luggage, examined at the accident site, contained disposable contact lenses, a pair of prescription glasses, an unopened pack of cigarettes, and pseudoepedrine tablets (a nonprescription antihistamine medication suitable for flying activities).

According to his wife, the first officer's health was good, and he was always in very good physical condition. She said that he did not drink alcohol or smoke tobacco, and took medicine sparingly when he had a severe headache or allergy difficulties. She said he would not have taken any drugs prior to the accident that would have affected his performance. The first officer's luggage, examined at the accident site, contained no medication.

The flight engineer’s family declined to be interviewed by the Safety Board. The flight engineer’s luggage, examined at the accident site, contained nonprescription medication for treatment of headache and cold.

According to the Jackson/Platt County Medical Examiner, the cause of death for all three crewmembers was traumatic injury. Toxicological specimens, obtained posthumously, were provided to the FAA’s Civil Aeromedical Institute (CAMI) for testing. Tests on urine proved negative for a wide screen of drugs, including alcohol and other major drugs of abuse, for all three crewmembers.

1.13.2 Crew Rest Aspects

A detailed description of the activities of the captain and the first officer in the period prior to the accident is presented in Appendix C. An abbreviated description of the flightcrew's activities from the start of the trip until the accident arc summarized below:

Local Date	Time UTC/Local	Flightcrew Activity
2/14	193511435	The flightcrew met and briefed details of the international operations checkride with the check pilot at Dover, Delaware.
2/14	2230/1730	The international operations checkride flight departed Dover for Ramstein, Germany.
2/15	0528/0628	The flight arrived at Ramstein, Germany. Flight time: 6 hours 58 minutes.
2/15	0815/0915	The flightcrew had breakfast at Ramstein and were in their hotel rooms by 08 15 UTC.
2/15	1800/1900	The flightcrew met for coffee prior to second leg of flight. They spent about 9 hours, 45 minutes in their hotel rooms.
2/15	2028/2128	The flightcrew departed Ramstein for Dover via Gander, Newfoundland. Their arrival in Gander was about 15 hours after their arrival in Ramstein.
2/16	0237/2237	The flightcrew arrived at Gander, Newfoundland. The local date was still **2/15.**
2/16	0328/2328	The flightcrew departed Gander, Newfoundland. The local date was still **2/15.**
2/16	0648/0148	The flightcrew arrived at Dover, Delaware. The total time between Ramstein and Dover was 10 hours, 20 minutes. The total flight time between Ramstein and Dover was 9

		hours 29 minutes.
2/16	0740/0240	The flightcrew checked in to a hotel at Dover.
2/16	0814/0314	The captain placed one minute phone call to ATI operations.
2/16	1302/0802	The captain placed phone call to his home. This call was not related to company business.
2/16	1530/1030	The captain received a call from the ATI manager of crew scheduling to notify the crew that they were to ferry aircraft from Dover to Orlando, Florida.
2/16	1530/1030	The captain placed a one minute phone call to the ATI ground services contractor at Dover.
2/16	1545/1045	The captain received a call from ATI crew scheduling to notify the crew that the Orlando ferry was canceled and that he should go back to sleep and be prepared for a 2300 UTC departure for Orlando or Dayton, Ohio.
2/16	174411244	The captain placed a 2 minute call to AT1 operations.
2/16	1900/1400	Two calls were received by the captain from ATI scheduling to notify crew of a proposed departure from Kansas City of a three-engine ferry flight to Dover, Delaware. The chief pilot joined in the second call. The departure time was to be as soon as possible. The captain indicated that he would depart within one hour.
2/16	1910/1410	The captain made a one minute call to a local retail establishment. This call was not related to company business.
2/16	2000/1500	The crew checked out of the hotel. Their time in the hotel was 12 hours, 20 minutes. The longest period of undisturbed time for the captain was 4 hours, 47 minutes.

2/16	201811518	The crew departed Dover for Kansas City.
2/16	233911739	The crew arrived at Kansas City. The flight time was 3 hours, 21 minutes.
2/17	0207/2007	Taxi instructions received for first takeoff attempt. The local date is still 2/16.
2/17	022712027	Accident. The local date is still 2/16/95.

1.14 Fire

Several witnesses described fire or flame associated with the No. 2 engine after the airplane rotated to a nose high attitude, but before impact with the ground. Concurrent with the observation of this fire, one of these witnesses described a "pop of an engine like a compressor stall." Another of these witnesses stated that he observed a "bright yellowish-orange ball of fire from the exhaust of the No. 2 engine" as the airplane rotated. Following left wing tip contact with the ground, the fuel tanks in that wing ruptured. Fuel was liberated along the wreckage trail and ignited almost immediately.

The Kansas City Fire Department was holding a night exercise on the airport at the time of the accident, and arrived at the accident site about 1 to 1 1/2 minutes after the crash. The fire was contained and extinguished shortly thereafter. Fire damage to the airframe is described in a previous section of this report.

1.15 Survival Aspects

All three flightcrew members were in the cockpit at the time of the accident, and fescue personnel reported that seatbelts were worn by all three. During the impact sequence, survivable space within the cockpit was compromised to the point that this accident is considered unsurvivable.

1.16 Tests and Research

1.16.1 Three-Engine Takeoff Procedural Comparison

A comparison was made between the published three-engine takeoff procedures of ATI, United Parcel Service, and the Douglas Aircraft Company, with special emphasis on pertinent information about asymmetric throttle application timing and rate.

ATI's DC-8 Cockpit Operating Manual states the following concerning asymmetric throttle application:

> Statically set partial power on the asymmetric engine and near max power on the symmetrical engines. After brake release, Set MAX power on the symmetrical engines and, as soon as possible, smoothly accelerate engine opposite the inoperative engine to MAX power during acceleration to Vmcg. The engine should be set at MAX power upon reaching this speed.
>
> CAPTAIN **-** Maintain directional control with rudder nose wheel steering. Smoothly advance power on the asymmetrical engine during the acceleration to Vmcg speed.
>
> The asymmetrical throttle must be aligned with the symmetrical engine throttles by Vmcg.

UPS's Engine-Out Ferry Manual states the following concerning asymmetric power application:

> Before brake release, set 50 percent **N1,** on asymmetric engine. Then set symmetrical engines at normal takeoff **N1,** (Max. Thrust).
>
> After brake release, use the rudder and rudder pedal steering to maintain directional control. Smoothly accelerate the third engine during acceleration to VMCG speed. The third engine should be set at Max. Takeoff Thrust at or before attaining VMCG.
>
> Do not be in too much of a hurry to bring the third engine power in.
>
> As the third engine power comes in, keep feeding in rudder as needed to maintain directional control.
>
> The Douglas DC-8 Flight Manual states:

Advance symmetrical engines to full takeoff thrust. Set engine opposite the inoperative engine to the maximum EPR which can be tolerated and still maintain control at the start of the takeoff roll. This is approximately 1.1 EPR for a dry, hard surface runway.

Smoothly accelerate the engine opposite the inoperative engine during the acceleration to **VMCg** speed. The engine opposite the inoperative engine should be set at full takeoff thrust at or before attaining **VMCg** speed.

1.16.2 Simulator Experiment

During the course of the investigation, several visits were made to the United Airlines Training Center in Denver, Colorado, to study the accident sequence of events. The Link DC-8-60 series simulator used by the accident flightcrew to train for three-engine takeoffs was used for these studies. This was one of two DC-8 simulators at Denver used by **ATI** and other operators to train flightcrews. The other DC-8 simulator is configured to simulate a DC-8-70 series airplane.

Multiple takeoffs were conducted with an **ATI** check captain in the left seat, a Douglas test pilot in the right seat, and an FAA Air Carrier Inspector in the flight engineer's seat. It became apparent that this particular DC-8 simulator could not accurately simulate the yawing moments associated with intentional three-engine takeoffs. The test pilot stated: "In my opinion the airplane data is not entered into the simulator." The **ATI** check pilot agreed with that assessment. In fact, in this device, with the wheel brakes set, three of four engines could be brought up to takeoff power (with an outboard engine at idle power), the brakes could be released, and runway centerline could be easily maintained by the pilot as the simulator accelerated **from** zero airspeed through ground minimum control speed, rotation speed, and beyond. According to the DC-8 qualified pilots participating in the experiment, under these circumstances, an actual DC-8-63 would experience severe directional control problems during the takeoff roll, until ground minimum control speed was achieved.

1.17 Organizational and Management Information

1.17.1 General

ATI, as it is currently formed, is the result of mergers and acquisitions. The current owner purchased ATI in 1988 and merged it with another airline owned by him, International Cargo Express, on October 1, 1994. The new company operates as a supplemental air carrier. The company headquarters is in Little Rock, Arkansas, and it employs about 400 full-time people. About 135 part-time employees (mostly mechanics at various airports) also work for ATI. There are no flightcrew bases because each flightcrew operates from his/her own residence and reports to the airport from which a trip sequence originates. At the time of the accident, the company was operating 22 DC-8 airplanes, and planned to add 2 DC-8s to its fleet. The company has passenger-carrying authority, but at the time of the accident carried passengers only while operating some military contract flights. Military flights comprised about 15 percent of its business.

The flight operations of ATI are worldwide in scope, including flights to China, Russia, India, and several countries in Africa and Europe. The company flew approximately 43,000 revenue hours in 1994. About 12,000 hours of this flight time involved international operations. The airline recently obtained new contracts that resulted in the addition of more airplanes and flightcrews. For instance, a review of the flightcrew hiring dates revealed that 42 percent of the 64 ATI captains were hired during 1993 and 1994. Also, 93.8 percent of the 80 ATI first officers, and 68 percent of the 73 flight engineers were hired during that same time frame. The Manager of Operations System and Training, the Manager of Flight Standards, and the Denver Training Coordinator were also hired between 1993 and 1994 to enhance management oversight during this period of growth.

According to the chief pilot, the difficulties of the job for an ATI pilot included those typical of the freight industry, such as frequent night work. ATI salaries were midrange when compared to industry standards, he said, but the company provided significant benefits to the pilots that were not available at competitor companies. For instance, the crews were based at home, the company provided free life and health insurance, and the company was run with low debt and a history of financial stability. The workforce is not unionized.

1.17.2 Flightcrew Pairing

ATI's chief pilot developed a policy that addressed the pairing of flightcrews in an attempt to avoid pairing inexperienced flightcrews. At the time this program was instituted, there was no regulatory requirement to do so. The scheduling department examined each flightcrew pairing and evaluated the results, based on a desired total score of "5" for the assigned flightcrew. Each flightcrew received a rating number, based on experience. For captains, this number ranged from 1 to 3. For first officers, the number was either 1 or 2. For flight engineers, the number was also either 1 or 2. Under this arrangement, the accident flightcrew was rated "7".

1.17.3 Captain Upgrade

The criteria for upgrading to captain were addressed in the Employee Handbook, which stated, in part:

> The first officer must have accumulated 4,000 hours.
>
> First officer must have 1,000 hours as pilot-in-command of transport category aircraft. (Credit is given for first officer time on a 2 to 1 ratio. 2,000 hours in a DC-8 as first officer, counts as 1,000 hours for this requirement.)
>
> The first officer must have 500 hours in type airplane.

First officers who bid for a captain position are evaluated in the simulator by an ATI check airman. A first officer who fails this evaluation may reapply after 6 months. Since August 1994, six first officers have failed the upgrade evaluation, and four who did pass the evaluation failed the upgrade training.

1.17.4 Company Authorization for Three-engine Takeoffs

ATI authorized all line flightcrews to perform three-engine ferry operations, if the flightcrews met the company-established crew pairing criteria and, according to company management, possessed the ability and experience to successfully complete the maneuver. During training, the accident flightcrew was provided with three-engine instruction and performed the takeoff maneuver in the DC-8-60 series simulator at Denver, Colorado.

The Safety Board surveyed nine other cargo operators to determine a sampling of the industry on the matter of which flightcrews are authorized to perform three-engine ferry operations. The following carriers were contacted: Arrow Air, AIA, Evergreen, Emory Air Express, Federal Express, United Parcel Service, DHL, Buffalo Airways, and Zantop Airlines. All but two of these operators restrict such operations to "select flightcrews." One of the two that use all line flightcrews use only "the most experienced and selected" line flightcrews. The majority of these operators further restrict such ferries to test pilots and "daytime only."

Early in this investigation, on March 30, 1995, the Safety Board recommended that the FAA:

> Limit operations of engine-out ferry flights to training, flight test, or standardization flightcrews that have been specifically trained in engine-out procedures. (Class II, Priority Action) (A-95-39)

The full text supporting this recommendation is included as Appendix D.

On June 13, 1995, the FAA stated that it agrees with this safety recommendation and that it will issue a flight standards information bulletin on the subject. The bulletin will direct principal operations inspectors to inform their respective operators to take additional measures to ensure: (1) that aircraft manual requirements for engine-out ferry flights are clear; (2) that flightcrew training segments are clearly outlined for engine-out operations; and (3) that operators use only flightcrews specifically trained and certified for engine-out operations.

The Safety Board is currently evaluating this response to recommendation A-95-39.

1.17.5 Department of Defense (DOD)

ATI carried freight and passengers for the U.S. military under contract, and several of their airplanes were committed to the Civil Reserve Air Fleet (CRAF). The most recent DOD survey of ATI was conducted on October 18 and 19, 1993. At that time, ATI was operating 14 DC-8 aircraft, 5 of which were committed to the CRAF. The survey recommended: ATI be found capable of providing airlift services to the DOD. No below average evaluation subjects and six above average evaluation subjects were noted during this survey.

1.17.6 FAA Oversight and Surveillance

The FAA's Air Carrier Operations Inspector's Handbook, Order 8400.10 describes the principal operations inspector (POI) surveillance duties as follows:

> The POI's are the primary surveillance program planners in the FAA, since they are the focal point for all operational matters between the FAA and the certificate holder. POI's must ensure that there are periodic reviews of all aspects of a certificate holder's operations. They must specifically determine the operator's compliance status by establishing effective surveillance programs, and evaluating previous surveillance data and other related information. POI's must establish a continuing program for evaluating surveillance data to identify trends and deficiencies and to decide upon and take appropriate courses of action.

Another element of the FAA's surveillance of operators is the Geographic Program. This program assists the POI's by providing surveillance of various functions within a specific geographic area. The handbook stated:

> The geographic program managers are responsible for planning and carrying out inspection programs within their area of responsibility and for ensuring the inspection results are accurately recorded. These managers ensure that all of the activities of a certificate holder conducting operations in their geographic area are inspected and the results are reported to the POI through the program tracking and reporting system (PTRS).

FAA Order 8400.10, described the PTRS as a means of "collection, storage, retrieval, and analysis of data resulting from many different job functions performed by inspectors in the field, the regions, and headquarters." When an FAA Air Carrier Inspector conducts any surveillance function, a PTRS form should be completed, and the data entered into a computer data base. This provides information for the POI to evaluate the adequacy of the surveillance of an air carrier.

PTRS records related to ATI were reviewed for the period from February 16, 1994, through February 16, 1995. This review also included records for International Charter Express (ICX), which was owned by the same management, but was operated under a different certificate, until the certificates were merged effective October 1, 1994.

There was one PTRS record that reflected a surveillance of the international operation. This record represented a Department of Defense (DOD) air mobility flight in September 1994. An FAA air safety inspector (ASI), assigned to a northeast FAA geographic unit, conducted an en route cockpit observation on a DOD flight from Germany to Saudi Arabia and return. Also during this flight, the AS1 performed a cabin en route observation. The FAA inspector stated, "I was very impressed with the professionalism of the whole crew and was pleased by the way they conducted all aspects of the flights." No other records were found for international surveillance of operations for the airline.

In the last several years, there has been a reduction in the number of inspectors assigned to the Denver, Colorado, FAA Flight Standards District Office (FSDO). While there were three DC-8 qualified inspectors in the FSDO in 1994, there was one DC-8 qualified person at the time of the accident. Also, at the time of the accident, the FSDO had 56 total inspectors, 23 of which were assigned to geographical inspections. The FSDO manager stated that by the end of the fiscal year, the total number of inspectors was to drop to 47, and the number of geographical inspectors was to drop to 7. Interviews with some of the inspectors revealed that there was confusion about the future of the geographic program within the FAA.

Lastly, several of the Denver geographic program inspectors stated to Safety Board investigators that POIs not assigned to the Denver FSDO often become "defensive" about the certificates they manage, and at times resent hearing negative comments reported by a geographic inspector from a distant FSDO.

The Safety Board noted that all the Denver geographic program inspectors who were interviewed for this investigation stated that they were favorably impressed by the overall operation of ATI. As an example, the manager of the Denver FSDO stated that ATI relations with the FAA were good. Another inspector stated that ATI was "the best of the [nonscheduled] operators" that he helps oversee, and that ATI pilot training was "thorough and very good."

An interview with the Little Rock FSDO POI for ATI revealed that at the time of the interview, he was unfamiliar with ATI's CRM training program, ATI's crew pairing program, and several aspects of ATI's ground training program at

Denver, Colorado. He was unfamiliar with proficiency check ride failure criteria, as outlined in the FAA Order 8400.10. Also, he had no knowledge of what amount of training, if any, could be provided during proficiency check rides. The **POI** was trained and received a type rating in the DC-8. He has had past experience as a **POI** with a 14 CFR Part 135 operator. He stated that he has about 13,000 hours of total flight time. He has been the **POI** for **ATI** for about 1 year, and the **ATI** certificate is the only one he oversees.

The **POI** for **ATI** was asked how often he had visited the **ATI** Denver training facility and the Denver FSDO, and he indicated "about three or four times last year." He indicated that funding problems in his office restricted his ability to travel to Denver from Little Rock.

Early in this investigation, the Safety Board issued a priority recommendation to the FAA concerning FAA oversight of **ATI.** The recommendation follows, and the full text of the recommendation letter to the FAA is included as Appendix D.

> Conduct an immediate in-depth inspection of Air Transport International **(ATI)** to examine training, operational philosophy, and management oversight. Also, as part of this inspection, examine the effectiveness of the oversight of **ATI** by the Little Rock and Denver Flight Standards District Offices. (Class II, Priority Action) (A-95-**38)**

1.17.7 FAA National Aviation Safety Inspection Program (NASIP)

On June 13, 1995, the FAA responded to recommendation A-95-38 by stating that it agrees with this safety recommendation and has conducted an in-depth National Aviation Safety Inspection Program (NASIP) inspection of Air Transport International. The NASIP inspection was completed on April **28, 1995,** and focused on the following operational areas: management training, qualifications, procedures, flight control, flight operations, records, and facilities. The NASIP inspection also focused on the following airworthiness areas: management, manuals and procedures, training, records, maintenance programs, and airworthiness directives compliance. The FAA furnished a copy of the NASIP report to the Safety Board.

The FAA also formed a special team from FAA headquarters to conduct an evaluation effectiveness of oversight of **ATI** by the Little Rock and

Denver FSDOs. It anticipates that the results of this evaluation will be published in September.

The Safety Board is currently evaluating these responses to recommendation A-95-38.

1.17.8 Previous AT1 Accidents

ATI has experienced three catastrophic DC-8 accidents since 1991 .[6] The Safety Board concluded that the probable causes were related to operational factors in the first two accidents.

In the accident that occurred in New York the Board determined that:

> The probable causes of this accident were improper preflight planning and preparation, in that the flight engineer miscalculated the aircraft's gross weight by 100,000 pounds and provided the captain with improper takeoff speeds; and improper supervision by the captain. Factors relating to the accident were an improper trim setting provided to the captain by the flight engineer, inadequate monitoring of the performance data by the first officer, and the company management's inadequate surveillance of the operation.

In the accident that occurred in Ohio, the Safety Board determined that:

> The probable cause of this accident was the failure of the flightcrew to properly recognize or recover in a timely manner from the unusual aircraft attitude that resulted from the captain's apparent spatial disorientation, resulting from physiological factors and/or a failed attitude director indicator.

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[6]Brief of Accident, JFK International Airport, New York, Air Transport International, March 12, 1991, NYC91-F-A086; Aircraft Accident Report, "Loss of Control and Crash, Swanton, Ohio, Air Transport International, February 15, 1992," NTSB/AAR-92/05; and Kansas City International Airport, Missouri, Air Transport International, February 16, 1995, DCA95MA020, the accident currently under investigation.

1.18 Additional Information

1.18.1 "V" Speeds and Vmcg Calculation

"V" is the symbol used to indicate velocity (speed). In the FAA certification of airplanes, V speeds are used to determine various performance criteria needed for the safe operation of the airplane. Most airline takeoff operations, including those of ATI, involve the use of the following V speeds:

V1 - Decision speed: The speed at which the pilot must make a decision, in the event of an engine failure, either to continue the takeoff or to reject the takeoff. The ability to stop the airplane on the runway remaining is assured if the refused takeoff is begun at or prior to V1. Conversely, enough runway remains ahead of the airplane at or below V1 speed to take off safely using the thrust from the remaining operating engines.

Vr - Rotation speed: this is the speed at which the pilot rotates the nose of the airplane to the takeoff pitch position in preparation for liftoff. This speed cannot be less than V1. The takeoff is considered "committed' after this speed.

V2 - Initial climb-out speed: the speed for climb after attaining a height of 35 feet above the takeoff surface during a takeoff with one engine inoperative.

When conducting a three-engine takeoff in a four-engine airplane, such as the DC-8, V1 speed is not used because the flight is already operating with an engine inoperative. Vmcg is computed during flight planning in place of Vl. For the purposes of this report, Vmcg is defined as follows:

Vmcg - Minimum control speed on the ground: the minimum speed at which it is possible to maintain control of the airplane with an engine inoperative, using primary aerodynamic controls alone, and thereafter maintain a straight path parallel to that originally intended.[7]

‘FAR 91.611, Authorization for Ferry Flight With One Engine Inoperative, paragraph (c) (3), states "The takeoff, flight and landing procedures...must be established. The airplane must be satisfactorily controllable during the entire takeoff run when operated according to these procedures."

Vmcg is a function of the airport pressure altitude, airplane flap setting, and ambient air temperature. A chart for 12 degrees flaps is included in the **ATI** DC-8 Cockpit Operating Manual, Chapter 2, Normal Procedures, Section 21, Three-Engine Ferry (figure 6). The **ATI** crewmember determining Vmcg would enter the weight column on the left side of the chart with the weight of the airplane to the nearest 10,000 pounds. Within that weight section, he or she would select the predicted ambient air temperature in degrees C, to the nearest 10 degrees. That weight/temperature line of data is used to select that section of the line that corresponds to the planned pressure altitude to the nearest 1,000 feet. The resulting block of data on the chart would reveal the takeoff distance, Vmcg, Vr, and V2, for the planned three-engine takeoff.

FLAPS 12° — 63 AIRPORT PRESSURE ALTITUDE — FLAPS 12"

	SEA LEVEL					1000 FEET					2000 FEET					4000 FEET					6000 FEET				
WT 1000 LBS	T °C	DIST	VMCG	VR	V2	T °C	DIST	VMCG	VR	V2	T °C	DIST	VMCG	VR	V2	T °C	DIST	VMCG	VR	V2	T °C	DIST	VMCG	VR	V2
	-10	7000	116	120	142	-10	7200	116	120	142	-10	7500	116	121	142	-10	7500	113	121	140	-10	7300	108	117	140
	0	7200	116	120	142	0	7400	116	120	142	0	7600	116	121	142	0	7400	110	116	137	0	7700	106	117	134
200	10	7400	1113	120	142	10	7500	115	120	141	10	7400	113	120	137	10	7300	107	116	134	ID	8200	103	117	133
	20	7700	114	120	141	20	7500	112	119	137	20	7200	109	118	136	20	7200	104	117	133	20	8700	99	118	133
	30	7800	109	118	140	30	7700	107	118	137	30	7500	104	117	134	30	7900	100	117	133	30	9000	96	118	133
	40	7000	104	116	136	40	7200	102	115	136	40	7700	99	117	133	40	8700	95	118	132	40	10000	91	119	132
	-10	7000	116	120	141	-10	7200	116	121	141	-10	7500	116	121	141	-10	7500	113	121	141	-10	7800	108	119	140
	0	7200	116	120	141	0	7400	116	120	140	0	7600	116	120	141	0	7400	110	119	137	0	8300	106	120	138
210	10	7400	116	120	141	10	7500	115	120	140	10	7400	113	119	137	10	7900	107	119	136	10	9000	103	120	138
	20	7700	114	120	140	20	7500	112	119	138	20	7300	109	119	137	20	8300	104	120	136	20	9500	99	121	138
	30	7800	109	118	139	30	7700	107	118	138	30	7600	104	119	137	30	8700	100	120	136	30	9900	96	121	138
	40	7400	104	116	138	40	7800	102	119	139	40	8400	99	120	136	40	9600	95	121	135	40	• C	•	•	•
	-10	7000	116	121	140	-10	7200	116	121	141	-10	7500	116	121	140	-10	7500	113	122	140	-10	8500	108	123	140
	0	7200	116	121	140	0	7400	116	121	141	0	7600	116	122	140	0	7900	110	123	140	0	9100	106	124	139
220	10	7400	116	121	140	10	7500	115	122	140	10	7500	113	122	140	10	6600	107	123	139	10	9600	103	124	139
	20	7700	114	122	140	20	7500	112	122	140	20	8000	109	123	140	20	9100	104	124	139	20	10400	99	125	139
	30	7800	109	122	140	30	7800	107	123	140	30	8300	104	123	139	30	9400	100	124	139	30	10900	96	125	139
	40	8000	104	123	139	40	8500	102	124	139	40	9100	99	124	139	40	10500	95	125	138	40	• C	•	•	•

C = No takeoff allowed at the stated temperature/weight/altitude because three-engine climb requirements would not be met.

Figure **6.--ATI** DC-8 three-engine takeoff data chart.

2. ANALYSIS

2.1 General

The flightcrew was properly certified to conduct this flight in accordance with the Federal Aviation Regulations and company requirements. They were suffering no discernible health problems and were not under the influence of drugs. The emergency response to the accident scene was timely and efficient.

The investigation revealed no evidence of preexisting structural defects in the airframe and no failure of airplane structure prior to ground impact. There was no evidence of any engine problems or in-flight fire other than reports of flame in or around the No. 2 engine. This flame was the result of an engine compressor surge caused by disrupted airflow into the engine during the high angle of attack flight of the airplane immediately after liftoff.

The airplane was inspected and maintained according to currently accepted practices, and all airplane systems appeared to be operating normally during the accident sequence of events. Available engine power was sufficient to successfully complete the takeoff, had the correct procedures been used by the flightcrew.

The presence of the tire marks on the runway indicates that the thrust asymmetry of the three-engine takeoff exceeded the capability of the rudder (and the nose wheel steering, if used) to maintain directional control. It is not known whether the captain utilized the steering tiller during any portion of the takeoff attempts. In addition, data available from Douglas show that the engine power of the No. 4 engine, as indicated on the CVR, would have exceeded the capability of full rudder and nose wheel steering to maintain directional control.

On both takeoff attempts, tire marks began early in the takeoff roll. This is consistent with data from the CVR showing that the thrust on the No. 4 engine was increased too quickly after brake release, resulting in excessive thrust asymmetry during the accident takeoff. FDR heading data and the presence of nose tire marks almost 10 feet to the right of runway centerline on the second takeoff attempt suggest that the captain may have steered the airplane to the right to provide the airplane more room to maneuver as the thrust from the No. 4 engine was increased, anticipating possible problems maintaining directional control.

2.2 Airplane Systems

2.2.1 Brakes, Landing Gear and Tires

The brake stacks were compressible and showed no evidence of melting, fusing or exposure to fire. In addition, there was no evidence of damage or malfunction to the nose wheel steering system, tires, or anti-skid system. No flat spots were seen on the tires, and no melted fuse plugs were observed. The V-shaped splits on the deflated tires are consistent with overload failure at impact. All damage to the landing gear appeared consistent with the gear being down at impact. The Safety Board found no evidence of malfunction of these systems.

2.2.2 Flight Controls

The flap handle in the cockpit was found in the 23 degree position; however, there were no witness marks to indicate its position at impact. The cockpit tumbled during the accident sequence; therefore it is possible that the flap handle changed position. Also, the flap actuators did not contain witness marks and therefore were not conclusive in determining flap position. However, the inboard flap lockout cylinder was found with a witness mark that corresponded to a flap position of 12 degrees at impact. In addition, the CVR recorded the first officer stating that the flaps were set at 12 degrees. Therefore, it is reasonable to assume that the flaps were correctly set to 12 degrees for takeoff.

An attempt was made to determine the rudder trim setting for takeoff. The rudder trim dial was found in a position corresponding to three units nose left trim. However, there were no witness marks associated with the handle which indicated its position at impact. Since the rudder trim system is cable driven, and the cables were stretched and broken during the accident sequence, it is possible that the handle position changed during the impact sequence. Measurement of the rudder load-feel mechanism revealed inconclusive evidence regarding the preimpact trim setting due to the stretching of the cables as the aircraft broke apart. Therefore, due to the nature of the impact and subsequent lack of definitive evidence, the Safety Board could not determine the rudder trim setting.

In summary, the airplane was configured with landing gear down, a stabilizer trim setting of 5.0 degrees aircraft nose up, and flaps set to 12 degrees. All these items were consistent with what was planned by the flightcrew, and were consistent with normal operating practice for a three-engine takeoff. The Safety Board concludes that there was no flight control system malfunction.

2.3 AT1 Operational Supervision

2.3.1 Flightcrew Background

The captain completed his probationary period with the company 1 month before the accident. Although he had an extensive flying background, there was evidence that he had experienced difficulty in the past with some aspects of flight proficiency and command authority. For instance, he failed his first DC-8 simulator rating ride in 1989. Also, while he was working for another operator, that management decided against upgrading him to captain. Following a simulator training session, a check airman for this operator stated that the pilot did not have the command authority needed for a pilot-in-command, and he did not recommend him for upgrade to captain.

About 10 months before the accident, ATI evaluated this captains ability to conduct international operations. After several flights, a check airman decided to restrict him to domestic operations for "more seasoning," because his performance was below that required for international operations. The day before the accident, he did pass an international line check conducted by a different check airman. A review of his personal logbooks revealed 3 three-engine takeoff events, but none in which he was the pilot-in-command; therefore, it is likely that this was the first three-engine takeoff during which he was the flying pilot.

The first officer was still on probation with ATI and had experienced only 4 months of line operations. His background was in much smaller twin engine airplanes, weighing about 7,000 pounds. He had a total of only 171 flying hours in the DC-8. Interviews with captains who had flown with the first officer described him as eager to learn, but lacking large airplane experience and lacking confidence in his own ability to fly large airplanes. There was no evidence that the first officer had ever been involved in an actual three-engine ferry flight.

The flight engineer was also on probation with ATI, with just over 5 months of line operations. He was new to the DC-8, with only 218 hours total time in the airplane, and he was new to any air carrier operations. Although his experience was extensive in the Lockheed C-141, interviews revealed that Air Force procedures did not include three-engine takeoffs except in emergency war-time situations; therefore, it is likely that this was his first three-engine takeoff. The flight engineer had most of his flight experience in the Lockheed C-141. In that airplane, the flight engineer did not advance the throttles during the takeoff; only the pilots move the throttles. Also, C-141 procedures specified that the Vmcg speed be calculated for each takeoff, in anticipation of losing one of the four operating engines. The concept of the use of Vmcg during a takeoff with one engine intentionally inoperative from the beginning of the takeoff roll was probably new to the flight engineer. This may explain the flight engineer's comments about Vmcg that are addressed later in this analysis.

2.3.2 Flightcrew Assignment

The Safety Board believes that the decision by the chief pilot to assign this flightcrew to the three-engine ferry operation did not take into consideration the experience levels of the available flightcrews, although it was within policy established by ATI, and within Federal regulations. ATI management's decision not to assign a more experienced flightcrew to the ferry flight was based upon a desire to minimize the delay of the scheduled revenue cargo flight from MCI to TOL. The accident flightcrew flying from DOV would not have met legal crew rest requirements for the revenue flight because they did not have sufficient crew rest in DOV following their previous Part 121 flight from Europe. They could have legally flown under Part 91 rules for the ferry flights; therefore, the decision was made to use this crew for the Part 91 flight. The Safety Board believes that company scheduling issues took priority, resulting in the less experienced flightcrew being assigned to the accident flight.

The chief pilot telephoned the captain prior to the ferry flight and discussed a possible crosswind problem at the destination airport and the matter of a landing curfew there. He did not, however, review three-engine takeoff procedures with him. The Safety Board believes that had the takeoff been discussed in more detail, it might have become apparent to the chief pilot that the captain did not fully comprehend the three-engine takeoff procedure.

During the investigation, a survey of nine other cargo operators revealed that only two used line flightcrews for three-engine takeoffs, and that one of those two operators restricted three-engine takeoffs to only "the most experienced and selected" flightcrews. Seven of the nine restrict such takeoffs to only management flightcrews, such as check airmen or special maintenance ferry crews. Therefore, the Safety Board concludes ATI's policy of routinely assigning line flightcrews for such operations, when almost all other operators restrict such flights, must be considered inappropriate.

2.4 Flightcrew Performance

2.4.1 Engine Start

The engine start sequence was interrupted because the flightcrew did not ensure that all appropriate circuit breakers were in on the No. 4 engine. While attempting to start this engine, it was obvious that the captain was unfamiliar with the starter duty cycle limitations, and he did not determine the correct limitations by reference to the flight manual. The flight engineer called attention to the matter during multiple start attempts of this engine.

2.4.2 Landing Curfew

The Safety Board believes that the flightcrew was concerned about trying to reach their destination before the landing curfew at Westover Airport, and that the crewmembers were unaware that the curfew time could be extended through ATI management channels. Prior to taxiing, the captain said that they should try to fly direct routes between navigational aids, in order to reduce the en route flight time. After the first takeoff attempt, the flightcrew again discussed the subject of trying to reach the destination airport. The comments by the first officer, "boy it's gettin' tight," followed by, "hey we did our best you know," clearly indicated continued concern over the curfew and their desire to arrive before the airport closed.

In addition, a time and distance calculation revealed that following the turn off the runway after the rejected takeoff, the flightcrew taxied the airplane to the departure end of the runway for another attempt at an average taxi speed of about 26 knots (about 30 miles per hour). The Safety Board believes that this is at, or may even exceed, the limit for a safe taxi speed, especially at night, and during a time when all three crewmembers were talking about the previous rejected takeoff. Therefore, the Safety Board believes that the flightcrew was convinced that they should arrive at their destination prior to the landing curfew, and that they were preoccupied with this goal. This probably influenced their judgment regarding the three-engine takeoff and added an element of stress to the entire decision-making process.

The Safety Board notes that there was no reason for AT1 management to telephone **Westover** Airport and ask for a curfew extension because they were unaware that the flight was behind schedule.

2.4.3 Performance Calculations

The takeoff data card found in the wreckage showed a Vmcg speed of 107 knots rather than 116 knots. The Safety Board believes that during preflight planning, the flight engineer entered the three-engine takeoff chart incorrectly during the calculations of the takeoff data. It appears likely that he used the temperature in degrees Fahrenheit, rather than Centigrade. Most of the **ATI** performance charts (but not the Vmcg chart) are entered using the Fahrenheit temperature scale. The fact that the Vmcg chart (figure 6) is entered in Centigrade temperature, and that the chart is used so infrequently at **ATI,** would make a calculation mistake more likely. **ATI** procedures stated that the captain or first officer will verify the data prior to the pilots setting their airspeed bugs. This apparently was not accomplished.

This error resulted in a Vmcg speed that was 9 knots too low. This meant that the flightcrew believed they should have applied takeoff power on all three operating engines 9 knots earlier, at 107 knots rather than at 116 knots. Directional control of the airplane is difficult if early power is applied on the asymmetrical engine. The faster the airplane is traveling, the more rudder authority will be available, and directional control becomes easier. In fact, if full power on the asymmetric engine is applied before 116 knots, it is impossible for the pilot to continually maintain runway centerline using the rudder alone.

The **ATI** accident in March of 1991 at Kennedy International Airport was also attributed to a miscalculation of performance data, when the flight engineer entered the performance chart with the incorrect aircraft gross weight and obtained V speeds which were too low. The company instituted procedures to improve the calculation and cross-checking of takeoff V speed data, but it appears that these efforts should be revisited.

2.4.4 Taxi and Takeoff

During the taxi for the first takeoff attempt, the captain briefly reviewed the three-engine takeoff and departure procedures. His description of the planned maneuver at this point was correct, as indicated by his statements:

"okay and l'll ease in ah No. four...and by ah Vmcg we'll have max."

During a continued review of the after-takeoff procedures, however, his briefing contained conflicting statements. For example, at one point he said, "at positive rate I'll call gear up I'll lower the nose slightly to gain two ten but still keep about two hundred to four hundred feet a minute climb." He then briefed, "okay then ah when we reach two ten I'll call for max continuous power." A few seconds later, he said, "okay and then we'll call ah reduce the flaps like that we'll climb at V2 all the way up to three thousand feet and then we'll call for the climb procedures." This procedure is incorrect. He should have stated that he would climb at V2 to 400 feet above the ground, then accelerate to 210 knots, retract the wing flaps, continue climb to 3,000 feet at 210 knots, then accelerate to climb speed, before reducing the power.

According to the CVR transcript and the sound spectrum analysis, during the first attempted takeoff, the power was advanced too quickly. In fact, full power on the asymmetric engine was obtained at about 100 knots, about 7 knots below the stated but incorrect Vmcg speed of 107 knots. The engine pressure ratio (EPR) of 1.5 was called 1 second before the airspeed alive (about 50 to 60 knots) call was made; followed by a call of 1.6 EPR, 1 second before the 80 knots call. Then, 90 knots was called, followed 1 second later by the 1.8 EPR (the target takeoff EPR was 1.91). One hundred knots was called 1 second later, followed by the sound of decreasing engine power, indicating the start of the rejected takeoff. Discussions with pilots experienced in three-engine takeoffs confirmed that the power on the asymmetrical engine needs to be applied very slowly, and it is not until much closer to Vmcg that the power can be increased to approach the takeoff EPR.

The Safety Board believes that the company operations manual section describing three-engine takeoffs might have contributed to some of the confusion concerning this procedure. One section of the company operations manual stated, "as soon as possible, smoothly accelerate the engine opposite the inoperative engine to MAX power during acceleration to Vmcg." The Safety Board believes that this particular instruction, taken out of context, implies that early ("as soon as possible") acceleration of the asymmetric engine is desirable. This section also stated, "The engine should be set at MAX power upon reaching this [Vmcg] speed." This sentence may also be open to interpretation by some pilots, especially in light of the earlier instruction. In a later, more detailed section, the manual stated "Smoothly advance power on the asymmetrical engine during the acceleration to Vmcg speed.

The asymmetrical throttle must be aligned with the symmetrical engine throttles by Vmcg.” The Safety Board believes that this instruction is reasonably clear and that the throttle alignment portion of the instruction is unambiguous. However, the three-engine procedures taken as a whole, especially the asymmetric engine acceleration rate descriptions, could be made more coherent and should emphasize the proper throttle technique.

Following the rejected takeoff, the flight engineer stated that the EPR for No. 4 engine “went all the way up to one nine zero as you ran it up, so it went up real fast.” The captain said, “yeah it jerked up.” The first officer asked, “you brought it up too fast or it jerked up or what?” The captain said, “it just came up too fast is what it did.” Examination of the engine revealed no discrepancies; therefore, the Safety Board believes the reason for the increase in EPR was most likely the result of the captain’s advancing the asymmetric throttle forward at a rate that was too fast. If the flightcrew believed that the engine was not accelerating properly, for whatever reason, a thorough discussion of options should have been in order. However, neither the captain nor the other crewmembers pursued this matter during the 6 minute taxi for a second takeoff attempt. During this post-rejected takeoff taxi, the flight engineer suggested, “if you want to try it again I can try addin the power if you like.” The captain quickly responded, “okay let’s do it that way yeah....”

This was a procedure that the flightcrew created themselves and was patently incorrect. The operating manual clearly states that the captain should control the throttles. This decision to allow someone else to do so was not challenged or even discussed by the flightcrew. Investigators who experimented with this takeoff procedure in the simulator found it extremely awkward and somewhat disconcerting. The Safety Board believes that allowing someone not even in nominal control of the airplane to apply the asymmetric power required the captain to constantly react to an unknown quantity of thrust and an unknown rate of thrust application during the accident takeoff roll. This increased his mental workload dramatically and probably contributed directly to the accident. The flight engineer could have placed himself in a similar predicament to that of the captain, if he was adding power on the asymmetric engine in response to the directional control inputs of the captain. Lastly, if the captain believed there was any possibility that a mechanical engine acceleration problem existed, the Safety Board finds it difficult to explain why he relinquished control of the throttle to another crewmember.

Shortly after the captain agreed to the unconventional takeoff procedure, the flight engineer asked the captain, "how much rudder were you stickin' in?" The captain replied, "I had it all the way in." This fact should have triggered a thorough, deliberate examination of all facets of the aborted takeoff, including a recalculation of Vmcg. However, there was never a discussion about why directional control could not be maintained, even though the captain used all the available rudder.

Shortly thereafter, the subject of the power increase again came up, when the captain said, "it seemed what happened, it was goin' up smoothly and then all of a sudden...it jerked and then yeah." The first officer then made a statement which clearly indicated that he did not understand the concept of Vmcg. The first officer said, ". ..when we...get near Vmcg or get near Vr or Vmcg if we're usin' all our rudder authority you might wanta' consider abort possibly because once we get higher we're gunnar be...in even worse trouble correct." The captain replied, "that's correct absolutely."

The flight engineer challenged the statement by saying, " No actually above Vmcg you[r] rudder has more authority it's helping you more." The captain did not respond to this statement, which was, in fact, correct. The flight engineer went on to describe a four-engine takeoff with the loss of an engine by stating, "if we were to lose ah about the time an outboard engine before Vmcg...you can't control the takeoff because you will lose directional control because you[r] other engine is already in." This statement, although correct, may have further confused the captain and the first officer, because it was not clear that he was describing a four-engine takeoff, rather than the takeoff at hand.

The first officer then said, "okay yeah you're right you're one hundred percent right." The captain was silent at that point. The Safety Board believes that the only person in the cockpit who had an understanding of the basic concept of a three-engine takeoff was the flight engineer. It is not clear, however, if any of the flightcrew understood the concept of the V speeds as applied to the three-engine takeoff.

The accident takeoff is compared to a Douglas demonstration of an ideal three-engine takeoff in figure 7. On the accident takeoff, the power on the No. 4 engine was increased at a more rapid rate than on the first takeoff. For instance, on the second takeoff, 1.6 EPR was called 1 second before the airspeed alive call (50 to 60 knots), whereas on the first takeoff, 1.6 EPR was called 1 second before

80 knots. This means that directional control was even more of a problem for the captain on the second takeoff.

Following the early rotation, the airplane impacted the ground as the airplane rolled to a nearly 90 degree left bank. The Safety Board believes the early rotation was in response to the fact that the airplane was about to leave the paved surface. The captain believed that he had enough speed to fly, and he elected to attempt to take off rather than risk certain damage to the airplane, and possible injury to the flightcrew.

2.4.4.1 Three-Engine Takeoff Procedure

The high rate of asymmetric throttle application by crewmembers in both the attempted takeoffs precluded successful completion of the maneuver. However, the Safety Board believes that even with the proper application of asymmetric throttle during a three-engine takeoff, the margin of safety is quite small. The procedure now calls for arriving at full takeoff power on the asymmetric engine at the computed Vmcg to provide for the minimum possible takeoff roll. A properly executed three-engine takeoff also entails full rudder application at the computed Vmcg. Any adverse crosswind condition, for instance, would place the flightcrew in a position in which they could not have full control of the airplane due to a loss of rudder authority. In addition, it is very difficult to time the throttle application to arrive at full power at exactly the computed Vmcg given the spool-up lag inherent in turbine engine operation.

A flightcrew, therefore, invariably reaches full asymmetric power early, and accepts a certain loss of directional control, or reaches full asymmetric power late, and accepts a longer takeoff roll. The Safety Board considers the latter to be the safer course of action, and believes that manufacturers should revise one-engine inoperative takeoff procedures to provide adequate rudder availability for correcting directional deviations during the takeoff roll compatible with the achievement of maximum asymmetric thrust at an appropriate speed greater than ground minimum control speed. Performance figures and runway requirements considering these factors should also be determined.

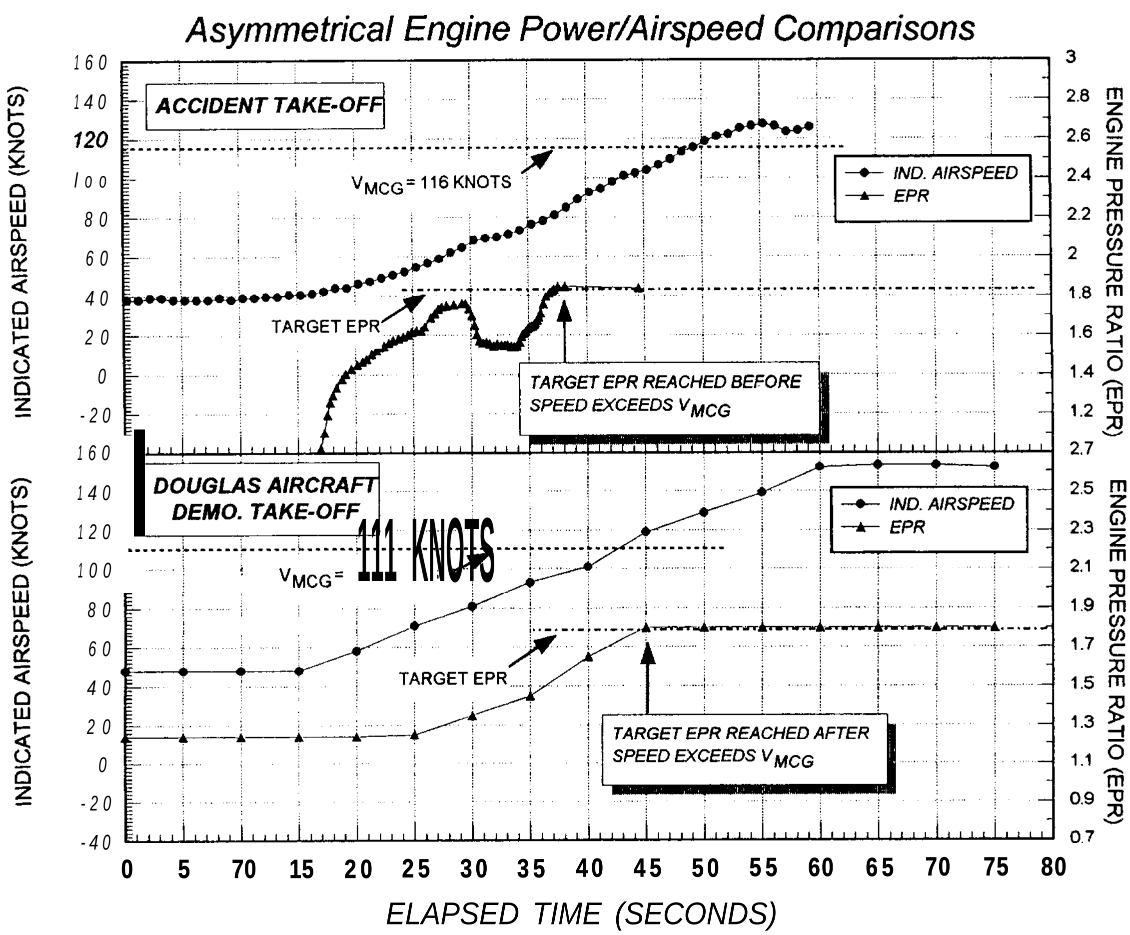

Figure 7.--No. 4 engine EPR/IAS comparison.

2.5 Flightcrew Training

2.5.1 Three-Engine Takeoff Training

The flightcrew had received three-engine takeoff training according to company standards within the 6 months prior to the accident. The last training received by the captain was in August 1994. The first officer had training in October 1994. The flight engineer's training was about the same time. The Safety Board believes that the three-engine takeoff training provided to this flightcrew by ATI was inadequate because of their demonstrated lack of knowledge of the maneuver. This is especially true considering the fact that the training was provided so recently for the entire crew.

2.5.2 Denver DC-8 Simulator

During the investigation, Safety Board investigators operated the DC-8-60 series simulator used by this company for flightcrew training for numerous simulated three-engine takeoffs. The simulator performance was not realistic in that the simulator was very easy to control, no matter how fast the power was applied on the asymmetrical engine during the simulated three-engine takeoffs. Both the company check airman and a manufacturer test pilot assisting in the exercise agreed with this assessment. A second set of three-engine takeoff experiments were accomplished by Safety Board investigators after the simulator had been adjusted by United Airlines Training Center personnel. Afterward, the three engine takeoffs were more realistic, but it was still possible to maintain runway centerline with full power on the asymmetric engine prior to Vmcg. Although there was no way to positively determine that the simulator was providing inaccurate simulation when the accident flightcrew received its three-engine training, the Safety Board concludes that the training conducted in this simulator probably did not provide the accident flightcrew with an accurate, realistic rehearsal for an actual three-engine takeoff.

2.6 Fatigue

Just before their assignment to the accident trip, the crew had completed a demanding round-trip flight to Europe that also was a potentially stressful international line check for the captain. These flights crossed multiple time zones (there are 6 time zones between Dover and Ramstein) in a short period of time. This, and the fact that the Dover-Ramstein-Gander-Dover legs were flown at night following daytime rest periods, caused the crew to experience circadian rhythm disruption. In addition, the captain's last rest period prior to the accident was repeatedly interrupted by the company.

According to the flight time limits and rest requirements of 14 CFR 121.503, following their 9 hours and 29 minutes of flying time to Dover, the crew was required to take a rest period of at least 16 hours before they could legally be assigned to any further Part 121 duty. However, only about 12 hours after checking into the hotel, they checked out to assume duty under FAR Part 91 ferry flight rules. There are no flight time limits or rest requirements for Part 91 ferry flights that follow Part 121 revenue flights.

Because the crewmembers were alone in the hotel rooms, the Safety Board could not positively establish the length or quality of sleep that the first officer and flight engineer received. However, in the case of the captain, telephone records and other evidence indicate that his opportunity to sleep in the hours before the accident was considerably disturbed. His longest uninterrupted rest period was 4 hours and 47 minutes. Therefore, the Safety Board believes that he was experiencing fatigue at the time of the accident. Many scientific studies indicate that fatigue degrades all aspects of performance, especially alertness and judgment. The captain's performance in the accident reveals many areas of degradation in which fatigue is probably a factor.[8] Similar considerations apply to the other two crewmembers, who were also subject to the same schedule and were most likely fatigued at the time of the accident. Several areas of performance degradation exhibited by the crew are characteristic of fatigue, such as the crew's difficulties in setting proper priorities and their continuation of the takeoff attempt despite disagreement and confusion on important issues.

The crew could not legally have flown a revenue trip at the time of the accident. The Safety Board believes, however, that the fact that the flight was legal under the terms of the Part 91 ferry flight provisions does not reduce the amount of rest needed to prevent crew fatigue. The Safety Board therefore concludes that the crewmembers were not properly rested. However, because of the deficiencies in

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[8] Rosekind, Mark R, Gregory, Kevin B; Miller, Donna L; Co, Elizabeth L; and Lebacqz, J. Victor; *Analysis of Crew Fatigue Factors in AIA Guantanamo Bay Aviation Accident* as Appendix E of Aircraft Accident Report, "Uncontrolled Collision With Terrain, American International Airways, Guantanamo Bay, Cuba, August 18, 1993," NTSB/AAR-94/04.

training and procedures noted previously, the extent to which their fatigue contributed to the accident could not be determined.

Regarding flight time limits and rest requirements, on May 18, 1994, the Safety Board issued two safety recommendations to the Federal Aviation Administration:

> A-94-105
> Revise the applicable subpart of 14 CFR, Part 121 to require that flight time accumulated in noncommercial "tail end" ferry flights conducted under 14 CFR Part 91, as a result of 14 CFR, Part 121 revenue flights be included in the flight crewmember's total flight and duty time accrued during those revenue operations.
>
> and
>
> A-94-106
> Expedite the review and upgrade of flight/duty time limitations of the Federal Aviation Regulations to ensure that they incorporate the results of the latest research on fatigue and sleep issues.

These recommendations were issued as a result of the Safety Board's investigation and report on the August 18, 1993 accident at Guantanamo Bay, Cuba, involving a Connie Kalitta Services, Inc., DC-8-61 freighter.

The FAA **first** responded to these recommendations on July 13, 1994, stating that it was considering the issuance of a Notice of Proposed Rulemaking to address both Safety Recommendations A-94-105 and -106. The Safety Board replied on August 11, 1994, classifying both recommendations "Open--Acceptable Response," pending the completion of rulemaking action. To date, the rulemaking action is still pending.

Because of the fatigue issues uncovered in this and other accidents, the Safety Board believes that it is critical for the FAA to expedite the finalization of the review of current flight and duty time regulations and to revise the regulations, as necessary, within 1 year to ensure that flight and duty time limitations take into consideration research findings in fatigue and sleep issues. Further, the new regulations should prohibit air carriers from assigning flightcrews to flights conducted under 14 CFR Part 91 unless the flightcrews meet the flight and duty time limitations of 14 CFR Part 121 or other appropriate regulations. Accordingly, the Safety Board is classifying Safety Recommendations A-94-105 and -106 "Closed--Acceptable Action/Superseded" and is issuing a new recommendation (see section 4).

2.7 Organizational and Management Information

The Safety Board believes that several actions by the company were commendable. The company developed a crew pairing policy and had begun to provide training in crew resource management when they were not required by regulation. All crewmembers and management staff interviewed during the course of this investigation appeared satisfied with their jobs. The company had also hired qualified new management to expand oversight in response to a period of rapid expansion of operations.

The Safety Board believes, however, that the circumstances of the accident revealed shortcomings in the company's training and scheduling programs. None of the three flight crewmembers had previously executed a three-engine takeoff, although the captain had been present during several such takeoffs. Unlike the majority of other operators, the company authorized all flightcrews to perform three-engine takeoffs. The company provided regular training in this procedure, but the poor description of the maneuver in the operations manual, and the inaccurate simulator portrayal, lessened the effectiveness of this training. All three crewmembers demonstrated a lack of understanding of this procedure in their comments during the two takeoff attempts.

Perhaps most disturbing, the crew did not calculate or verify the accuracy of the takeoff data prior to the first takeoff attempt and then did not recalculate the data after the first takeoff attempt failed. The company suffered a previous accident due to the flightcrew determining incorrect takeoff data, and the evidence indicates that the company did not instill a proper concern among flightcrews for the accuracy of takeoff information during the time period between the two accidents.

Also, the company scheduled the ferry flight without regard to the shortened crew rest time allowed for this crew, despite the fact that a more experienced, rested crew was already available in Kansas City. The crew scheduler also interrupted the captain's rest period with telephone calls. Therefore, the Safety

Board believes that the company failed to provide a flightcrew sufficiently experienced, trained, or rested to perform the nonroutine ferry flight operation.

2.8 FAA Oversight of AT1

The Safety Board believes that the FAA POI was not performing his oversight responsibilities adequately. He did not have sufficient knowledge of the surveillance that was being performed by FAA geographic units, both in the international operations and at the Denver training facility. Additionally, he was not aware of other important facts, such as the new CRM program, which ATI had started in the recurrent training program, and he had no knowledge of the existence of an ATI crew pairing policy. With the growth in the number of new pilots, he should have been keenly interested in this matter.

He was hampered by restricted funding for travel to DEN to monitor simulator and ground training. Additionally, he maintained that a lack of funding limited the number of other oversight activities, such as en route observations, especially observations of international operations performed by ATI. While the company was expanding rapidly and hiring large numbers of new pilots, the POI was immersed in the administrative detail of merging two certificates. This limited his time available for other important surveillance functions.

The Safety Board is concerned about the decrease in the number of inspectors assigned to the geographical program at the Denver FSDO. Interviews with DEN geographic inspectors indicated that there was confusion in that FSDO about the future of the geographic program. The Safety Board is also concerned that the pending cutbacks may further weaken the surveillance of supplemental air carrier training functions at the United Airlines Training Center.

An accident in 1994, involving another supplemental air carrier,[9] revealed a serious lack of geographic support. The Safety Boards report stated:

> Many of the flight safety issues brought to the attention of the FAA and the Safety Board were problems that had occurred away from the home base. Due in part to budget constraints, the FAA was dependent upon geographic support for oversight and surveillance

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‘Refer to Aircraft Accident Report, “Uncontrolled Collision With Terrain, American International Airways, Guantanamo Bay, Cuba, August 18, 1993,” NTSB/AAR-94/04.

> of the worldwide operation....the geographic surveillance was vital to the POI's oversight responsibility and should have carried a high priority, considering the fact that foreign operations...required different operational rules and regulations.
>
> The Safety Board is concerned that the lack of geographical support required to fulfill the surveillance requirements of the operations, are detrimental to the overall ability of the individual inspectors...to ensure that the operations are conducted in accordance with FARs.

Some of the problems with surveillance of supplemental cargo air carriers are that most of their flights are at night, much of the flying is to overseas destinations, and the schedules frequently change. Inspectors must make significant modifications in their work schedules in order to conduct en route observation flights of these operators. The FAA does not appear to take these factors into consideration at this juncture.

Additionally, the communication lines between the POI and the geographic inspectors appear to be occasionally characterized by hostility and resistance to criticism. It was reported that POIs often become "defensive" about the certificates they manage, and at times resent hearing negative comments reported by a geographic inspector from a distant FSDO. The Safety Board believes that this behavior detracts from their effectiveness in achieving the assigned mission.

If the FAA plans to continue the geographic program, changes should be considered, including:

> Better communication links between the POI's and the geographic inspectors.
>
> Adequate staffing of the geographic position.
>
> Increase funding of POI and geographic unit budgets to permit inspectors to schedule flights on supplemental air carriers that occur at nor-routine airports, at nonroutine times.

3. CONCLUSIONS

3.1 Findings

1. The airplane was properly certified and maintained in accordance with existing regulations. It was also properly prepared for the three-engine departure by maintenance personnel.

2. There was no evidence of any systems malfunction that may have contributed to the accident. Specifically, there was no evidence of malfunction of the flight controls, landing gear, tires, brakes, or nose wheel steering system that would have led to directional control difficulties on the runway.

3. The flightcrew was properly certified for the flight in accordance with existing regulations.

4. The flightcrew assigned to the ferry had a shortened rest break after performing an international trip. Federal regulations permit companies to eliminate these rest periods after flying a 14 CFR Part 121 operation when the flight will be conducted as a ferry operating under 14 CFR Part 91.

5. At the time of the accident, the flightcrew was suffering from fatigue as a result of the limited opportunities for rest, disruption to their circadian rhythms, and lack of sleep in the days before the accident. However, the Safety Board was unable to determine the extent, if any, to which their fatigue contributed to the accident.

6. The flightcrew did not have adequate, realistic training in three-engine takeoff techniques or procedures because the DC-8 simulator with which they trained was not programmed to replicate actual yaw forces, and the three-engine takeoff procedure description in the airplane operating manual was confusing.

7. There was no record that the captain had previously performed a three-engine takeoff as pilot in command, and it is unlikely that the other flight crewmembers had ever assisted in a three-engine takeoff prior to the accident takeoff.

8. The flightcrew did not adequately understand the three-engine takeoff procedures, including the significance of Vmcg.

9. Another more experienced flightcrew was available to conduct the ferry flight.

10. Flightcrew comments on the CVR prior to the accident suggested that they were operating under self-induced pressure to make a landing curfew at the destination airport, and that this may have influenced their decisionmaking.

11. The flight engineer improperly determined the Vmcg speed, resulting in a value that was 9 knots too low. Neither the captain nor the first officer detected the error.

12. During the first attempted takeoff, the captain was not able to maintain directional control because he applied high power to the asymmetrical engine too soon, and he rejected the takeoff. During the taxi back for a second takeoff, he and his crewmates did not properly analyze the reasons for the loss of control.

13. The captain agreed to modify the three-engine takeoff procedure by allowing the flight engineer to advance the throttle on the asymmetrical engine, a deviation of the prescribed procedure. The captain was unable to maintain directional control on the second takeoff, decided not to reject the takeoff, and rotated the airplane early in an attempt to take off prior to departing the paved runway surface.

14. FAA oversight of ATI was inadequate because the AT1 POI and the geographic inspectors were unable to effectively monitor domestic crew training and international operations, respectively.

15. Existing FAR Part 121 flight time limits and rest requirements that pertained to the flights that the flightcrew flew prior to the ferry flights did not apply to the ferry flights flown under FAR Part 91. This permitted a substantially reduced flightcrew rest period when conducting the nonrevenue ferry flights.

16. Current one-engine inoperative takeoff procedures do not provide adequate rudder availability for correcting directional deviations during the takeoff roll compatible with the achievement of maximum asymmetric thrust at an appropriate speed greater than ground minimum control speed.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable causes of this accident were:

(1) the loss of directional control by the pilot in command during the takeoff roll, and his decision to continue the takeoff and initiate a rotation below the computed rotation airspeed, resulting in a premature liftoff, further loss of control and collision with the terrain.

(2) the flightcrew's lack of understanding of the three-engine takeoff procedures, and their decision to modify those procedures.

(3) the failure of the company to ensure that the flightcrew had adequate experience, training, and rest to conduct the nonroutine flight.

Contributing to the accident was the inadequacy of FAA oversight of ATI and FAA flight and duty time regulations that permitted a substantially reduced flightcrew rest period when conducting a nonrevenue ferry flight under 14 CFR Part 91.

4. RECOMMENDATIONS

As a result of the investigation of this accident, the National Transportation Safety Board makes the following recommendations:

--to the Federal Aviation Administration:

Review the effectiveness of the geographic unit oversight program, with particular emphasis on the oversight of supplemental air carriers and their international operations, and the improvement of overall communications between principal operations inspectors and geographic inspectors. (Class II, Priority Action) (A-95- 110)

Evaluate the surveillance programs to ensure that budget and personnel resources are sufficient and used effectively to maintain adequate oversight of the operation and maintenance of both passenger and cargo air carriers, irrespective of size. (Class II, Priority Action) (A-95-l 11)

Require airplane manufacturers to revise one-engine inoperative takeoff procedures to provide adequate rudder availability for correcting directional deviations during the takeoff roll and provide performance figures and runway requirements compatible with the achievement of maximum asymmetric thrust at an appropriate speed greater than ground minimum control speed. (Class II, Priority Action) (A-95-l 12)

Finalize the review of current flight and duty time regulations and revise the regulations, as necessary, within 1 year to ensure that flight and duty time limitations take into consideration research findings in fatigue and sleep issues. The new regulations should prohibit air carriers from assigning flightcrews to flights conducted under 14 Code of Federal Regulations (CFR) Part 91 unless the flightcrews meet the flight and duty time limitations of 14 CFR Part 121 or other appropriate regulations. (Class II, Priority Action) (A-95-l 13)

--to Air Transport International:

Review the ATI DC-8 operating manual discussion on three-engine takeoffs to ensure that it is understandable to all pilots who must accomplish such takeoffs. This section of the manual should emphasize the specifics of proper throttle application technique. (Class II, Priority Action) (A-95-l 14)

Discontinue the company policy of routinely assigning line flightcrews for three-engine ferry operations. Allow only specifically designated, highly experienced crewmembers to perform such operations. (Class II, Priority Action) (A-95-l 15)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

James E. Hall
Chairman

Robert T. Francis II
Vice Chairman

John Hammerschmidt
Member

John J. Goglia
Member

August 30, 1995

5. APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The National Transportation Safety Board was notified of the accident about 2130 on February 16, 1995. An investigative team was dispatched the next morning and arrived in Kansas shortly thereafter. Investigative specialists for operations/human performance, airplane performance, structures, wreckage documentation, systems, and power-plants gathered evidence on scene for about 1 week. Investigative groups for the cockpit voice recorder and the flight data recorder were also formed in Washington, D.C. Safety Board Chairman Jim Hall accompanied the investigative team to Kansas City.

Parties to the investigation included Air Transport International, the Kansas City, Missouri, Aviation Department, the Douglas Aircraft Company, United Technologies Pratt and Whitney, and the Federal Aviation Administration.

2. Public Hearing

There was no public hearing conducted in conjunction with this investigation.

APPENDIX B

COCKPIT VOICE RECORDER TRANSCRIPT

1957:17		start of recording
1957:17		start of transcript
1957:19	CAM-2	oh where landing lights okay.
1957:27	INT-3	hello.
1957:32	INT-3	can you hear me?
1957:33	INT-4	yeah ground power's off.
1957:35	INT-3	okay we've got we've got pressure in and we got clearance to start.
1957:40	INT-4	you got it .
1957:41	CAM-2	okay turnin' three.
1957:42	INT-3	startin' three.
1957:43	CAM-l	turning.
1957:43	INT-4	clear.
1957:44	CAM-3	valve's open .
1957:45	CAM-l	rotation.
195748	CAM-2	here's your ● .
1957:49	CAM-l	yeah.

1957:51
CAM-3 oil pressure, N-l, *
pneumatics.

1957:56
CAM-l yeah .

1957:57
CAM-2 fifteen percent.

1957:58
CAM-l . set, fuel flow, light up,
EGT.

1958:10
CAM-l thirty five percent starter's
released.

1958:11
CAM-3 valve's closed.

1958:12
CAM-1 ready on four.

1958:15
INT-3 start four.

1958:16
CAM-3 ready four.

1958:17
INT-4 clear.

1958:17
CAM-l turning.

1958:18
CAM-3 start valve's open.

1958:18
CAM-l rotation .

1958:24
CAM-2 I'm watching three.

1958:25
CAM-3 oil pressure - pressure's
holding twenty seven.

195829
CAM-3 N-l.

1958:30
CAM-l fifteen percent fuel, flow,
and --.

1958:39
CAM-2 come on baby.

195844
CAM-l we got fuel flow?

1958:46
CAM-2 you got fuel flow here.

195848
CAM-3 fuel flow.

1958:50
CAM-l we don't have a light up.

1958:53
CAM-3 so you want to turn this off. continue to motor right?

1958:55
CAM-l yeah.

1958:56
CAM-3 we got ten seconds.

1958:57
CAM-l okay tell, yeah --.

1958:59
CAM-3 fuel flow.

1959:00
CAM-l yeah we don't have a light up or EGT okay it's comin' down just tell him that we --.

1959:06
INT-3 we're stop start on number four.

1959:08
INT-4 all right.

1959:10
CAM-3 I'll give you time for thirty seconds.

1959:12
CAM-l call thirty seconds.

1959:13

INT-3 no ignition.

1959:14
CAM-l yeah .

1959:14
INT-4 yeah you're **blowin'** smoke.

1959:15
INT-3 yeah we're we're **motorin'** right now to clear.

1959:32
CAM-3 that's cause we pulled engine ignition number four

1959:34
CAM-2 thirty seconds.

1959:35
CAM-l okay released.

1959:37
INT-3 okay the number four ignition circuit breaker was open instead of number one

1959:39
INT-4 yeah it looks like you're **blowin'** water.

1959:43
CAM-l okay we'll start number two .

1959:45
CAM-3 valve's open.

1959:47
CAM-l just tell him - oh what's he **doin'?**

1959:50
CAM-3 valve's open.

1959:53
CAM-l okay we'll start number two.

1959:58
CAM-3 valve's closed.

2000:01
CAM-l we're not --.

2000:02
INT-3 okay ground this is cockpit.

2000:03
INT-4 yeah.

2000:05
INT-3 okay the reason we didn't get a start on number four is because when we we're preparing for this ferry flight the number four ignition circuit breaker was opened as opposed to number one as it should be I've reset the circuit breakers and we may get a little bit of torch out that when we start number four.

2000:20
INT-4 okay.

2000:22
CAM-l okay .

2000:23
CAM-2 we startin'two?

2000:25
CAM-l yeah we ah have zero on N-l ?

2000:27
CAM-3 four?

2000:28
CAM-l number four.

2000:28
CAM-3 number four?

2000:30
INT-3 is number four stopped turnin'?

2000:32
INT-4 yeah.

2000:33
CAM-l okay we're startin' number four.

2000:34
INT-3 okay starting four.

2000:35
CAM-l turning.

2000:36
INT-4 clear.

2000:37
CAM-3 valve's open.

2000:38
CAM-l rotation.

2000:40
CAM-3 pressure's holding thirty, twenty eight, oil pressure, N-l.

2000:47
CAM-l fifteen percent, fuel, flow, light up, EGT.

2000:53
INT-4 you got a fire you got a fire.

2000:55
CAM-2 you got a fire .

2000:56
CAM-l okay coming down.

2000:58
INT-3 stop start.

2000:59
INT-4 it's blowin' smoke out.

2001:01
(sound of momentary power interruption to CVR).

2001:04
CAM-l it's still burning?

2001:05
INT-3 still burnin'?

2001:06
INT-4 no.

2001:09
CAM-l okay.

2001:12

INT-3	how much of a torch did it have?
2001:14	
INT-4	oh about three inches.
2001:18	
INT-3	a real good one huh ?
2001:19	
INT-4	yeah.
2001:20	
INT-3	okay that should have cleared most of it out then huh?
2001:22	
INT-4	I think it did.
2001:25	
CAM-l	you got thirty seconds?
2001:26	
CAM-3	no, got about another ten.
2001:27	
CAM-l	okay.
2001:29	
INT-3	we're motorin' this one to clear again
2001:31	
INT-4	okay you're clear.
2001:35	
CAM-l	okay -.
2001:35	
CAM-3	time.
2001:36	
CAM-l	okay and we got --.
2001:37	
CAM-3	you can release.
2001:38	
CAM-l	I'm just going to continue it --
2001:41	
CAM-3	you going to continue the start again?

2001:42
CAM-l yeah .

2001:43
CAM-3 okay what's the duty cycle on the starter though?

2001:45
CAM-l okay we'll stop , we'll start number two .

2001:46
CAM-3 okay let's give let's give it a rest .

2001:52
CAM-2 okay number two

2001:53
INT-3 okay we're going to start number two and then we'll come back to number four.

2001:55
INT-4 okay you're clear for two .

2001:57
CAM-l okay.

2001:58
CAM-l turning two .

2001:58
CAM-2 turn two.

2001:59
CAM-3 valve's open .

2002:01
CAM-l we'll let that dry out for a moment.

2002:04
CAM-3 * turn, oil pressure .

2002:06
CAM-l yeah rotating.

2002:07
CAM-3 N-l.

2002:10
CAM-l I think it just **torched,** is what happened .

2002:14

CAM-3 that's what happened

2002:15
CAM-l fifteen percent, fuel, flow, light up, EGT, thirty five percent, starter released.

2002:28
CAM-3 ah valve's closed.

2002:30
CAM-l okay.

2002:32
CAM-l we'll try number four.

2002:34
CAM-3 yeah I want to check to see what the starter duty cycle is, -- I don't remember what it is, two minutes on oh two minutes --.

2002:38
CAM-l two minutes on then ah --.

2002:41
CAM-3 then thirty minutes off.

2002:42
CAM-l then thirty minutes off.

200248
CAM-2 so we're within? --.

2002:49
CAM-l yeah we should be within.

2002:51
INT-3 has number four stopped turning?

2002:54
INT-4 hold on for a second.

2002:56
CAM-3 he's going to check.

2002:57
INT-4 yeah its stopped.

2002:59
CAM-l okay we'll try four again.

2003:00
I NT-3 **startin'** four again.

2003:02
INT-4 you're clear.

2003:03
CAM-l turning.

2003:04
CAM-3 valve's open.

2003:07
CAM-l rotation.

2003:08
CAM-3 oil pressure, N-l.

2003:13
CAM-l fifteen percent, fuel, flow, light up, EGT, I guess it worked, thirty five percent, starter release.

2003:26
INT-4 looks good .

2003:27
CAM-3 and valve's closed.

2003:28
CAM-l internal when you can get a chance.

2003:30
CAM-3 okay we are internal.

2003:32
INT-3 you can disconnect air.

2003:33
INT-4 disconnected.

2003:36
CAM-l okay when we talk to the tower we've got to let them know this is a three engine ferry.

2003:41
CAM-2 with ground or with tower? or both?

2003:43
CAM-l both .

2003:47

CAM-2 okay.

2003:47
(sound of two momentary power interruptions to the cvr).

2003:51
CAM-l okay let me see what all of this -- lights

2003:52
CAM-3 we're internal.

2003:59
CAM-l I hate this when I can't find ---

2004:00
INT-3 okay whenever you are ready.

2004:02
INT-4 okay just a second.

2004:04
CAM-2 do we need to call push back here do you know?

2004:06
CAM-l naw its not necessary.

2004:07
INT-4 release brakes.

2004:07
CAM-l brakes are released.

2004:10
INT-3 brakes are released.

2004:11
INT-4 okay.

2004:13
CAM-l okay overhead lights where are they at here this I need and this I need okay .

2004:24
CAM-3 I wanta know why I can't hear # what am I doin' wrong.

2004:28
CAM-3 can you hear okay?

2004:29
CAM-2 yeah all this volume. and I'm on the radio here.

2004:32
CAM-3 no and he can hear though.

2004:33
CAM-l yeah I can hear --.

2004:35
CAM-3 which radio?

2004:35
CAM-2 number one .

2004:36
CAM-3 number one radio.

2004:40
CAM-l okay let's do an after start check.

2004:42
CAM-3 after start check.

200444
CAM-3 door lights are checked out, electrical system checked, hydraulic system?

2004:47
INT-4 what's your block out time?

2004:49
CAM-l stand-by he's ah **callin'** for block out.

2004:51
I NT-3 say again.

2004:52
INT-4 what's your block out time?

2004:54
INT-3 ah zero two zero zero.

2004:56
INT-4 all right.

2005:01
CAM-3 I can hear a hum now.

2005:06
CAM-l oh I know why you've got your interphone still on.

2005:08
CAM-3 I've got my what.

2005:09
CAM-l the interphone's still on, okay it wasn't.

2005:15
CAM-3 okay.

2005:16
CAM-3 yeah just ask for a radio check- .

2005:17
CAM-l okay.

2005:17
CAM-3 hydraulic system?

2005:18
CAM-l checked

2005:20
CAM-3 aileron and rudder power?

2005:22
CAM-2 clear.

2005:23
CAM-l clear.

2005:24
CAM-3 it's on, rain removal?

2005:28
CAM-l checked left light's are out.

2005:29
CAM-2 checked right--.

2005:30
CAM-3 ground equipment to go.

2005:32
CAM-l okay, okay what we are going to need to do too is ah get as much direct as we can that will allow us to fly a little bit better than eight zero if we can .

200545
CAM-2 a little better that eight zero.

2005:46
CAM-l yeah because we got we got two hours to make it to go over there for flight time and right now it's past.

2005:51
CAM-2 **pushin'**.

2005:52
CAM-l yeah .

2005:54
INT-4 set brake.

200554
CAM-l brakes are set.

2005:55
INT-3 brakes are set.

2005:57
CAM-3 I see what's your **sayin'**.

2005:58
CAM-l yeah.

2006:02
CAM-3 what was the winds?

2006:04
CAM-l ah they were -- .

2006:10
CAM-3 I wrote it all down some place.

2006:11
CAM-2 ah **I'll** request either one left or --.

2006:13
CAM-l one ninety at three.

2006:15
CAM-2 one ninety at three?

2006:16
CAM-l yeah .

2006:17
CAM-2 so we'll -- so we'll be **usin'** okay one nine right?

2006:20		
CAM-2	I'll request the right because you'll get an extra thirteen hundred feet .	
2006:23		
CAM-I	okay.	
2006:24		
CAM-3	is it farther is it a farther taxi though?	
2006:26		
CAM-2	ah no we're right there, we're right here right? one nine right's right there.	
2006:31		
CAM-I	yeah.	
2006:32		
CAM-2	go out bravo three hang a right .	
2006:34		
CAM-I	okay I got the pin.	
2006:38		
CAM-2	I think he needs to show you the --.	
2006:40		
CAM-I	I got the pin.	
2006:41		
CAM-2	oh you got the pin?	
2006:42		
CAM-I	yes.	
2006:56		
CAM-2	this will be a three engine departure.	
2006:58		
CAM-I	yes.	
2007:00		
CAM-I	okay clear on the left.	
2007:02		
INT-2	okay all ground equipment's clear?	

2007:04
INT-4 all ground equipment's clear, have a safe flight.

2007:06
CAM-2 clear on the right.

2007:07
I NT-2 thank you for all of your help -.

2007:08
INT-4 •

2007:09
INT-2 have a nice nap.

2007:09
INT-4 you're welcome.

2007:19
CAM-3 okay ground equipment's clear, gust lock?

2007:21
CAM-2 it's off.

2007:23
CAM-3 after start checks complete.

2007:24
CAM-l okay he's gone .

2007:26
CAM-2 yeah clear on the right left right .

2007:31
CAM-l I don't know what that guy is doing there.

2007:37
CAM-2 ready for the call?

2007:38
CAM-l yeah.

2007:39
RDO-2 Kansas city ground this is Air Transport seven eighty two ready to taxi at ah Burlington and ah we're going to be three engine departure.

200748
GND Air Transport seven eighty two

International ground south on bravo taxi runway one left.

200753
RDO-2 okay south on bravo taxi one left Air Transport seven eighty two - what's the winds?

2007:58
CAM-l what's ah.

2007:59
GND wind's two four zero at four .

2008:00
RDO-2 roger

2008:02
CAM-2 okay it's to one left .

2008:03
CAM-3 that's ah tail wind right?

2008:05
CAM-l yeah.

2008:06
CAM-2 two four zero and we're runnin' into what --.

2008:08
CAM-l five.

2008:09
CAM-3 five knots.

2008:10
CAM-2 just what we need. there's your marshal giving you a left you got that I can see.

2008:15
CAM-l yeah I got it.

2008:21
CAM-2 he said bravo right?

2008:21
CAM-l yes.

2008:22
CAM-3 they wouldn't let us do an opposite direction takeoff.

2008:24
CAM-3 pardon me.

2008:26
CAM-l we we can ask 'em sure .

2008:30
CAM-2 I'll ask 'em.

2008:30
CAM-l sure . that will get us off right here *.

2008:31
RDO-2 ground what's the chance for ah one nine right for Air Transport seven eighty two?

2008:36
GND a looks like we'll have a slight delay we've got traffic on ah ten mile final to the left.

200843
CAM-2 you want to go ahead and take it .

200844
CAM-l yeah we'll just go down there-- ** okay.

2008:45
GND if you want you can hold short of bravo and I'll check with departure to see if you got a slot after that.

2008:49
RDO-2 ah roger we'll hold short.

2008:51
CAM-2 hold right here.

2008:53
CAM-l okay let's go flaps twelve, taxi check.

2008:55
CAM-2 twelve.

2009:01
CAM-3 taxi check.

2009:02
CAM-2 flaps are twelve.

2009:04
CAM-3 anti-ice? .

2009:05
CAM-2 ah where the # is it.

2009:07
CAM-l here.

2009:08
CAM-2 is off.

2009:09
CAM-3 de-ice is off, pitot heat?

2009:17
CAM-2 is on.

2009:19
CAM-3 takeoff data?

2009:20
CAM-l okay this is - stand-by.

200922
GND and Air Transport seven eighty two heavy they got some more inbounds after him also, be unable opposite direction south on bravo one left.

2009:27
RDO-2 south on bravo one left left ah Air Transport seven eighty two thanks

2009:35
CAM-l okay this is ah max takeoff one point niner one speeds Vr is one twenty three, one forty and two ten. VMCG of one oh seven.

2009:47
CAM-2 I got VMC of one oh seven , ah one one twenty three for Vr, and one forty for V2 and then two two ten for the cleanup.

200958
CAM-l set.

2010:02
CAM-3 okay ah stab and trim tabs?

2010:08
CAM-2 okay ah is that a five, put the light up here, yeah okay five point one, zero, zero.

2010:20
CAM-l five point one zero zero is set.

2010:24
CAM-3 fuel levers?

2010:28
CAM-2 two three four in detent one's down detented.

2010:32
CAM-3 okay yaw damper?

2010:35
CAM-2 it's on and it clicked it's checked.

2010:39
CAM-3 and flight controls and you have the hydraulic gauges.

2010:41
CAM-l yes I got them right here.

2010:42
CAM-2 I need to have the ah spoiler pump on.

2010:46
CAM-l okay did it go on.

2010:48
CAM-2 you ready?

2010:49
CAM-l hold on a second here.

2010:50
CAM-2 okay.

2010:52
CAM-l ah okay spoiler pump is on.

2010:54
CAM-2 aileron, left, neutral.

2010:58
CAM-l checked.

2010:59
CAM-2 aileron right, neutral.

2011:02
CAM-l checked.

2011:03
CAM-2 okay lookin' for the EPI gauge, where's that at? okay here it is I got it, down, up.

2011:09
CAM-2 EPI's checked.

2011:10
CAM-l okay rudder right, neutral. did you see that?.

2011:17
CAM-3 what you, you might need to turn one of the one of the spoiler pump off and the rudder -- and one of the engine pumps go to by-pass and then try it.

2011:24
CAM-l okay.

2011:25
CAM-l rudder right, neutral, okay checked rudder left, neutral checked.

2011:31
CAM-2 I got I got now turn them both back on.

2011:34
CAM-l both on.

2011:35
CAM-3 yeah and we're going to have to put the aux pump on as well. might as well do that now while we're thinkin' about it.

2011:39
CAM-l yup good very good.

2011:42
CAM-2 did you see that okay, let me know if you need a light or anything I'll shine it.

2011:48
CAM-l okay continue with the checklist

2011:51
CAM-3 continue with the checklist, flight controls are checked, flight instruments and radios?

2011:55
CAM-l set DME's on.

2011:58
CAM-2 set DME's on.

2012:15
CAM-3 okay altimeters?

2012:17
CAM-l last one was three zero three two and I've got nine hundred and fifty feet and zero set.

2012:23
CAM-2 three zero three two ah thousand and fifteen and zero's set.

2012:29
CAM-3 TC overspeed's checked cabin is secured, long range nav?

2012:33
CAM-l okay data four, okay and aux four, A-F-G okay checked.

2012:50
CAM-3 crew briefing?

2012:51
GND Air Transport seven eighty two heavy you can transition alpha **taxiway** at your convenience.

2012:55
RDO-2 Air Transport ah seven eighty two roger

2012:58
CAM-2 that must be a hint that he wants us to cut in or somethin'.

2013:00
CAM-l yeah.

2013:04
CAM-2 yeah well.

2013:05
CAM-l just ask him if we can go all the way down -- well that's all right I can see where he --.

2013:10
CAM-2 he said it's at our convenience .

2013:08
CAM-l yeah.

2013:09
CAM-2 ah bra - bravo cuts in at bravo ten and it does - bravo nine might be more preferred because ten **kinda** back tracks a little bii you got to little zag --.

2013:21
CAM-l well this is it here we can go down this way and then a left turn.

2013:24
CAM-2 yeah **that'll** work fine.

2013:25
CAM-l okay.

2013:28
CAM-l okay this will be a left seat takeoff, we got number one engine is inoperative, we reviewed the procedures for three engine takeoff and ever and if nobody has any questions --.

2013:50
CAM-2 no questions.

2013:50
CAM-l okay just to review one more time what we're going to do is set max power on number two and number three --.

2013:56

CAM-2 right.

2013:56
CAM-3 right.

2013:57
CAM-l okay and I'll ease in ah number four -.

2014:01
CAM-3 and I'll call increments of point one.

2014:03
CAM-l yeah absolutely and by ah VMCG we'll have max power on number four.

2014:13
CAM-3 right co-pilot er first officer's going to call airspeed-.

2014:16
CAM-2 airspeed alive eighty knots and ten increment to VMCA, then I'll call you rotate--.

2014:21
CAM-l right.

2014:22
CAM-2 positive rate.

2014:23
CAM-l okay and I'll ah after rotate I'll call for positive gear ah er positive rate gear up within three seconds --.

2014:32
CAM-2 okay.

2014:33
CAM-3 VMCG.

2014:34
CAM-l yes.

2014:34
CAM-2 yes.

2014:35
CAM-l I'll lower, I'll lower, oh pardon me.

2014:38

CAM-3	VMCG is minimum ground control speed.
2014:40	
CAM-l	right.
2014:41	
CAM-2	understood okay.
2014:43	
CAM-l	at positive rate I'll call gear up I'll lower the nose slightly to gain two ten but still keep about two hundred to four hundred feet a minute climb .
2014:51	
CAM-2	right.
2014:52	
CAM-l	okay then ah when we reach two ten I'll call for max continuous power.
2014:58	
CAM-2	okay.
2014:59	
CAM-l	okay and then well call ah we'll reduce the flaps like that, we'll climb at V2 all the way up to three thousand feet then we'll call for the climb procedures.
2015:09	
CAM-2	okay just to verify, I had V2 to four hundred AGL then two ten.
2015:13	
CAM-l	yeah.
2015:14	
CAM-2	okay that's true but we'll take it to three thousand before we okay I'll point that
2015:18	
CAM-3	and we won't start flap retraction until two ten.
2015:20	
CAM-2	right.

2015:21
CAM-l right okay.

2015:22
CAM-l okay and ah --.

2015:23
CAM-2 I'm going to tower.

2015:24
CAM-l all right.

2015:27
(sound similar to frequency change).

2015:28
CAM-l and it'll be the royal three departure -- out of here.

2015:30
CAM-2 that radar **vec**- runway heading radar vectors -- you got it? **I'll** read it to you. ah fly assigned heading and altitude for vectors to appropriate route expect filed altitude ten minutes after departure --.

2015:41
CAM-l **okay**.

2015:42
CAM-2 then it's got some transitions you don't need to worry about not yet --•.

2015:44
CAM-l okay.

2015:47
CAM-3 and ah of course we'll all be watching' real close for loss of directional control.

2015:51
CAM-l yeah and also of any other ah problem that we have okay they said that they had a fire bell on number four okay --.

2015:58

CAM-2 yeah.

2015:59
CAM-l ah I talked with the engineer and I talked with the captain both he they both said that it was a false indication to their knowledge. The mechanic said that he fixed it --.

2016:10
CAM-3 yeah fire loop lain' on the cowling.

2016:11
CAM-2 you will be running all the throttles right -.

2016:13
CAM-l yes.

2016:14
CAM-2 I won't even touch the throttles.

2016:15
CAM-l I ah that is correct you will ah just set them up ah 'til we're ready there.

2016:21
CAM-3 are you ready to go?.

2016:22
CAM-2 I'll let him know it's three engine.

2016:23
CAM-l yeah ah let's do the before takeoff down to gust lock.

2016:27
CAM-3 all right.

2016:28
CAM-l down to the line I'm sorry.

2016:29
CAM-2 can I arm this?

2016:30
CAM-l yes oh yea.

2016:33 CAM-3	where the # okay my rudder pump is on.
2016:36 CAM-l	okay we did finish the ah -.
2016:40 CAM-3	taxi checklist's completed yes sir.
2016:42 CAM-l	taxi checklist okay.
2016:45 CAM-3	If I can find every thing.
201648 CAM-3	fuel panel is checked, boost pumps are boost and feed, rudder pump is on, freon, **TC's** are off, spoiler pump ?
2016:57 CAM-l	is on.
2016:58 CAM-2	**it's** yours.
2017:00 CAM-3	and pressure's checked?
2017:02 CAM-l	pressure's checked.
2017:02 CAM-3	flight recorder is on, anti-skid?
2017:06 CAM-2	armed.
2017:07 CAM-3	reverse pump is on, aux pump?
2017:10 CAM-l	**it's** on.
2017:11 CAM-3	for three engine procedures it should be on-.
2017:12 CAM-?	right.

2017:13
CAM-3 do you have the reverse pump okay.

2017:14
CAM-? yes.

2017:15
CAM-3 on the line.

2017:16
CAM-3 I don't have the reverse pump.

2017:17
CAM-2 where is it?

2017:18
CAM-l right here .

2017:18
CAM-2 okay # is it on.

2017:20
CAM-3 no it's not push down, oh there you go.

2017:23
CAM-l it's on.

2017:24
CAM-3 reverse pump on.

2017:25
CAM-l okay.

2017:27
CAM-3 we're to the line.

2017:28
CAM-l okay ah ya tell them we're ready to go it's a three engine ferry we're gunnar need a couple minutes on the runway for static run up.

2017:35
CAM-2 okay.

2017:38
RDO-2 Kansas City tower Air Transport seven eighty two's ready to go one niner right this is going to be a three engine ah takeoff. we're gunna' need ah couple minutes on the runway for static run up.

201748
TWR Air Transport seven eight two roger hold short.

2017:50
RDO-2 hold short Air Transport seven eighty two

2017:53
CAM-2 I think we have to hold short for him huh.

2017:55
CAM-l yeah.

2017:56
CAM-2 he pretty close.

2017:56
CAM-l yeah.

2017:57
CAM-2 oh we're one left what the **#** am I saying.

2018:01
CAM-l and the length of one left is?

2018:04
CAM-2 ten ah ten thousand eight hundred feet for one left.

2018:10
CAM-3 seventy eight hundred foot takeoff distance.

2018:17
TWR Air Transport seven eighty two taxi into position and hold runway one left.

2018:20
RDO-2 position and hold one left Air Transport seven eighty two

2018:23
CAM-l below the line.

2018:23
CAM-3 transponder?

2018:24
CAM-2 on.

2018:27
CAM-3 ignition override?

2018:29
CAM-2 that's all engines.

2018:31
CAM-3 we got the aux pump on?

2018:32
CAM-l pump is on.

2018:33
CAM-3 exterior lights?

2018:33
CAM-l to go.

2018:35
CAM-? go.

2018:42
CAM-l clear left.

2019:07
TWR Air Transport seven eighty two runway one left turn right heading zero three zero cleared for takeoff.

2019:12
RDO-2 okay cleared for takeoff one left and turn right zero three zero for Air Transport seven eighty two

2019:19
CAM-l okay lights are extended and on.

2019:22
CAM-3 before takeoff checks complete.

2019:23
CAM-l okay comin' up, two and three.

2019:25
(sound of engines spooling up).

2019:42
CAM-l there set max power.

2019:46
CAM-2 max power on two and three.

2019:48

CAM-l okay, number four's comin' **up.**

2019:51
CAM-2 okay, one point, start ● *.

2019:56
CAM-3 button's in.

2020:02
CAM-3 one point three.

2020:05
CAM-3 point four.

2020:08
CAM-3 point **-** point four.

2020:11
CAM-3 one point five.

2020:12
CAM-2 airspeed's alive.

2020:13
CAM-3 one point six.

2020:17
CAM-3 one point six.

2020:18
CAM-2 eighty knots.

2020:19
CAM-l ahh.

2020:21
CAM-2 ninety knots.

2020:22
CAM-3 one point eight.

2020:23
CAM-2 hundred knots.

2020:24
CAM-l ah **#**.

2020:25
CAM (sound of decreasing engine noise).

2020:26
CAM-1 abort.

2020:29
CAM-3 call tell 'em we're abortin' on the runway.

2020:31
CAM-l spoilers.

2020:32
CAM (sound of increasing engine noise similar to engines in reverse) .

2020:33
RDO-2 Air Transport seven eighty two, we're aborting takeoff.

2020:36
TWR Air Transport seven eighty two roger when able turn right and ah ground point eight off the runway do you need any assistance

202044
CAM-2 negative assistance?

2020:45
CAM-l no negative.

2020:46
RDO-2 negative assistance Air Transport seven eighty two.

202046
TWR Ah ground point eight when you get off.

2020:50
RDO-2 ground point eight when off.

2020 :54
CAM-2 I don't worry about callin' on the radio when we got another problem, that's the least of our worries.

2021:02
CAM-l I couldn't even get dev-

2021:03
CAM-3 well how far were we up close to.

2021:05
CAM-2 we we're about ah --.

2021:06

	CAM-3	we were at one six , and then power went all the way up to one ah one nine zero as you ran it up, so it went up real fast.		
2021:15	CAM-l	yeah it jerked up.		
2021:17	CAM-2	you brought it up too fast? or it jerked up or what?		
2021:19	CAM-l	it just came up too fast is what it did.		
2021:22	CAM-3	if you want to try it again I can try **addin'** the power if you like.		
2021:24	CAM-l	okay let's do it that way yeah ah tell em' --.		
2021:27	CAM-3	*		
2021:29	CAM-2	like to go back and do it again?		
2021:29	CAM-l	yeah tell 'em that we ah we just ah stand-by one let **me-** oh just tell 'em we'd like to taxi back and have another try at it.		
2021:39			RDO-2	Kansas City ground Air Transport seven eighty two's clear we'd like to taxi back and depart one left again.
2021:47			GND	Air Transport seven eighty two heavy roger taxi one left.
2021:50			RDO-2	one left Air Transport seven eighty two
202152	CAM-l	okay.		

2021:55
CAM-3 I'll take off before the line.

2021157
CAM-2 yes let's back that one up.

202156
CAM-3 you want the anti-skid off?

2022:00
CAM-l no ah let's just ah --.

2022:02
CAM-3 to the line?

2022:03
CAM-1 yeah all the way down to the line.

2022:06
CAM-3 okay, transponder ignition override back to off.

2022:10
CAM-3 how much rudder were you stickin' in?

2022:11
CAM-l I had it all the way in.

2022:13
CAM-3 I was lookin' *.

2022:14
CAM-l that's why I ah -.

2022:17
CAM-3 okay when do I have to have max power in on the outboard engine?

2022:21
CAM-l one hundred and seven.

2022:23
CAM-3 by VMCG.

2022:24
CAM-l yeah.

2022:24
CAM-3 okay.

2022:26
CAM-l okay ah we didn't use

brakes on that so brake energy ah chart should be okay.

2022:31
CAM-3 no.

2022:36
CAM-l it seemed what happened, it was **goin'** up smoothly and then all of a sudden -.

2022:40
CAM-2 it **kinda** ah --.

2022:40
CAM-l it jerked and then yeah.

2022:44
CAM-2 a question to consider Captain is ah when we hit when we get near VMCG or get near Vr or VMCG if we're **usin'** all our rudder authority you might **wanta'** consider abort possibly because once we get higher we're gunnar be in be in even worse trouble correct.

2023:01
CAM-l that's correct absolutely.

2023:07
CAM-3 no actually above VMCG you rudder has more authority it's helping you more.

2023:11
CAM-2 I understand.

2023:14
CAM-3 if we were to lose ah about the time an outboard engine before VMCG -.

2023:18
CAM-2 right.

2023:19
CAM-3 you can't continue the takeoff because you will lose directional control because you other engine is

already in.

2023:25
CAM-2 okay yeah you're right you're one hundred percent right.

2023:29
CAM-l okay do me a favor just write down what time we aborted.

2023:32
CAM-3 okay well we aborted at ah about zero?

2023:34
CAM-2 yeah that's about right.

202344
CAM-l okay.

2023:44
CAM-2 boy it's **gettin'** tight.

2023:45
CAM-l yeah I know.

202346
CAM-2 hay we did our best you know.

2023:51
CAM-1 yeah.

2024:06
CAM-l and you can tell 'em that we'll ah be ready for takeoff again at the end.

2024:15
CAM-2 tell them now?

2024:20
RDO-2 Kansas City tower Air Transport seven eighty two we'll be ah ready to go at the end of one left.

2024:26
GND roger contact the tower you'll be number one.

2024:27
RDO-2 okay

2024:28
CAM-2 yeah that might • *.

2024:32
(Sounds similar to flight switching frequency).

2024:36
RDO-2 Kansas City tower Air Transport seven eighty two be ready to go at the end ah one left ah three engine takeoff.

2024:42
TWR Air Transport seven eighty two heavy tower one left turn right zero three zero cleared for takeoff.

2024:47
RDO-2 okay cleared to go one left after departure zero three zero on the heading Air Transport seven eighty two

2024:52
CAM-l okay and the checklist.

2024:54
CAM-3 we are to the line.

2024:56
CAM-l okay below the line.

2024:56
CAM-3 transponder?

2024:59
CAM-2 its on again.

2025:01
CAM-3 ignition override?

2025:02
CAM-2 all engines.

2025:07
CAM-3 exterior lights.

2025:08
CAM-l to go.

2025:10
CAM-3 ah I'm gunnar need a minute.

2025:11
CAM-l yeah.

2025:12
CAM-3 I need to balance fuel out a little bit it's heavy on this side.

2025:15
CAM-l okay.

2025:33
CAM-2 clear left.

202543
CAM-3 **I'll . I'll** let you know when I have enough there.

2025:46
CAM-l okay.

2025:54
CAM-l **I'll** line up just a little right of the center line here.

2025:58
CAM-2 good idea.

2026:11
CAM-3 okay outboard fuel is balanced.

2026:12
CAM-l okay and we're cleared for takeoff, lights are extended and on. checklist is complete?

2026:24
CAM-3 checklist is complete.

2026:24
CAM-l okay.

2026:25
CAM (sound of increasing engine noise).

2026:33
CAM-l make sure that ah two and three is is ah -.

2026:37
CAM-3 at max power?

2026:37

CAM-l yeah.

2026:39
CAM-3 okay.

2026:40
CAM-3 I'll set max power.

2026:46
CAM-3 one one.

2026:49
CAM-3 one two.

2026:50
CAM-3 one three.

2026:52
CAM-3 one four.

2026:54
CAM-3 one five.

2026:58
CAM-3 one six.

2026:59
CAM-2 airspeeds alive.

2026:59
CAM-3 one seven.

2027:01
CAM-l god bless it.

2027:05
CAM-l keep it goin'.

2027:06
CAM (sound of engine noise increasing).

2027:07
CAM-3 keep it goin'?

2027:07
CAM-l yeah.

2027:07
CAM-2 eighty knots.

2027:11
CAM-2 ninety knots.

2027:13
CAM-2 one hundred knots.

2027:17
CAM-l okay.

2027:17
CAM (sound of loud crash).

2027:20
CAM-2 we're off the runway.

2027:21
CAM-l go max power.

2027:26
CAM-l max power.

2027:27
CAM-2 get the nose down.

2027:28
CAM-l max power.

2027:29
CAM-2 you got it.

2027:30
CAM-? we're **gunnar'** go -.

2027:30
CAM (sound of loud crash))

CAM (sound of screams).

2027:32
end of recording

APPENDIX C

ACTIVITIES OF THE CAPTAIN AND FIRST OFFICER PRIOR TO THE ACCIDENT FLIGHT

According to his wife, the captain normally went to bed between 2200 and 2230 and awoke between 0700 and 0730 when he was off duty. He attended a 1 week training course in Denver and returned home on Sunday, February 12. His wife met him at the airport (DTW) about 0230. He had been delayed departing Denver because of a storm. The captain slept until 1100. He spent Sunday at home and went to bed at 2300. On Monday, February 13, he awoke at 0730. He spent most of the day at home and departed for the airport with his wife about 1800 to fly to Dover, Delaware. His wife said he seemed "fine." He checked into the crew hotel at Dover at 2330 and made a short telephone call to ATI from his room at 0056, on February 14, and he made another call the following morning, at 1136, to ATI. Prior to flying, he telephoned his wife. She said he stated that the first officer on his upcoming trip was rather new to the company or the airplane, and that this fact would add to his workload.

The first officer's wife said that he normally went to bed between 2230 and 2300 and awoke between 0600 and 0700 when he was off duty. He also took occasional naps. On Friday and Saturday, February 10 and 11, he spent a routine day at home. He went to bed late on Saturday, perhaps after midnight, mountain standard time. On Sunday, he awoke at 0700, went to church, spent time with the family, and went to bed between 2230 and 2300. On Monday, February 13, he awoke about 0700, and his wife drove him to the airport around 1000 to fly to Dover. The first officer checked in to the crew hotel on February 13 at 2330 EST and, at 2336, he made a telephone call to a calling card number from his room. The next morning, at 1054, he telephoned home to say he would be going to Ramstein, Germany. He sounded normal and was very excited because of the international trip, according to his wife.

The activities of the flight engineer prior to the accident trip could not be determined. He checked in to the crew hotel in Dover on February 14 at 1050.

The check pilot met the crew at 1435 to brief the upcoming flight. They departed Dover at 1730 and arrived at Ramstein, Germany about 7 hours later, at 0628 local time. The three crewmembers and the check pilot ate breakfast together at the crew hotel and remained there talking until 0915. They met again for coffee at 1900 prior to their departure from Ramstein at 2128. The flight arrived at Dover about 11 hours later at 0148 local time (following a stop at Gander). The check pilot said that the captain did an excellent job, including good landings in difficult wind conditions at Ramstein and Gander. He said that the first officer was new to the airplane, but that he was eager to learn and that he did well. He described the flight engineer as very conscientious. The crewmembers did not seem fatigued, and there was no evidence that any of them had medical difficulties.

According to hotel records, the three crewmembers checked in to the crew hotel at Dover at 0240 EST on February 16. The captain placed a short call to AT1 from his room at 0314. The next morning, he telephoned home at 0802 and spoke for 25 minutes. His wife said he had just awakened and that he sounded relaxed and very happy because of the successful check ride. The ATI Manager of Crew Scheduling telephoned the captain at 1030 to inform him that a ferry to MCO was scheduled, but he telephoned back in 15 minutes to say that the trip was canceled. The captain sounded fine, according to the manager, although he had probably been sleeping. The captain telephoned AT1 for 2 minutes at 1244. The AT1 Manager of Crew Scheduling telephoned the captain at 1400 and 1410 to arrange the trip to MCI and to ask him to depart as soon as possible. The captain said that he could depart within 1 hour or less. His mood sounded good, according to the manager, and, in response to a question, the captain indicated that he was rested. The ATI Chief Pilot participated in the second telephone call to discuss the possibility of adverse wind conditions for the scheduled three-engine ferry landing at Westover. They did not discuss the three-engine takeoff procedures. The Chief Pilot said that the captain was in good spirits and anxious to get to the airplane.

The three crewmembers checked out of the hotel shortly after 1500. The desk clerk said that all three of them appeared rested and appeared to get along well with each other. The crew departed Dover at 1518 and arrived at MCI at 1739 local time.

The captain, who had flown the accident airplane into MCI, met the three crewmembers briefly at 1825 and spoke with the captain for about 10 minutes (until his own departure on the airplane that the accident captain had delivered). He described the captain's mood as fairly good, and he said that all three crewmembers appeared alert and free from evident medical difficulties. The captain indicated that he had reviewed the three-engine ferry procedures, and the other captain checked and confirmed the captain's ballast fuel figure. The first officer telephoned his wife from MCI to tell her that he was preparing to fly a three-engine ferry flight. She said he sounded normal.

APPENDIX D

SAFETY BOARD RECOMMENDATIONS A-95-38 AND -39

Date: March 30, 1995

In reply refer to: A-95-38 and -39

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

On February 16, 1995, at 2027 eastern standard time, a Douglas DC-8-63, operated by Air Transport International (ATI), crashed as the flightcrew was attempting to make a three-engine takeoff from runway 01 left at Kansas City International Airport (MCI), Kansas City, Missouri.

The airplane was to be ferried to a maintenance facility in Massachusetts because the No. 1 engine on the airplane could not be operated due to a mechanical problem. The first takeoff attempt was rejected because of directional control problems on the runway. On the second takeoff, directional control problems also occurred, and the captain rotated the airplane just before the airplane departed the paved surface off the left side of the runway. The tail of the airplane struck the runway and a tail skid mark was found on the paved surface and in the sod to the left of the paved surface.

The operational procedures at ATI for a three-engine takeoff begin by Statically setting near maximum power on the symmetrical engines and partial power on the asymmetric engine. After brake release, maximum power should be set on the symmetrical engines. As soon as possible, the asymmetric engine should be smoothly advanced toward maximum power during airplane acceleration to the precomputed ground minimum control speed. The asymmetric engine should be set at maximum power upon reaching this speed. Rudder pedal steering should be used to maintain directional control. Normal rotation procedures should be followed at the precomputed rotation speed.

According to the ATI DC-8 Cockpit Operating Manual, specific three-engine limitations include a maximum en route speed of 0.84 mach, a maximum takeoff weight of 260,000 pounds, a flap setting of 12 degrees, a maximum takeoff crosswind component of 10 knots, and a maximum tailwind component of 5 knots. Also, all three-engine takeoffs must be made from a dry runway with anti-skid operative, and all air conditioning and anti-ice systems must be off. Lastly, no three-engine takeoff shall be made unless VFR conditions exist at the airport of departure and exist or are forecast for the airport of destination. All of these conditions were met at the time of the attempted takeoff.

Witnesses reported that they observed the airplane rotate to a higher-than-normal pitch attitude. The flight data recorder (FDR) data revealed that the rotation occurred at 103 knots or about 20 knots before the three-engine takeoff rotation speed (123 knots). The airplane briefly became airborne while in an unusually high pitch attitude. It then rolled, catching a wing tip on the ground during a slight descent. The airplane was destroyed by impact forces, and all three flightcrew members were fatally injured. Weather conditions were reported as good.

The Safety Board's investigation of this accident is continuing, and the probable cause(s) have not been determined. However, the investigation has raised several safety concerns that the Safety Board believes the Federal Aviation Administration (FAA) should take immediate action to correct.

As a routine part of this investigation, the Safety Board interviewed the FAA principal operations inspector (POI) for ATI at the Little Rock, Arkansas, Flight Standards District Office (FSDO). The POI has been employed by the FAA as an Aviation Safety Inspector (ASI) for about 12 years, all of which have been at the Little Rock FSDO.

The POI was trained and received a type rating in the DC-8. In addition, he has ratings in the Douglas DC-3 and the Falcon 10. He has had past experience as a POI with a 14 Code of Federal Regulations (CFR) Part 135 operator. He stated that he has about 13,000 hours of total flight time. He has been the POI for AT1 for about 1 year, and the ATI certificate is the only one he oversees. He is responsible for oversight of the certificate by himself, however, two other ASIs in the Little Rock FSDO occasionally help with oversight activities. These ASIs are not qualified in DC-8s. The POI depends upon the Denver FSDO for geographic assistance, since ATI training occurs in Denver, Colorado. The interview revealed, in part, the following information:

The POI was asked about the effectiveness of the crew resource management (CRM) program that ATI had begun offering its flightcrews in January 1995. He was unaware that the company had a formal CRM program and he knew nothing about the classes.

The POI stated that he realized that the company had grown considerably in the past several years, and that he was concerned about its growth. However, when he was asked to describe ATI policies concerning its crew pairing program, he replied that he was not aware of such a program. The Safety Board believes that crew pairing is an important safety issue for an expanding company. It also believes that the POI should be familiar with the FAA's crew pairing standards, especially at a growing company.

The POI was asked to describe the ATI ground training program (this training also has been conducted in Denver since last spring) and how often he monitors it. He replied that he has not monitored ground training, and that he did not know whether the Denver FSDO monitors such training. AT1 uses retired United Airlines instructors as simulator instructors in Denver. The POI replied that he had no knowledge of such an activity. However, a letter from the POI to ATI authorizing this practice was found in AT1 training records.

The POI was unaware of other functions that the Denver FSDO performs concerning oversight of ATI. He was shown a letter from the AT1 training department (dated February 2, 1995) that indicated that two out of 278 ATI airmen proficiency check rides had been conducted by FAA personnel. The POI believed that those numbers were probably accurate. Concerning proficiency check rides, he stated that ATI bypasses him entirely in the scheduling and performance of these check rides and that this procedure expedites this check ride activity. He was unfamiliar with proficiency check ride failure criteria as outlined in the FAA Inspector's Handbook, Order 8400.10. Also, he had no knowledge of what amount of training, if any, could be provided during proficiency check rides.

The POI for AT1 was asked how often he had visited the ATI Denver training facility and the Denver FSDO, and he indicated "about three or four times last year." He indicated that funding problems in his office restricted his ability to travel to Denver from Little Rock. He was asked how often AT1 conducted pilot safety meetings, and he thought that they did, but was unaware of how often. The investigation revealed that AT1 does not hold formal safety meetings. He was asked to provide copies of the AT1 check airmen authorization letters, and he produced seven letters from his files. Company records show that 17 check airmen are currently performing check ride duties.

Based on the interview, the Safety Board believes that the POI's surveillance of AT1 and his knowledge of the company were weak. Because of the growth of the company since 1993, and other factors such as the separate locations of the POI and the training center, he has been unable to monitor the safety level of AT1 adequately.

AT1 has experienced three catastrophic DC-8 accidents since 1991.[10] The Safety Board concluded that the probable causes were related to operational factors in the first two accidents. In the accident that occurred in New York the Board determined that:

The probable causes of this accident were improper preflight planning and preparation, in that the flight engineer miscalculated the aircraft's gross weight by 100,000 pounds and provided the captain with improper takeoff speeds; and improper supervision by the captain. Factors relating to the accident were an improper trim setting provided to the captain by the flight engineer, inadequate monitoring of the performance data by the first officer, and the company management's inadequate surveillance of the operation.

In the accident that occurred in Ohio, the Safety Board determined that:

The probable cause of this accident was the failure of the flightcrew to properly recognize or recover in a timely manner from the unusual aircraft attitude that resulted from the captain's apparent spatial disorientation, resulting from physiological factors and/or a failed attitude director indicator.

Although the analysis of the circumstances of the recent accident is not complete, operational factors, such as computation errors and procedural discrepancies, are involved in the accident sequence of events.

"Brief of Accident, JFK International Airport, New York, Air Transport International, March 12, 1991, NYC91-F-A086; Aircraft Accident Report, Loss of Control and Crash, Swanton, Ohio, Air Transport International, February 15, 1992, NTSB/AAR-92/05; and Kansas City International Airport, Missouri, Air Transport International, February 16, 1995, DCA95MA020, the accident currently under investigation.

AT1 experienced much growth since 1993. For instance, 27 of the 64 line captains currently flying for ATI were hired since 1993, 75 of the 80 line first officers were hired since 1993, and 46 of the 73 line flight engineers were hired since 1993. Recently, ATI's operating certificate was reissued by the FAA, allowing it to carry passengers. In fact, it does so on some of the military contract flights that make up approximately 15 percent of its missions.

Because of ATI's growth rate, the common operational thread that appears to tie the three accidents together, and the apparent weak surveillance and oversight provided by the POI, the Safety Board believes that the FAA should take immediate action to examine ATI training, operational philosophy, and management oversight. In addition, the FAA should immediately examine the effectiveness of the oversight process of the Little Rock and Denver FSDOs. This examination of the company and the Little Rock and Denver FSDOs should be accomplished by FAA personnel not associated with any of these entities.

Lastly, all line ATI flightcrews are considered qualified to perform engine-out ferry flights, as long as they have been trained to do so in the simulator and appropriate engine-out ferry preflight procedures are followed. The captain involved in the Kansas City accident had a total of 3129 hours of flying time as a DC-8 captain and had just completed his probationary period with ATI. The first officer had been a line pilot with AT1 for 4 months and had a total of 171 hours of DC-8 flying time. The flight engineer had been a line flight engineer with the company for 4 months also, and had a total of 218 hours of DC-8 flying time.

The McDonnell Douglas Aircraft Company and most operators of three or four-engine airplanes require that only a specially trained cadre of training, flight test, or standardization flight crewmembers be allowed to perform such engine-out operations. Considering the unusual nature of engine-out operations and the relative infrequency of the need for such operations, the Safety Board believes that limiting the engine-out qualified crewmembers within an organization to those with the most flying experience is critical.

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

> Conduct an immediate in-depth inspection of Air Transport International (ATI) to examine training, operational philosophy, and management oversight. Also, as part of this inspection, examine the

effectiveness of the oversight of ATI by the Little Rock and Denver Plight Standards District Offices. (Class II, Priority Action) (A-95-38)

Limit operations of engine-out ferry flights to training, flight test, or standardization flightcrews that have been specifically trained in engine-out procedures. (Class II, Priority Action) (A-95-39)

Chairman HALL, Vice Chairman FRANCIS, and Member HAMMERSCHMIDT concurred in these recommendations.

By: Jim Hall
Chairman

APPENDIX E

DOUGLAS, UNITED PARCEL SERVICE, AND AT1 THREE-ENGINE FERRY PROCEDURES

PC-8 | FAA APPROVED | APPENDIX I
OAC-33163 | | SECTION IV PAGE 6
Date: G-28-67 | | PERFORMANCE

TAKEOFF PROCEDURE: 12° Flaps

The takeoff fleld length charts presented in this appendix are based on the following procedures.

prior to takeoff the pilot should determine the stabilizer setting, engine pressure ratio settings, V_{MC_g} speed, VR speed, V_2 speed and that sufficient field length is available for the conditions of gross weight, temperature, altitude, wind and runway slope of the particular takeoff. All cabin-turbo-compressors and both freon systems should be turned "OFF" manually prfor to applying takeoff power. The blow away jet switch should be turned off approximately 5 seconds after brake release, but before reaching 40 knots. Adjust seat and rudder pedals to assure full rudder pedal control. Secure the inoperatfve englne in accordance with established DACo procedures: Pneumatic "OFF", generator disconnected, all doors closed. Set rudder, aileron and stabilizer trim in accordance wfth normal takeoff procedures (rudder and aileron zero and stabilizer set for the proper c.g., gross welght and V_2 speed). Turn "ON" auxiliary hydraulic pump.

Advance symmetrical engines to full takeoff thrust.' Set engine opposfte the inoperative engine to the maxfmum EPR which can be tolerated and still maintain control at the start of the takeoff roll. This is approximately 1.1 EPR for a dry, hard surface runway. After brake release use the rudder and rudder pedal steering to maintain dfrecttonal control. Rudder pedal steering effectiveness can be Increased by maintaining down elevator during the takeoff roll to the V_R speed. Smoothly accelerate the engine opposite the inoperative engine during the acceleration to V_{MC_g} speed. The engine opposite the inoperative engine should be set at full takeoff thrust at or before attaining V_{MC_g} speed. Rotate the airplane in accordance wfth normal rotationprocedures at the VR speed.

Initiate gear retraction within three seconds after lift-off. Climb at the recommended V_2 speed to at least 400 feet and accelerate in level flight until a speed of at least 200 knots, IAS, is attained, Initfate flap retraction at 200 knots IAS and accelerate to the two-engine final segment climb speed of 208.3 knots IAS.

All cabin turbo-compressors should be "OFF" until a height of 400 feet or a height at which obstacles are cleared, whichever is higher, is attained at which time two cabin turbo-compressors (one at a time) should be turned "ON". The remaining turbo-compressor may be turned "ON" only after power is reduced to maximum continuous rating. The freon systems may be turned "ON" at any time after two turbo-compressors are turned "ON".

**The three engine ferry takeoff EPR settings (set between 40 and 80 knots) presented In this appendix should be used In lieu of comparable four engine curves presented in the basic report, DAC-33163. Statically, set the EPR on the symmetrical engines to the value shown on the Takeoff Thrust Setting Curve (for airspeeds of 40 to 80 knots) less 0.03.*

TAKEOFF FIELD LENGTH (Flaps 12°)

Charts of minimum takeoff field lengths are shorn for various air temperatures, airport pressure altitudes, alrcraft takeoff velghts, wind components, runway slopes and for a flap setting of 12 degrees.

The wind correction chart Includes factors of 50 percent and 150 percent applied to reported headwinds and tailwinds, respectively. The reported vind is taken as the component along the runway at a height of 50 feet above the runway.

The minimum takeoff field length is 115 percent of the horizontal distance from the start of takeoff to a point 35 feet above the runway at the V_2 speed, assuming two symmetrical engines operating from the start of takeoff, with the third engine being brought in as quickly as possible while maintaining positive control.

Appropriate abnormal bleed corrections are presented on separate charts.

The limitations occur in the following manner:

a. An additional engine failure is not considered prior to completion of takeoff path.

b. V_R must not be less than 1.05 $V_{MC_{air}}$. If the V_R allowed by the lift-off speed is less than 1.05 $V_{MC_{air}}$, it must be Increased to be equal to or greater than 1.05 $V_{MC_{air}}$. A weight equal to or greater than the maximum weight at which this limitation occurs is shown on the chart entitled MAXIMUM WEIGHT AT WHICH TAKEOFF SPEEDS ARE AFFECTED BY MINIMUM CONTROL SPEEDS.

c. V_2 is dependent on V_R; therefore, when the V_R has to be increased, it produces an increase in V_2.

d. Takeoff performance vas calculated for a dry, hard surface runway.

EFFECT OF ABNORMAL BLEED ON TAKEOFF PERFORMANCE

A separate page is presented to determine the effect of additional systems operative on takeoff field length. The procedure for its use is as follows:

Enter temperature-altitude grid for the system operative in question. Read the takeoff field length. Using this value enter the normal bleed Plot at the reference weight and proceed in the same manner as the sample problem.

FLIGHT OPERATIONS PROCEDURES – DC8

NOTE: Authorization for the operation of an engine–out ferry is contained in UPS Operations Specifications D, entitled Special Flight Permit With Continuous Authorization To Conduct Ferry Flights. UPS Operations Specifications D, *UPS* Ferry Permit and this manual comply with UPS and FAA approvals and procedures. This applies to B727, B747 and DC8.

1. Operational Procedures

   A. Certificate Limitations – the limitations contained in this supplement conform to the FAA AFM limitations and the observance of such limitations is required by law. The certificate limitations contained in the UPS AOM are applicable except as amended herein.

      NOTE: UPS Ferry Permit, Form 52–19–014 (GMM) is required. Obey its stipulations. One copy of the permit is to be left with flight documents at airport of departure. One copy is to be kept with Captain's flight papers.

      (1) Weight Limitations – The operating weight should be limited to the minimum necessary for the particular ferry flight (FAR 91.611).

      (2) Maximum Airspeed Limitations – VMO or .84M (AFM); .7 mach max cruise recommended (DACO DC8 OEL #22M 6–15–87).

      (3) Flight Crew – No persons other than required members of the flight crew shall be carried.

         NOTE: A UPS Maintenance Specialist may be designated as a required flight crewmember essential for in–flight engine monitoring, inspection of engines at enroute fuel stops, etc.

   B. Operational Limitations

      (1) The flight must not be dispatched to or operated in regions of forecast or reported icing conditions.

      (2) Takeoff may not be made which would require that the initial climb be made over a thickly populated area.

      (3) Military airfield – appropriate permission from Base Commander.

      (4) If three engine take off weight exceeds 240,000 lbs., an intermediate refueling airport should be considered.

   C. Takeoff Configuration

      (1) Flap setting must be:

         DC–8–73 – 12 degrees
         DC–8–71 – 15 degrees

      (2) Four cowled engines must be installed.

(3) One engine driven hydraulic pump and the auxiliary pumps must be on and operating during takeoff if an inboard engine is inoperative, otherwise both engine driven hydraulic pumps must be on and operating with the auxiliary pump on..

(4) The anti-skid system and auto ground spoilers must be operative.

(5) Ignition "all engines and both" selected.

(6) Both packs must be off until reducing thrust to MCT.

(7) The standby rudder power should be ON.

(8) Yaw damper ON is desirable.

2. Emergency Procedures

The emergency procedures contained in the UPS AOM and QRH are unaltered.

3. Flight Planning and Performance Data

UPS Flight Control and Performance Engineering will provide all takeoff and flight data necessary for the successful execution of the ferry flight. The Captain and Second Officer will compute performance data and compare it with data supplied by Engineering. This data will be approved by the Technical Chief Pilot or designee prior to being supplied to the captain.

4. Normal Procedures

The normal operating procedures contained in the UPS AOM are unaltered with the exception of the following recommended procedures:

A. Before Start

(1) Pull inoperative engine ignition circuit breakers.

(2) Move fire shutoff lever to SELECT AGENT position (full forward).

B. Before Takeoff

(1) Review takeoff speeds, minimum control speeds and climb speeds.

(2) VR and V2 are to be predicated upon the runway limit weight in lieu of the actual takeoff weight.

(3) Review procedures for loss of another engine during takeoff or initial climb. Consideration should be given to the effect of other types of failures, such as hydraulic pump, which may preclude gear and flap retraction and result in loss of power control at a critical time.

(4) Complete normal checklists except:

(a) Standby rudder power - ON.

(b) Aux. Hyd. pump (if inboard engine is inoperative) - ON.

C. Takeoff

(1) The Captain will move the throttles and set the thrust.

(2) Before brake release, set 50 percent N1, on asymmetric engine. Then set symmetrical engines at normal takeoff N1, (Max. Thrust).

(3) After brake release, use the rudder and rudder pedal steering to maintain directional control. Smoothly accelerate the third engine during acceleration to VMCG speed. The third engine should be set at Max. Takeoff Thrust at or before attaining VMCG. Hold nosewheel firmly on the ground until VR.

(4) Use normal rotation procedures.

(5) At liftoff, use rudder and aileron displacement as necessary to maintain directional control. Avoid unnecessary rolling and yawing.

(6) The aircraft should attain V2 at or prior to 35 feet AGL

(7) Climb at V2 to at least 400 feet or 40 feet above an obstacle clearance and accelerate in level flight or a shallow climb, as terrain permits, to obtain two–engine VMCA (VMS) as soon as possible. Accelerate to flap retraction speed, simultaneously retract flaps and set MCT.

(8) Operation at Vms with two engines inoperative on one side below 3,700 feet pressure altitude may require bank angles of 9 degrees to 10 degrees to maintain heading until thrust is reduced from three engine MCT to two engine MCT. After setting two engine MCT, operation at Vms with two engines inoperative on one side may only require bank angles up to five degrees.

(9) The climb, cruise, descent, holding, landing and go–around procedures are contained in the UPS AOM, DC8 AFM and this manual.

(10) Three engine performance data is obtained from UPS Engineering and the performance section of the DC8 AFM, UPS AOM and Operational Engineering Letters.

(11) Three engine enroute data is provided in computer flight plan form from UPS flight control.

5. Takeoff Techniques

A. Keep nose wheel on runway, F/O keeps yoke forward for directional control.

B. Stay on centerline of runway.

C. Do not be in too much of a hurry to bring the third engine power in.

D. As the third engine power comes in, keep feeding in rudder as needed to maintain directional control.

E. Do not use nose wheel steering.

F. Advancing dead engine throttle out of idle will eliminate nuisance "gear not latched" light when airborne.

LIMITATIONS

Air Transport international is authorized to conduct one engine inoperative ferry flights of DC-8 airplanes without the necessity of FAA ferry permit, subject to the following limitations and procedures:

No persons other than the required flight crew or persons essential to the operation shall be carried during the three-engine ferry.

Prior to conducting a three-engine ferry takeoff, consideration should be given to the effect of various types of failures, such as the loss of another inboard engine or hydraulic pump which may preclude retraction of gear and flaps and result in loss of flight control power at a critical time.

If an inboard engine is inoperative, at least one engine driven hydraulic pump and the auxiliary hydraulic pump must be ON and operating during takeoff, otherwise both engine driven hydraulic pumps must be ON and operating.

Planning for a three-engine ferry takeoff and flight should include the normal weather and other considerations as well as careful planning for an early landing at the depanure airport or a suitable nearby or enroute alternate airport. Departure area, enroute terrain, weather, and depanure area congestion should also be taken into account. The two-engine enroute terrain clearance should be checked against the terrain to be crossed to'prepare a plan of action against the possibility of the failure of another engine.

Maximum airspeed: V_{MO}/.84M.

The takeoff runway lengths required by the tables in this section are valid for a dry, level, hard surface runway at the stated temperatures, pressure altitudes and weights; with the engine wind milling, a flat engine plug installed against the inlet guide vanes of the inoperative engine, or a faired nose cover on the inoperative engine. Any change from the stated conditions for runway length and of climb limits will reauire reference to:

1. DC-8-61 AFM, Appendix 1A
2. DC-8-62 AFM, Appendix 16
3. DC-8-63 AFM, Appendix 1B
4. DC-8-71 AFM, Appendix 1B

NOTE: On the 61, when utilizing a flat engine plug installed against the inlet guide vanes or a faired nose cover on thr inoperative engine, the fan reverser doors [Venetian blinds) must be secured in the closed position.

No takeoff shall be made unless VFR conditions exist at the airpon of depanure and exist or are forecast for the airpon of destination. Normal enroute weather minimums shall apply for all three-engine ferry flights. All takeoffs must be made from a dry runway with anti-skid system operative, and all air conditioning end anti-ice systems OFF.

Three-engine ferry maximum takeoff weight range is:

60 series aircraft - 260,000 pounds
70 series aircraft - 280,000 pounds

Takeoff flap settings are:

61/71 - 15°
62/63 - 12°

L(Cont'd)ONS

At takeoff weights below 200,000 pounds, the runway lengths and "V" speeds for 200,000 pounds will apply at the stated temperatures and pressure altitudes. Takeoff weights below 200,000 pounds do not necessarily reduce the runway length 'required for takeoff because of VMC considerations. Takeoff weights below the "MAXIMUM WEIGHT AT WHICH MINIMUM CONTROL SPEEDS AFFECT TAKEOFF SPEEDS AND FIELD LENGTHS, WMC,' ara limited to the runway lengths and takeoff speeds at the weight derived from the noted chart for the expected temperature and pressure altitude. Reference the following:

1. DC-8-61 AFM, Appendix 1 A, Sections IV-A
2. DC-8-62 AFM, Appendix 1B, Section IV
3. DC-8-63 AFM, Appendix 1 B, Section IV
4. DC-8-71 AFM, Appendix 1B, Section IV

The tables in this section are derived with this factor included in the figures presented. This is why, at low weights and low altitudes, the higher temperatures may require shorter runways than the same weight at lower temperatures.

Maximum winds for takeoff: Crosswind - 10 KTS. Tailwind - 5 KTS.

All other limitations listed in this manual apply.

No three-engine ferry flight shall be made without direct authorization from the Director of Maintenance or Director of Quality Control to implement the validity of Operations Specifications 084. Only the Director of Operations, or in his absence the Chief Pilot, can provide the operational release for a three-engine ferry. Refer to Air Transport International's General Operations Manual, Chapter 5.

Before making an engine-out takeoff at a military installation, appropriate Operations personnel (i.e., Base Flying Safety Officer, Base Operations Officer, or Base Operations Duty Officer) will be notified of the captain's intentions.

MAINTENANCE PREPARATION

Maintenance requirements prior to three-engine ferry will be found in Air Transpon International's Maintenance Manual, Chapter Three.

OPERATIONAL PROCEDURES

The runway length and speed tables derived in this section meet three-engine ferry takeoff and climb requirements for altitudes below 6000 feet without specific obstacle restrictions and normal bleed conditions.

Consideration for the use of rain removal, engine or airframe ice protection is not included in these tables.

If the aircraft is likely to depart from higher altitudes, encounter obstacles, or be in conditions requiring the use of any of the pneumatic rain or ice protection systems during depanure or initial climb, the takeoff weights and runway lengths in the table may not be valid. In that event, determine a new takeoff weight from the DC-8 AFM for the conditions to be expected.

Adjust seat and rudder pedals to assure full rudder control. Zero the rudder trim and the aileron trim.

Prior to takeoff, place AUX HYD PUMP and STANDBY RUDDER POWER to START. Check AUX PUMP ON and STANDBY RUDDER POWER lights illuminated.

OPERATIONAL PROCEDURES (Cont'd)

TAKEOFF

The following additional procedures will apply to three-engine takeoff:

Statically set partial power on the asymmetric engine and near max power on the symmetrical engines. After brake release, set MAX power on the symmetrical engines and, as soon as possible, smoothly accelerate engine opposite the inoperative engine to MAX power during acceleration to V_{MCG}. The engine should be set at MAX power upon reaching this speed. (See TAKEOFF PROCEDURES on following pages for details).

Use rudder pedal steering to maintain directional control. Use normal rotation procedures.

Initiate gear retraction within three (3) seconds after lift off (positive rate of climb).

At lift-off, rudder and aileron displacement should be applied with discretion in order to avoid unnecessary rolling and yawing.

About ¼ of the total rudder pedal deflection will be required to maintain heading at lift-off if an outboard engine is inoperative. Aileron displacement will vary, but it normally should not exceed ¼ of the wheel travel away from the failed engine. Rudder and aileron forces are light and require small trim inputs.

As airspeed increases, less rudder and aileron will be required to keep the wings level.

Acceleration on three engines is such that the aircraft will obtain V2 at 35 feet if the correct lift off attitude is maintained.

Climb at V2 to 400 feet AGL and accelerate to the three-engine flap retract speed of 210 KIAS, retract flaps and continue climb at 210 (60) 230 (70) KIAS to 3000 feet AGL. Set climb power when climb airspeed is established. Perform climb check above 3000 feet AGL.

Under normal circumstances, the aircraft rate of climb should not be allowed to exceed 500 feet per minute and not be less than 200 feet per minute during the acceleration to 210 KIAS where the flaps are retracted. This procedure will ensure the five minute restriction for maximum power will not be exceeded.

Operation at maximum weights with the loss of an additional engine may require 9° to 10° bank angles to maintain directional control until thrust is reduced to MCT, at which time bank angles up to 5° may be required.

Climb, cruise, descent, landing and go-around procedures are the same, but use three-engine cruise and go-around data.

THREE-ENGINE FERRY CHECKLIST

Consult 3-Engine Runway Analysis For Takeoff Weight; Do Not Exceed Maximum. Consider Enroute MEA's For Two-Engine Drift Down.

inoperative engine secured for ferry.

Maximum Takeoff Weight - 260,000 Pounds (60), 280,000 Pounds (70).

Minimum Fuel Load - 30,000 Pounds.

Maximum Flap 15° (61/71) 12° (62/63)

Captain's seat adjusted to permit full rudder throw.

Rudder and aileron trim zero.

Normal Checklist Completed.

Auxiliary Hydraulic Pump ON,

First officer will hold full forward on yoke.

(60) Symmetrical engines full power. If the inoperative engine is an outboard, set 1 .1 EPR, 80% N2 on the operating engine prior to brake release.

(70) Symmetrical engines at 70% - N_1. If the inoperative engine is an outboard, set 50% N_1 on the operating engine prior to brake release.

CAPTAIN - Maintain directional control with rudder nose wheel steering. Smoothly advance power on the asymmetrical engine during the acceleration to V_{MCG} speed. Maintain sufficient forward elevator pressure to aid directional control.

The asymmetrical throttle must 'be aligned with the symmetrical engine throttles by V_{MCG}. Leave hand on throttles to VR then on the yoke. At VR make normal rotation, maintaining required rudder inputs.

F/O - Call airspeed alive, 80 knots and each 10 KTS to V_{MCG} speed. At VR, call "ROTATE,' call V2 and positive rate of climb. Adjust symmetrical throttles after Captain sets initial power to MAX EPR between 40 and 80 KIAS.

F/E - As the Captain adds power to the asymmetrical engine, call EPA in 0.10 increments (1.2, 1.3, etc.) until max power, then call 'MAX POWER SET.'

Initiate gear retraction within 3 seconds after lift off.

Retract flaps at 210 knots. This ensures two engine V_{MCA}.

Auxiliary hydraulic pump OFF after area climb and ON before final or landing.

Maximum ferry speed - V_{MO}/M.84.

RUNWAY CORRECTIONS

The slope and wind corrections on the following chart apply to all weights and attitudes found in this section.

APPENDIX F

FAA INTERVIEW SUMMARIES

Manager, Little Rock FSDO

The manager was asked about the FAA Geographic Program as it relates to oversight of ATI. He stated that the program was designed so that POIs, like the one overseeing ATI, would not have to travel extensively to monitor the airline operation. He said that funding limitations had an impact on the extent to which ASIs could travel. The manager said that when a carrier expanded significantly, there should be additional funding available to the office carrying the certificate to accommodate the needed expenses. The manager was asked his opinion of ATI/FAA relations, and he stated, "They are good."

Aviation Safety Inspector, Denver FSDO

At the time of the accident, he was not performing inspector duties in the DC-8, because his airplane currency had run out, and his new POI responsibilities demanded his full-time attention. Additionally, this AS1 thought that funding was low in the FAA for such recurrent training. In the years 1993 and 1994, he was assigned to perform geographic functions, primarily with the DC-8 operation at the United Airlines Training Center. This involved oversight of several air carriers using the two simulators in Denver, including ATI.

This individual stated that in his opinion, AT1 was "the best of the non-scheds." He felt that the AT1 training was "thorough and very good." He said that the flightcrews were well prepared for checks. Since the change to a new chief pilot, many former problems at AT1 had been eliminated. He said that the ATI check airmen were very good and that there were fewer check ride failures with the ATI pilots than some of those from other carriers. He said that the reason for this was that AT1 would not assign a pilot for a check unless he was ready. ATI did not restrict extra training when needed, in his opinion.

Concerning the use of retired United Airlines' instructors as simulator instructors was discussed. This AS1 said that these contract instructors were, in general, "ok." He thought that a couple of them were not so good, but that overall they did a thorough job.

Concerning three-engine ferry operations, this individual believed that airline management or other select flightcrews should be the only ones performing such takeoffs, and that they should be performed in day, VFR conditions. He characterized the maneuver as "non-routine...something not done everyday...a bad deal to ask line pilots to do things not normally done." He said that the DC-8-61 simulator at the United Training Center was not a good one in which to perform three-engine takeoff training. He thought that the model 61 simulator was not as realistic as the model 71 simulator.

This individual said that he did not have much contact with the ATI POI in Little Rock. He recalled that the POI requested help with checks, but not with other surveillance functions. He said that he would have responded to requests for additional oversight activities, but that he was not asked.

He believed that the FAA geographic program was a good idea, but that it was not being supported by the FAA upper management. He said that the number of inspectors assigned to this activity in Denver had declined nearly 50 percent in recent months, but that the number of airlines needing oversight activity, such as check rides, had not declined. He thought that the geographic program would "die." One of the problems with the geographic concept, in his opinion, was that some POIs were too sensitive or defensive when negative comments were made by the geographic inspectors about the POI's operators. It seemed to him that the geographic inspectors were gradually being reassigned to other duties and were not being replaced, and he believed that this was an error. He said that if the geographic program was diminished or eliminated, there would be a significant reduction in oversight for many types of operations. In his view, the program worked very well in the past, as long as it had the support of senior management. He thought that this support had been lost. He believed that some operators would not be adequately surveilled; specifically some of the "night freighters."

Geographic Unit Supervisor, Denver FSDO

This unit supervisor said that the geographic program was the "eyes and ears of the POI." He said the program was being "gutted, because inspectors were being reassigned to other functions and not replaced." His unit had lost about 19 ASIs. At the time of the interview, he only had one AS1 qualified in the DC-8. He believed that this severely restricted his ability to provide support to the POIs and the operators. There were no plans to add another AS1 to this activity. He thought that there would be increased risk of accidents and incidents when the geographic program faded out completely. This individual also believed that funding restrictions were hurting oversight functions.

Aviation Safety Inspector, Denver FSDO

This individual had been assigned to the FAA Training Center Program since October 1993. This duty involved monitoring the private training schools in the Denver area, such as the United Airlines Training Center. He said that ATI students were very well prepared, and that he was therefore favorably impressed with ATI training.

He stated that the FAA's geographic program was a good concept, but that it had been reduced and appeared to be phasing out. He said the problem with the geographic program mainly involved POIs being overly protective of their operators. They would often resent any reports from geographic inspector that reflected unfavorably on their operator. He pointed out that the geographic inspector did not have any strong allegiance to one carrier, so he could be more objective in evaluating. The geographic inspector was able to "call things as he saw them."

He said that he was the only DC-8-qualified inspector in the Denver area, and that he was "stretched too thin" to adequately perform all the requirements, even just for check rides, not to mention other duties. In addition, he saw this new Aircrew Program Manager duty as the "wave of the future...APMs in different locations."