National Transportation Safety Board
Aviation Accident Final Report

Location:	ANCHORAGE, AK	**Accident Number:**	ANC95FA008
Date & Time:	11/04/1994, 1125 AST	**Registration:**	N611FE
Aircraft:	MCDONNELL DOUGLAS MD-11/F	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	2 None
Flight Conducted Under:	Part 121: Air Carrier - Non-scheduled		

Analysis

ACCORDING TO THE FLIGHT DATA RECORDER, WHEN 50 DEGREES OF FLAPS WERE SELECTED AT 985 FEET AGL, THE FIRST OFFICER, WHO WAS FLYING THE AIRPLANE, DID NOT STABILIZE THE APPROACH. THE PITCH ATTITUDE OF THE AIRPLANE VARIED APPROXIMATELY 2 DEGREES WITH CORRESPONDING ELEVATOR POSITION CHANGES. AT 40 TO 50 FEET THE PITCH ATTITUDE OF THE AIRPLANE WAS DECREASING. THE CAPTAIN STATED HE FELT A HIGHER THAN NORMAL RATE OF DESCENT AT 20 FEET SO HE GRABBED THE YOKE AND PULLED BACK. THE AIRPLANE LANDED HARD, BOUNCED, AND OSCILLATED AT LEAST THREE TIMES, REACHING A MAXIMUM PITCH UP ATTITUDE OF 12.3 DEGREES. THE TAIL STRUCK THE RUNWAY DURING THE OSCILLATIONS. THE CAPTAIN DID NOT USE VERBAL INSTRUCTIONS AS REQUIRED BY THE FLIGHT MANUAL AND COMPANY PROCEDURES, WHEN TAKING CONTROL OF THE AIRPLANE. BOTH PILOTS WERE MANIPULATING THE CONTROLS DURING THE BOUNCED LANDING RECOVERY.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: THE FLIGHT CREW'S IMPROPER RECOVERY FROM A BOUNCED LANDING. FACTORS ASSOCIATED WITH THE ACCIDENT ARE THE FIRST OFFICER'S LACK OF FAMILIARITY WITH THE AIRPLANE, HIS FAILURE TO STABILIZE THE APPROACH, AND THE CAPTAIN'S DELAYED REMEDIAL ACTION.

Findings

Occurrence #1: HARD LANDING
Phase of Operation: LANDING - FLARE/TOUCHDOWN

Findings
1. (F) AIRCRAFT CONTROL - INADEQUATE - COPILOT/SECOND PILOT
2. (F) LACK OF FAMILIARITY WITH AIRCRAFT - COPILOT/SECOND PILOT
3. (F) REMEDIAL ACTION - DELAYED - PILOT IN COMMAND

Occurrence #2: DRAGGED WING,ROTOR,POD,FLOAT OR TAIL/SKID
Phase of Operation: LANDING - FLARE/TOUCHDOWN

Findings
4. (C) RECOVERY FROM BOUNCED LANDING - IMPROPER - FLIGHTCREW

Factual Information

HISTORY OF FLIGHT

On November 4, 1994 at 1125 Alaska standard time, a McDonnell Douglas, MD-11 airplane, N611FE, operating as Federal Express flight number 016, experienced a hard landing at Anchorage International Airport while landing on runway 6R, Anchorage, Alaska. The airplane landed hard and bounced. The tail struck the runway's surface. The airplane was substantially damaged. The all cargo flight, operating under 14 CFR Part 121, departed Kansai, Japan, on an instrument flight rules flight plan. The destination was Anchorage. Visual meteorological conditions prevailed. The Captain and the First Officer, the only occupants, were not injured.

According to the crew, they were following a Japan Air Lines Boeing 747, which preceded them by an estimated 3 miles. The Federal Express crew was cleared for a visual approach to runway 6R and they used the ILS course for guidance. The Captain stated that the airplane flew through a little bit of turbulence when crossing the shoreline but it was nothing unusual. At 50 feet above the ground everything looked normal, but at 20 feet the Captain stated he perceived an increase in the airplane's sink rate. He and the first officer (the flying pilot) both pulled the yoke back. The airplane hit the runway and bounced upward. The nose of the airplane began to pitch up and the crew pushed the yoke forward. The tail then struck the ground. The nose began to respond, and they landed normally.

DAMAGE TO AIRCRAFT

The airplane received substantial damage. Approximately 32 feet of lower fuselage skin on the underside of the tail section was scraped and dented. There were small puncture/scrape holes in the skin. The aft pressure bulkhead and supporting steel structures were crushed and bent. The VHF antenna, located on the underside of the tail section, was sheared off.

PERSONNEL INFORMATION

According to Federal Express flight crew records log, the Captain was hired and received his basic indoctrination into Federal Express on September 1, 1967. He has functioned as a Captain on the Boeing 727 and 747 airplanes. On August 25, 1992, he received transition/upgrade training to the MD-11 airplane. On October 28, 1992 he completed his Initial Operating Experience (IOE) as Captain on the MD-11. According to Federal Express records, the Captain had 1216 hours in the MD-11 airplane.

According to Federal Express flight crew records log, the First officer was hired and received his basic indoctrination to Federal Express on February 12, 1988. He was assigned to the Boeing 727 as a second officer on March 3, 1988. On February 8, 1989 he was assigned to the DC-10 as a second officer. On August 31, 1994, he received transition/upgrade training on the MD-11 airplane and completed his IOE on October 13, 1994. According to Federal Express records, the First Officer had 56 hours in the MD-11 airplane. The first Officer stated, this was his third landing after his IOE.

FLIGHT RECORDERS

The cockpit voice recorder and flight data recorder were retrieved and sent to NTSB Headquarters, Washington, D.C. for readout. The cockpit voice recorder did not contain any pertinent information.

The flight data recorder was deciphered and analyzed. The vertical rate of descent information (VSPD) was not valid on the main readout and was computed by the NTSB HQs flight data recorder analyst by using the altitude and time readouts. This information was portrayed on a chart (included) and at 100 feet above ground level (agl), the rate of descent increased to just over 1000 feet per minute with a nose pitch up attitude of 2.46 degrees. The rate of descent then decreased to 850 feet per minute and again increased to 900 feet per minute when the airplane was 50 feet above the ground. At this point the airplane's pitch attitude was 2.11 degrees up.

A review of the pitch attitude during the approach showed that the airplane's pitch attitude was approximately 3.87 degrees while flaps were selected and set at 35 degrees. The flight data recorder readout frame count number 115 shows that flaps were at 39.731 degrees which shows a transitory position. The pitch attitude of the airplane reached 4.57 degrees. At 785 feet agl, the flaps reached the selected 50 degree position and the airplanes's pitch attitude reduced to 2.11 degrees. From frame count 115 to frame count 127, the airplane's pitch attitude varied from a low of 1.41 degrees to a high of 4.57 degrees. There were two cycles of variation and at frame count number 127; the pitch attitude was decreasing through 2.46 degrees to reach a low of 2.11 degrees.

The flight data recorder elevator positions were examined and were found to fluctuate with the pitch attitude changes. The airplane's pitch attitude would reach its maximum deflection approximately 1 second after the maximum elevator input.

The flight data recorder readout shows that between 55 and 40 feet agl, the airplane's pitch attitude was increasing from 2.11 degrees to 2.81 degrees. The elevator position information shows a positive increase in elevator position. The pitch attitude of the airplane continued to increase to 8.44 degrees until ground contact. Upon ground contact, the elevator position began decreasing from its positive deflection. The flight data recorder readout shows elevator deflection varying to positive pitch up two more times before going to a negative position for the completion of landing.

According to McDonnell Douglas Aircraft, and Federal Express, Inc., the MD-11 has a tendency to pitch up when the spoilers deploy. The spoilers were designed to deploy only to the half position at main wheel spin up and if the throttles were retarded to less than 46 degrees of throttle travel. This was designed to reduce the pitch up effect. According to the flight data recorder readout information, the spoilers did not deploy upon initial ground contact. Throttle position travel was approximately 37 degrees. The spoilers did deploy to the half position upon the second touch down of the main wheels. The following information is excerpted from the flight data recorder readout and shows the relationship between the frame count, average elevator position between left and right and inboard and outboard elevators, spoiler position, and airplane pitch attitude.

frame count	avg elev position	pitch attitude	spoiler position	grnd contact
129	7.316	3.16	8.004	-
11.797	4.22	--	-	8.239
7.03	9.147	-	2.198	8.44
--	initial	130	-0.6367	5.27
7.828	-	15.159	3.16	--
-	5.031	7.73	27.090	second
-	-7.66	12.30	--	131
-	10.282	9.84	26.387	third + final
-	11.6875	4.22	--	-
15.15	-0.35	26.739	-	-7.294
0.70	--	132	-14.613	0.00
58.667				

This information shows that the airplane's pitch attitude responded to the control inputs selected by the flight crew.

WRECKAGE AND IMPACT INFORMATION

There was no wreckage or debris on the runway after landing.

The damage to the airplane was discovered during the maintenance crews post flight examination of the airplane.

TESTS AND RESEARCH

Flight simulator tests conducted at the Federal Express Training facility, Memphis, Tennessee, showed that the airplane had a pronounced tendency for the nose to pitch up upon main gear touchdown. The nose pitch up tendency was exaggerated by the deployment of the spoilers which occurred upon main landing wheel spin up. Upon main landing wheel spin up, the spoilers deployed to the half deployed position.

The simulator tests distinctly showed that upon main gear touchdown and spoiler deployment, the flying pilot had to physically push the yoke forward to prevent the nose from pitching up. The pilot had to anticipate this control input. If the pilot waited for the nose of the airplane to begin movement in any direction, his control input effect was greatly diminished. The control input effectiveness was also affected by the position of the airplane's center of gravity. If the center of gravity was near the forward position, the control input took a longer time to effect a change in the momentum of the nose pitching rate. Conversely, when the center of gravity was near the rear limit, the control input more quickly effected a change.

The nominal center of gravity range for the MD-11 airplane during landing is 25 to 27 percent of MAC (mean aerodynamic chord). According to the Captain, the airplane's landing center of gravity was 23 percent of MAC.

A demonstration by the company MD-11 instructor pilot showed that if a stabilized approach was flown and the touchdown was normal, the nose of the airplane pitched up and stabilized at approximately 10 degrees nose up. He demonstrated this by removing his hands from the flight controls upon touchdown.

A pilot not rated in the MD-11 airplane flew an unstabilized approach and upon touchdown did not anticipate the pitch up tendency. The nose of the airplane pitched up at touchdown and full forward control input was applied before the pitch up movement was arrested. At this point the nose of the airplane began to drop rapidly toward the runway. The pilot entered a maneuver commonly termed as a pilot induced oscillation. The tail did not strike the runway during this maneuver. After three to four pitch oscillations, the main landing gear touched the runway and the pilot applied immediate full forward yoke and the airplane landed normally and stayed on the runway.

Examination of the company's training program showed that tail strike awareness is discussed. The Captain and the First Officer both stated during their interviews that they received information during training referencing tail strikes.

Examination of the MD-11 Flight Manual, page 7-113, under the section titled "Tail and Wing Clearance," subsection "Landing," revealed the following statement, "Attempting to make the smoothest landing possible can result in decreased clearances which in turn could result in a tail strike." The section further states that high descent rates on short final could lead to late

or early flares which could also lead to a tail strike. The Flight Manual recommends against aerodynamic braking due to the increased possibility of a tail strike. The Manual states "Another contributor to tail strikes during landing is the nose- up pitching force generated by the automatic ground spoiler deployment at main gear spin-up. This is quickly noted and pilots are taught to compensate for it during initial transition training. It then becomes part of the MD-11 pilot's reflexes. Spoiler pitch-up is still present during every landing, and must be counteracted. If touchdown does occur with higher than normal pitch attitude, the nose should be lowered promptly to prevent spoiler deployment from further increasing the pitch attitude...." "In short there is not a substitute for a well- executed, stabilized approach to position the airplane for proper flare, touchdown at the proper spot and stopping while there is runway remaining."

The Flight Manual further states that a normal landing configuration would give the airplane a vertical rate of descent between 650 and 800 feet per minute. The pitch attitude should be 5 degrees with the flaps set at 35 degrees, a mid center of gravity, while on a 2.5 degree glide slope descent angle. The use of 50 degrees of flaps will reduce the pitch attitude by 1 degree. The manual also states that the pitch attitude necessary to attain a near zero rate of descent under the described conditions would normally be 8 to 9 degrees.

According to the flight data recorder information, the airplane had a pitch attitude of 4 to 5 degrees while the flaps were extended to 35 degrees. Approximately 850' above the ground, 50 degrees of flap were selected and the pitch attitude of the airplane reduced to approximately 1 degree and continued to vary throughout the approach. The variation was between 2 and 4.5 degrees until the event.

According to the instrument approach plate for Anchorage International Airport, ILS runway 6R, the descent angle for the glide slope is 3.0 degrees. The Captain and First Officer both stated that the airplane was on course and on glide slope.

The average rate of descent for the airplane during the approach, up until the time of the event was 856.73 feet per minute. However, the rates of descent varied from 2000 feet per minute to a climb of 350 feet per minute. These rate of descent points were taken from the point were 50 degrees of flaps were applied.

Examination of the training program showed that tail strike awareness is taught and the training objectives coincided with the information in the airplane flight manual. However, the training objective stated that with 35 degrees of flaps extended the pitch attitude during approach should be 6 degrees; at flaps set to 50 degrees, the pitch attitude should be 5 degrees. There is no reference to descent angle.

According to a representative of McDonnell Douglas Aircraft, those are nominal numbers for the flight crews to show an example of the approach sight picture. It was stated that a stabilized approach is very important and that a 2 degree variation of the pitch attitude during the final phases of the approach is not a very stabilized approach, "considering the size of this airplane."

The training program also listed a section dealing with transfer of airplane control. The training program did not list any specific method for performing the transfer of airplane control. However, on page 7-7 of the MD-11 flight manual, a specific procedure for the transfer of airplane control is listed. According to the Federal Express Flight Operations Manual, page 2-10, there is a discussion about airplane control. It states in part, "At any time, during ground

or flight operations, if the First Officer is controlling the airplane and the Captain becomes concerned about the airplane's flight path or ground track, the Captain must take physical control of the airplane and state 'I have the airplane.' The First Officer must then completely relinquish control of the airplane." The Captain did not use any verbal commands in this accident to acquire control of the airplane.

Discussions conducted with the Federal Express Training Department and the Standardization Department revealed that the standardization department was responsible for the information taught by the training department. The Training Department stated that they had trouble getting the most current information through their company distribution system. The training department indicated that they would like to implement training procedures based upon information given in the various McDonnell Douglas publications, such as "All Operator Letters" and "Know your MD-11" letters. Individual instructors in the Training Department stated they receive the update information faster by getting the publications directly from McDonnell Douglas Aircraft.

The distribution of these publications, within Federal Express, is handled by the Standardization Department. One individual in the Standardization Department is responsible for reviewing the documents/publications and routing the documents to their destinations such as maintenance, operations, or training.

According to the Standardization Department Manager, the company separated standardization and training as a method to check the quality of training. However, the Standardization Department is responsible for the curriculum information sent to the Training Department. The manager stated, "they teach only what we tell them to teach."

There was no written procedure for training program development or distribution of publications.

ADDITIONAL INFORMATION

The MD-11 airplane is equipped with a dual chamber, main landing gear, shock strut. If this strut is not serviced correctly, it may cause the airplane to rebound more than usual during landing. The landing gear struts on the accident airplane were examined and found to be over serviced with both fluid and nitrogen. According to McDonnell Douglas Aircraft, this strut is very difficult to service and there is no simple way for the flight crew to determine whether the strut has been correctly serviced. The traditional method of strut extension examination, as used by most flight crews, is not a valid method for determining correct servicing. The amount of strut extension is dependent on many factors, such as airplane gross weight, terrain/ramp slope, or fuel load distribution. These elements may lead to uneven strut extension. McDonnell Douglas Aircraft stated that if the strut is not leaking oil, and it was serviced correctly during maintenance, it should operate properly.

According to McDonnell Douglas Aircraft, they do not feel that the landing gear strut over service problem has been attributed to the cause of any tail strike in the MD-11 airplane.

They do believe that the rebound potential created by the over servicing could assist in aggravating a pilot induced oscillation during an unstabilized touchdown.

According to Federal Express, the main landing gear struts are checked only when the airplane gets a "B" maintenance check. There is no way for the flight crew or line maintenance crew to determine if the struts have been properly serviced. Federal Express did not have a

written procedure in place, for flight crews or line maintenance crews, to determine the servicing level of the main landing gear struts.

National Transportation Safety Board Supplements C, D, and I, were not completed or submitted with this report.

Pilot Information

Certificate:	Airline Transport	**Age:**	54, Male
Airplane Rating(s):	Multi-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim.	**Last Medical Exam:**	05/17/1994
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	12084 hours (Total, all aircraft), 1216 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	MCDONNELL DOUGLAS	**Registration:**	N611FE
Model/Series:	MD-11/F MD-11/F	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Transport	**Serial Number:**	48604
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	10/17/1994, Continuous Airworthiness	**Certified Max Gross Wt.:**	625500 lbs
Time Since Last Inspection:	227 Hours	**Engines:**	3 Turbo Jet
Airframe Total Time:	3974 Hours	**Engine Manufacturer:**	GE
ELT:	Installed, not activated	**Engine Model/Series:**	CF6-80C2DIF
Registered Owner:	FEDERAL EXPRESS, INC	**Rated Power:**	60240 lbs
Operator:	FEDERAL EXPRESS, INC	**Air Carrier Operating Certificate:**	Supplemental

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	ANC, 124 ft msl	**Observation Time:**	1050 AST
Distance from Accident Site:	0 Nautical Miles	**Direction from Accident Site:**	0°
Lowest Cloud Condition:	Scattered / 8000 ft agl	**Temperature/Dew Point:**	-2°C / -8°C
Lowest Ceiling:	Broken / 11000 ft agl	**Visibility**	20 Miles
Wind Speed/Gusts, Direction:	3 knots, 160°	**Visibility (RVR):**	0 ft
Altimeter Setting:	28 inches Hg	**Visibility (RVV):**	0 Miles
Precipitation and Obscuration:			
Departure Point:	KANSAI, JP (KIX)	**Type of Flight Plan Filed:**	IFR
Destination:		**Type of Clearance:**	IFR
Departure Time:	1248 GMT	**Type of Airspace:**	Class D

Airport Information

Airport:	ANCHORAGE INTERNATIONAL (ANC)	**Runway Surface Type:**	Asphalt
Airport Elevation:	124 ft	**Runway Surface Condition:**	Dry
Runway Used:	6R	**IFR Approach:**	ILS; Visual
Runway Length/Width:	10897 ft / 150 ft	**VFR Approach/Landing:**	Straight-in

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	GEORGE KOBELNYK	**Adopted Date:**	08/31/1995
Additional Participating Persons:	GEORGE MCCAMMETT; ANCHORAGE, AK		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/.		

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