



National Transportation Safety Board Aviation Accident Final Report

Location:	WALLOPS ISLAND, VA	Accident Number:	IAD99FA008
Date & Time:	10/27/1998, 1456 EST	Registration:	N454LJ
Aircraft:	Learjet 45	Aircraft Damage:	Destroyed
Defining Event:		Injuries:	2 Minor, 1 None
Flight Conducted Under:	Part 91: General Aviation -		

Analysis

The Learjet was participating in water ingestion tests, which required multiple landing rolls through a diked pool on the runway. On one of the landing rolls, the airplane's left main landing gear and nose landing gear tracked through the pool, while the right main landing gear tracked outside the pool. The airplane veered to the left, departed the left side of the runway, and struck a pickup truck parked adjacent to the runway. The airplane came to rest inverted and on fire. Formal hazard identification and risk management procedures were not employed and no alignment cues were in place on the runway to facilitate pool entry alignment. Further, the accident truck, other vehicles, heavy equipment, and personnel were placed hundreds of feet inside the FAA recommended runway-safe and object-free areas during the test.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The failure of the pilot to obtain/maintain alignment with the water pool, which resulted in the loss of control. Factors in the accident were the inadequate preflight planning of the flight test facility and the airplane manufacturer which resulted in hazards in the test area and the subsequent collision of the airplane with a vehicle.

Findings

Occurrence #1: LOSS OF CONTROL - ON GROUND/WATER

Phase of Operation: LANDING - ROLL

Findings

1. AIRCRAFT PERFORMANCE, HYDROPLANING CONDITION - ENTERED
 2. AIRCRAFT WEIGHT AND BALANCE - EXCEEDED - COMPANY/OPERATOR MANAGEMENT
 3. (C) PROPER ALIGNMENT - NOT OBTAINED/MAINTAINED - PILOT IN COMMAND
 4. AIRCRAFT CONTROL - NOT POSSIBLE - PILOT IN COMMAND
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Occurrence #2: ON GROUND/WATER COLLISION WITH OBJECT

Phase of Operation: LANDING - ROLL

Findings

5. (F) OBJECT - VEHICLE
6. (F) PREFLIGHT PLANNING/PREPARATION - INADEQUATE - OTHER GOVERNMENT PERSONNEL
7. (F) PREFLIGHT PLANNING/PREPARATION - INADEQUATE - COMPANY/OPERATOR MANAGEMENT

Factual Information

HISTORY OF FLIGHT

On October 27, 1998, at 1456 eastern standard time, a Learjet 45 registered in the experimental category, N454LJ, was destroyed after a loss of control during landing roll and collision with a ground vehicle at the NASA Wallops Flight Facility (WAL), Wallops Island, Virginia. The certificated airline transport pilot (ATP) was not injured. The ATP rated copilot and the flight test engineer received minor injuries. There were no injuries on the ground. Visual meteorological conditions prevailed for the local test flight that originated at WAL, at 1449. No flight plan had been filed for the flight conducted under 14 CFR Part 91.

According to the pilot, the airplane and crew were involved in flight test certification for a new nose wheel tire. For the test, the airplane was passed through a "pool" or "trough" of water on the runway at different speeds. Then data was collected using video, still photography, and on-board diagnostic equipment. The airplane was loaded, configured, and operated inside and outside the weight-and-balance and performance envelopes of a Learjet 45 registered in the normal category. The pool was 30 feet wide, 200 feet long, formed with flexible rubber dikes, and contained 3/4 of an inch of standing water. Beginning the day prior to the accident, the crew had successfully completed 10 passes through the test pool.

In a written statement, the pilot described the flight prior to the accident. He further described adjustments made on final approach to reach the intended touchdown point; 1,000 feet beyond the approach end of runway 22. The pilot said:

"Initial alignment during rollout was uneventful. [Thrust reversers] were selected to, and maintained at, idle reverse until a point where I thought we needed to select maximum reverse to get full reverse thrust and enter the pool at target speed of 80 knots. As soon as the [thrust reversers] reached full reverse, the aircraft pulled to the right. Left rudder was input to realign the fuselage.

"At pool arrival, the aircraft had almost re-aligned and I left left rudder and nose wheel steering in to attempt to drift the aircraft left a couple of feet, since it appeared the right mains were on the edge of the pool. The aircraft began a fishtail to the right (nose left) and I immediately input right rudder and stowed the [thrust reversers]. I believe this arrested the fishtail, but a runway [left] side departure was evident."

The pilot described the maneuvers necessary to avoid striking test participants, vehicles, and equipment along the left side of the runway after the airplane departed the pool. However, he was unable to prevent the right wing from striking an unmanned pickup truck parked on an intersecting runway. After collision with the truck, the wings separated from the airplane, the fuselage rolled inverted, and spilled fuel ignited.

In a written statement, the co-pilot said:

"The aircraft entered the trough with maximum thrust reversers selected. [I] gave a "mark" to specify trough entry. My impression was that the aircraft had a slight right drift at water entry. Immediately after entering the trough, the aircraft yawed left. While this yaw was apparent, [I] felt the aircraft was controllable. The aircraft corrected back to the right slightly then yawed hard left. At this point, [I] felt the aircraft was in an uncontrollable hydroplaning condition and that the aircraft was going to depart the runway."

A review of videotape revealed that left rudder inputs and movement of the airplane's nose to the left were evident just prior to pool entry. The nose wheel and rudder remained deflected as the airplane entered the pool. The airplane continued to yaw left as the tail "fishtailed" to the right. The airplane departed the left side of the runway, struck the pickup truck, and came to rest inverted and on fire.

When questioned about the airworthiness of the airplane, both pilots stated there were no deficiencies with the airplane or its performance.

The accident occurred during the hours of daylight approximately 37 degrees, 56 minutes north latitude, and 75 degrees, 27 minutes west longitude.

PILOT INFORMATION

The pilot held an Airline Transport pilot certificate with ratings for airplane single engine land, multi-engine land, and instrument airplane. He also held a flight instructor certificate for airplane single engine land, multi-engine land, and instrument airplane.

His most recent Federal Aviation Administration (FAA) First Class Medical Certificate was issued on November 17, 1997.

The pilot reported 13,073 hours of flight experience, 767 hours of which were in make and model.

The co-pilot held an Airline Transport pilot certificate with ratings for airplane multi-engine land, and instrument airplane. He also held a commercial pilot certificate with ratings for airplane single engine land, rotorcraft-helicopter, and instrument helicopter.

His most recent Federal Aviation Administration (FAA) First Class Medical Certificate was issued on June 22, 1998.

The co-pilot reported 4,202 hours of flight experience, 93 hours of which were in make and model.

AIRCRAFT INFORMATION

The airplane was a 1996 Learjet 45, registered in the experimental category to Learjet, Inc., for the purposes of research and development.

The airplane was on an annual inspection program with the most recent inspection completed on October 12, 1998. The airplane had accrued approximately 5 hours of flight time since that date and had a total of 339.4 hours at the time of the accident.

METEOROLOGICAL INFORMATION

The weather reported at Wallops Island was scattered clouds at 1,800 feet with winds from 070 degrees at 12 knots.

AERODROME INFORMATION

The National Aeronautics and Space Administration operated the Wallops Flight Facility, of the Goddard Space Flight Center for the purposes of flight testing. NASA, the military, various branches of the federal government, and private industry use the facility.

At the airport were three intersecting runways oriented 10-28, 17-35, and 04-22 degrees. The runways were 8,000, 4,820, and 8,750 feet respectively. All three runways were 150 feet wide and constructed of asphalt and concrete. Runway 04-22 was equipped with a water ingestion

trough for water ingestion testing.

WRECKAGE INFORMATION

The wreckage was examined at the scene on October 28, 1998, and all major components were accounted for at the scene. Examination of the runway and the test pool revealed the tire tracks from the accident run were still visible. The tire tracks revealed that upon pool entry, the left main gear and the nose gear tires tracked through the pool, while the right main gear tires tracked outside the pool.

The wreckage path was approximately 300 feet long and oriented approximately 180 degrees. The wreckage path was measured from the point of collision with the truck and the final resting point of the fuselage. The truck was originally parked on the left side of runway 22 at the intersection of runway 17-35.

The truck was completely destroyed by frontal collision and post crash fire and came to rest approximately 150 feet down the wreckage path. The airplane came to rest inverted, oriented approximately 240 degrees, and was also consumed by post crash fire. Fire destroyed the airplane's exterior on the north side of the wreckage and consumed the interior. The south side of the wreckage was unmarked by fire damage.

The emergency exit door on the south side of the fuselage was undamaged and unopened.

AIRCRAFT RESCUE FIRE FIGHTING (ARFF)

A review of videotapes revealed ARFF units arrived at the accident site approximately 40 seconds after the accident. Water was dispensed from the first unit approximately 1 minute after its arrival. However, the unit, an Amertek C-4000 pumper truck, was unable to dispense water onto the fire. The turret mounted nozzle sprayed water between the truck and the fire, and then the flow of water was stopped.

The driver/firefighter egressed the cab of his truck, without his full complement of Personal Protective Equipment (PPE), and attempted to deploy the hand-held hose from his truck. The flow of water started and stopped intermittently, and the firefighter appeared to struggle with the equipment. The first response vehicle performed no effective fire fighting.

In a telephone conference, the Wallops Installation Safety Officer, Aviation Safety Officer, and Fire Chief said that their internal investigation revealed deficiencies in ARFF equipment and training.

According to the Fire Chief, the failure of the first vehicle to effectively fight the fire was the result of incomplete training and equipment malfunction. The Chief then described the equipment modifications that were performed and the subsequent training of all ARFF personnel at Wallops Island.

A written statement from the Wallops Safety Office outlined the equipment and training upgrades. According to the statement:

"In the summer of 1998, prior to the accident, [the] Chief... arranged for the Virginia Department of Fire Programs to bring their Mobile Aircraft Fire Trainer to WFF in June 1999. All WFF fire fighters that are authorized to operate ARFF vehicles have completed a NFPA 1003 certification program sponsored by the Virginia Department of Fire Programs. This training included daytime, nighttime, and backup system operation of the ARFF vehicles. It also included wheel/brake fires, engine fires, and crew rescue. The next training session is

scheduled for one week starting March 2, 2000. We intend to conduct this training annually."

The equipment problem with the Amertek C-4000 germane to this accident was stuck turret valves. The United States Navy identified this problem and published a solution. The Wallops Fire Department reviewed the Navy's solution but rejected it in favor of their own fix.

According to the statement:

"The Navy fix was rejected in favor of replacing the actuator with a larger diameter actuator rather than slaving another cylinder into the linkage. Additionally, we sent the mechanics to the Army Vehicle Maintenance facility for two weeks of ARFF training."

SURVIVAL ASPECTS

The crew of the airplane was secured in their seats by 5-point harnesses and was uninjured during the accident sequence. The occupants were suspended inverted in their harnesses when the airplane came to rest. Release of the harnesses resulted in the crew falling to the roof of the aircraft and 2 of 3 crewmembers sustaining minor injuries.

The crewmembers stated the emergency and crew coordination training each received from the United States Military, NASA, and Learjet, along with the coordinated efforts of the crew, resulted in a successful egress from the burning wreckage

In a written statement, the pilot explained the crew was unable to open the main exit, so he and the flight-test engineer moved to the emergency exit to attempt egress. While the pilot and engineer worked unsuccessfully on the emergency exit, the co-pilot was able to open the main door and all three crewmembers exited that door. According to the pilot:

"I estimate that almost any more delay and we would not have made it, due to flames and the cabin filling up with smoke. My crew's crew coordination during the egress sequence was superb, and they were directly responsible for our successful exit from the burning wreckage."

ADDITIONAL INFORMATION

An Operations and Safety Directive (OSD) was prepared for the water ingestion tests on October 15, 1998. Members of the Operations and Safety staffs of the Wallops Flight Facility approved the test as outlined in the OSD.

Examination of the OSD, the accident site, and interviews with the crews revealed that formal risk management had not been employed. Hazard identification, risk assessment, control measure development, implementation of controls, and control evaluation was not performed.

Objects beyond the departure end of the trough (vehicles, generators, cameras, and personnel) were not identified as hazards, nor were the personnel positioned there identified as being at risk. Several test personnel on the ground reported they abandoned their stations to avoid being struck by the accident airplane. Further, the runway was not marked with alignment cues or a go/no go point to assist the aircrew.

On scene, the Wallops Flight Facility Aviation Safety Officer (ASO) asked how future tests could be accomplished more safely. In response, formal written hazard identification, risk assessment, and risk management procedures were suggested by the Safety Board Investigator. Specific control measures offered to mitigate risk in further water ingestion tests were offered in a letter to the ASO. They were:

1. Improved alignment cues:

Temporary Highway Department grade marking tape line approximately 1,000 feet in length prior to and centered on target area.

2. Determination and marking of Go/No Go point along alignment tape:

Tape line placed over and perpendicular to alignment tape. This line would be used to determine if alignment for test run is suitable, or if test run should be abandoned in favor of aircraft control issues only.

3. Unmanned remote mounted cameras for recording event.

The Wallops Flight Facility convened a Mission Operation Review Team in response to the accident. A report of their findings and recommendations was published April 27, 1999.

Among the suggestions for water ingestion test planning were:

1. Conduct a hazard analysis and document the mitigating features. Define specific limitations on personnel locations and details on the acceptability of project equipment within the hazard area.
2. Establish aircraft alignment cues.
3. Develop and implement abort/contingency procedures.
4. Investigate the ability to satisfy mission requirements through the use of remotely operated cameras and/or longer length optics (operated from a farther distance).
5. Update the OSD to provide a map showing personnel location..."

According to FAA Advisory Circular 150/5300-13 Table 3-1, the design standard for the Runway Safety Area Width and the Runway Object Free Area Width were 500 feet and 800 feet respectively. These distances were measured from the runway centerline. Examination of diagrams provided by NASA and a review of videotape revealed that the accident pickup truck, a step van, and a trailed generator were all parked approximately 150 feet from the runway centerline.

The airplane wreckage was released to the owner on October 28, 1998.

Pilot Information

Certificate:	Airline Transport	Age:	52, Male
Airplane Rating(s):	Multi-engine Land; Single-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):	Airplane Multi-engine; Airplane Single-engine; Instrument Airplane	Toxicology Performed:	No
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim.	Last FAA Medical Exam:	11/17/1997
Occupational Pilot:		Last Flight Review or Equivalent:	
Flight Time:	13073 hours (Total, all aircraft), 767 hours (Total, this make and model), 7790 hours (Pilot In Command, all aircraft), 91 hours (Last 90 days, all aircraft), 24 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Learjet	Registration:	N454LJ
Model/Series:	45 45	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Experimental	Serial Number:	45-004
Landing Gear Type:	Retractable - Tricycle	Seats:	4
Date/Type of Last Inspection:	10/12/1998, Annual	Certified Max Gross Wt.:	20200 lbs
Time Since Last Inspection:	5 Hours	Engines:	2 Turbo Fan
Airframe Total Time:	339 Hours	Engine Manufacturer:	Allied Signal
ELT:	Not installed	Engine Model/Series:	TFE 731-20R-1
Registered Owner:	LEARJET, INC	Rated Power:	3500 lbs
Operator:	LEARJET, INC	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	WAL, 41 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	1455 EST	Direction from Accident Site:	0°
Lowest Cloud Condition:	Scattered / 1800 ft agl	Visibility	10 Miles
Lowest Ceiling:	None / 0 ft agl	Visibility (RVR):	0 ft
Wind Speed/Gusts:	12 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	70°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30 inches Hg	Temperature/Dew Point:	17° C / 13° C
Precipitation and Obscuration:			
Departure Point:	(WAL)	Type of Flight Plan Filed:	None
Destination:		Type of Clearance:	VFR
Departure Time:	1152 EST	Type of Airspace:	Class D

Airport Information

Airport:	WALLOPS FLIGHT FACILITY (WAL)	Runway Surface Type:	Concrete
Airport Elevation:	41 ft	Runway Surface Condition:	Dry; Wet
Runway Used:	22	IFR Approach:	None
Runway Length/Width:	8750 ft / 150 ft	VFR Approach/Landing:	Traffic Pattern

Wreckage and Impact Information

Crew Injuries:	2 Minor, 1 None	Aircraft Damage:	Destroyed
Passenger Injuries:	N/A	Aircraft Fire:	On-Ground
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Minor, 1 None	Latitude, Longitude:	

Administrative Information

Investigator In Charge (IIC):	BRIAN C RAYNER	Report Date:	04/06/2001
Additional Participating Persons:	EDWARD L HALL; RICHMOND, VA JAMES B TIDBALL; WICHITA, KS RICH ROGERS; WALLOPS ISLAND, VA		
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 pubinquiry@ntsb.gov , or at 800-877-6799. Dockets released after this date are available at http://dms.nts.gov/pubdms/ .		

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The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).