APPENDIX A

A.2*

Flight 1080

"As pilot-in-command of Delta Air Lines Flight 1080, he maneuvered his malfunctioning aircraft more than 100 miles through 8,000 feet of solid overcast to a safe landing. His professional judgment and skill merit the gratitude of America's flying public."

From Distinguished Service Award presented by the Federal Aviation Administration to Capt. Jack McMahan, August 1977

By Capt. Jack McMahan (DAL)

On April 12, 1977, I was the captain of Delta Flight 1080 which experienced, on the San Diego to Los Angeles leg, a serious control problem in the pitch axis immediately after takeoff. At night, overwater and on instruments, it appeared to be almost certain disaster.

At departure time, the San Diego weather was reported as 800 feet overcast, visibility 5 miles, temperature 58°F, wind 260° at 8 knots. The L-1011's gross weight was 300,000 pounds with 42,000 pounds of fuel, 41 passengers and a crew of 11. The following takeoff data was applicable: V_1—123 knots; V_R—126 knots; V_2—138 knots; 3.5° stabilizer setting; 28% mean aerodynamic chord; 1.465 engine pressure ratio—alternate thrust.

The other flight crew members were First Officer Will Radford and Second Officer Steve Heidt.

During taxi out, Will performed a flight control check of the stabilizer, ailerons and spoilers while I made the rudder check. The proper control response was verified by the SPI (surface position indicator) and no abnormal control "feel" was experienced. The flight controls on the L-1011 are fully hydraulic using four separate and independent 3,000 PSI (pounds per square inch) hydraulic systems.

The visibility appeared to be deteriorating. I recall thinking that the San Diego and Los Angeles weather would probably be at or near minimums within a couple of hours as the entire coastline had a heavy stratus deck moving onshore.

The flight departed San Diego at 23:53 Pacific standard time, an overwater departure to the west on Runway 27. The clearance was a Scorpion Six departure to Los Angeles at an assigned altitude of 10,000 feet.

During the takeoff roll, quite a bit of aircraft vibration was experienced due to the roughness of Runway 27. I relaxed forward pressure on the control column and reduced the vibration somewhat. Acceleration was normal, but at V_R of 126 knots, the aircraft lifted off with little or no control input and a zero stick force. Immediately after liftoff an abrupt nose-high excursion in pitch was experienced that was controllable although I did hit the full forward limit of the control column during this abrupt pitch up. I quickly doublechecked the stabilizer setting. It was correctly set at 3.5° aircraft nose up. Climb attitude of 15° pitch was reestablished with air speed increasing, gear retracted and landing lights extinguished. The aircraft appeared to return to a normal takeoff flight profile.

Check and doublecheck

At an altitude of approximately 400 feet and an air speed of 168 to 170 knots, the pitch started to become excessive, exceeding 15° to 18°. I was exerting a light push force on the control column and trimming electrically by use of thumbwheel trim when the thumbwheel movement stopped. The pitch controls felt very sluggish and I immediately attempted to utilize the mechanical trimwheel which serves as a back-up system and overides the electric trim. There was no response with the mechanical trim. I found that the trim was already zeroed out with full nose-down stabilizer trim as indicated on the stabilizer trim indices and

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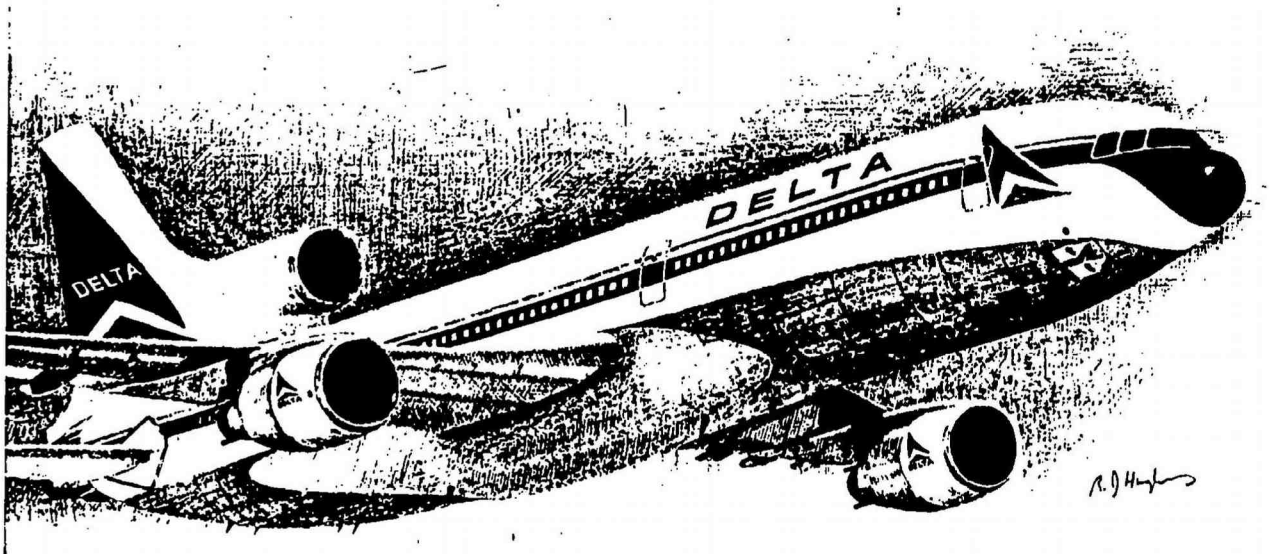

zero stabilizer indicated on the SPI instrument. I reset the electric trim switches with no effect; the thumbwheel trim remained immovable.

At this time we went on instruments at 800 feet MSL (mean sea level) and I started a right turn on course. I remarked to Will that I was having trim problems and asked Steve to check the hydraulic system. I was not overly concerned at this time as the L-1011 has a fine primary flight control system consisting of a flying stabilizer, four independent hydraulic systems, a well designed light legend to alert the pilot of a malfunction and plenty of redundancy in the system. I was confident that one of several possible procedures would correct our pitch problem.

I unlatched and reset all switches associated with trim—pitch trim, mach trim and pitch trim monitor—with no effect. Will conducted an area test of the switchlights to verify light integrity as there were no lights illuminated on the various panels. Steve double-checked hydraulics and checked for any opened circuit breakers. By 3,000 MSL, all emergency procedures for trim, pitch axis jam, flight control path jam and hydraulic malfunction were exhausted with no effect on controllability.

San Diego Departure Control was informed that we were experiencing a pitch problem and was asked to stay with us. Later we received a handoff to Coast Approach.

The first officer and I both were on the controls at this time and exerting full forward force on the control column. The aircraft continued to pitch up and air speed continued to decrease. I recall observing 3,000 feet-3,500 feet-4,500 feet on the altimeter. Pitch attitude exceeding 18°-20°-22°. Air speed decaying: 150-145-143-140. Then an air speed of slightly less than the V_2 speed of 138 knots. We were also experiencing a roll problem. In attempting to maintain a right bank, I hit the stops a couple of times in roll control.

Can't 'fly'

Suddenly, I had the horrifying realization that the loss of the aircraft was imminent. (Will and Steve later expressed the same opinion.) It appeared certain that the aircraft would enter a stall and, having no control over pitch to affect recovery, crash into the ocean.

It is remarkable how the mind functions during periods of extreme stress. Many thoughts race through your mind which can later be recalled with amazing clarity. When it became apparent that we were in deep trouble, my first thought was "I have always emphasized the mental discipline of 'fly the aircraft' and I can't even 'fly' this one."

Then, a very unusual experience occurred. I had a clear mental picture of exactly what the aircraft was going to do—stall, roll to the left and descend vertically disappearing into the clouds—at night—over water. The sensation was as if I was outside the aircraft observing it from some distance away. I remember thinking of the triumvirate theory: accidents occur in series of threes. There was the Canary Islands accident involving KLM and Pan Am, then the Southern DC-9 at New Hope, Ga. I thought we were about to become the third!

Finally, I recall thinking: "We are going to crash into the ocean and no

one will ever know what happened. Inevitably the conclusion will be *pilot error.* 'Pilot became disoriented while executing a night overwater takeoff and encountering instrument conditions.'" I have read this statement a number of times as the probable cause of an accident.

Suddenly I was jolted back to reality: "Wait just a minute—as many night over-water takeoffs and landings as I have made! We may lose this aircraft, but it won't be because we're not hanging in there and it won't be because of pilot error."

At this instant, I felt an intense compassion for my passengers and fellow crew members. Their lives, their safety, were my responsibility. Perhaps this selflessness is the catalyst that provides the inner strength or starts the adrenalin pump, permitting one to overcome impossible circumstances.

"Thrust is affecting pitch. Drag is affecting air speed. If I can reduce pitch, if I can regain air speed," I thought, "we might have a chance to recover some degree of controllability."

I abruptly reduced thrust on all three engines and recognized a modest change in control "feel." I then advanced No. 2 throttle full forward. Will called my attention to the No. 2 engine pressure ratio and I recall observing a 1.565 reading. Almost simultaneously, I had to increase thrust on engines 1 and 3 to prevent any further loss of air speed. I observed pitch correcting back through 20° to somewhere around 18° and the air speed slowly increasing above 140 knots. I had to further increase thrust on the No. 1 engine to compensate for a left roll tendency. I felt certain that we were about to recover from a most desperate situation.

As soon as possible, about 150 knots, the flaps were retracted from 10° (takeoff setting) to 4° and the air speed started to increase at a better rate. Performance data called for 198 knots (V_{REF} + 60) before going to the clean configuration.

Moonlight and momentary relief

Will and I both were still exerting full forward pressure on the control column and the pitch attitude remained at 18° to 20° nose high. Steve made a full scan of all the circuit breakers and switchlight panels in a futile attempt to determine the nature of the malfunction.

Radio contact with Coast Approach was established and they were informed that we were experiencing control problems. They acknowledged immediately with a proffer of assistance and we were cleared direct to Seal Beach VOR to maintain 10,000 feet. I recall methodically returning my VOR receiver to 115.7 MH as if we had no problems whatsoever, then resetting the heading select mode and realigning the VOR radial.

At an altitude of approximately 9,000 feet, we broke out of the overcast into the clear with quite a bit of moonlight—a very welcome change from the solid instrument conditions we had encountered. I had been having a difficult time just coping with the conditions, in addition to attempting to identify the problem and execute emergency procedures.

At about the same time as reaching on top of the clouds, the air speed had increased sufficiently and the remaining 4° flaps were retracted. With an indicated air speed of approximately 190 knots, still climbing sharply with no control over pitch, it became evident that the aircraft would climb right on through our assigned altitude of 10,000 feet. Coast Approach was advised and they responded with a block altitude of 10,000 feet to 12,000 feet. Climbing through 11,500 feet with no improvement in our ability to control pitch, it was apparent that we could not maintain 12,000 feet either. We informed Coast Approach and they very cooperatively replied, "We have you on radar and all altitudes are clear. We will stay with you."

The aircraft continued to climb steeply even though Will and I had the control column full forward, almost touching the instrument panel. My mind reeled: "We recovered from the worst condition when it appeared certain that the aircraft was going to stall around 5,000 feet, now the problem is we can't stop the climb and, if I don't do something rather quickly, this aircraft is going to climb to some unknown altitude, 25,000 or even 30,000 feet, then run out of air speed and controllability and descend as steeply as it went up."

Approaching an altitude of 14,000 feet, I had no alternative except to retard the thrust on Engines 1 and 3. The aircraft slowly responded with a slight pitch change and I attempted to descend back to 10,000 feet. I was unable to stop the descent rate at 10,000 feet, but with constant power adjustment I was able to regain control at 9,500 feet. Then we were back up to 10,400 feet, then below 10,000 feet again and finally fairly well stabilized at 10,000 feet.

The pitch attitude to maintain level flight was 12° to 14° with thrust equivalent to climb power due to the induced drag. The air speed stabilized at 195 to 197 knots. The throttles were severely staggered to maintain control over pitch and a roll tendency. No. 2 throttle was well in advance of No. 1 and No. 1 in advance of No. 3 throttle. The air speed had to be controlled below 200 knots or the aircraft would again start climbing. I was quite concerned about the extreme nose high attitude of 12° to 14° pitch and the amount of thrust required to maintain level flight. It appeared that we were working within a narrow air speed envelope—too fast and control over pitch and altitude was impossible, too slow and a stall would occur.

Again, all emergency procedures were doublechecked in a futile attempt to identify the nature of the problem. There were no known procedures relating to the malfunction we were experiencing.

The flight attendants were briefed on the situation at this time. We told them we had a control problem, but that it was now pretty well under control and they should not be overly concerned about the unusually high deck angle. In an attempt to improve the center of gravity, we asked them to move all the passengers forward and, as a precaution, to position them as near the emergency exits as possible. We assured them we would keep them fully informed of our progress and course of action.

Now the decision had to be made where to go from here. Our position was halfway between San Diego and Los Angeles. We had our hands full with a partially disabled aircraft, which we had to attempt to get safely on the ground, but where?

Low ceilings, poor visibility and a heavy overcast predominated the coastal region, virtually eliminating Los Angeles, Long Beach and El Toro airports. San Diego was out of the question—no way I was going back into those conditions. The weather was good on the eastern side of the mountains and my first choice was Palmdale Air Force Plant or Edwards

Air Force Base. However, it was now well after midnight and I knew that both of these facilities normally close down at 10 p.m. and that their control towers are not staffed during this period. It would take considerable time to alert the tower personnel, turn the runway lights on and have the emergency equipment standing by. Time, related to fuel, now became a critical factor.

Las Vegas and Phoenix were also considered as possible available airports, but fuel and the high minimum enroute altitude along these routes presented a major problem. Altitudes of 11,000 feet to 13,000 feet are necessary for terrain clearance in these areas, which would require us to climb. And there was a strong possibility of encountering turbulence enroute. With our limited control over the aircraft, any encounter with turbulence might easily cause us to lose control altogether.

The decision to proceed to Los Angeles, even though the weather was marginal (700 feet and 4 miles visibility) was made primarily due to our rather limited options. Most importantly, we were stabilized in smooth air and over water, with plenty of altitude to work with in the event we had further difficulties, and Los Angeles offered our best chance for a long, straight-in, stabilized approach to Runway 6R. It's an approach I was very familiar with—a strong plus factor.

We contacted Los Angeles Air Route Traffic Control, declared an emergency, explained our control problems and requested a 15 to 18-mile straight-in approach to 6R.

Prepare for the worst

The flight attendants were briefed on the landing plans and instructed to prepare for emergency evacuation of the passengers. A water ditching was a possibility and a land evacuation a probability. We told them to prepare for the worst and hope for the best. In a low-key manner an announcement was made to the passengers that, in accordance with company procedures, precautionary measures were being taken to insure their safety and that we would be landing in Los Angeles in a few minutes.

The next question was: "How do we land this aircraft? Obviously we have very little pitch control, we have a roll problem, none of the emergency or abnormal procedures have been effective. Why isn't the stabilizer more effective? The huge flying tail of the L-1011 has a tremendous amount of authority in pitch; the aircraft is trimmed full nose down—why no response? Do we have a spoiler problem causing the roll? Is the problem hydraulic?"

We had a confounding number of unanswered questions.

I thought a normal landing utilizing 33° flaps and an air speed pad of perhaps 10 to 12 knots would not be feasible for a number of reasons. I was afraid that on landing, with no control over pitch, when the aircraft entered ground effect I would not be able to force it on the runway and we might float all the way across the airport. Or worse, when we set up the landing flare the aircraft might pitch up to an altitude of 200 or 300 feet, stall and crash. And we would be helpless to prevent it.

Another consideration was the thrust/drag curve during the approach. If we got behind the power curve, would there be enough thrust to overcome drag and still be able to control the aircraft? My evaluation was that there was a strong possibility we might reach an altitude of 400 or 500 feet during the approach and lose control. This reasoning was also a major consideration in selecting the west to east approach to Runway 6R at Los Angeles. We elected to remain over water to avoid endangering lives and property on the ground. Although landing east to west on Runway 24 is a better approach, it is over residential areas. I had a mental picture of what a holocaust this could create. I thought to myself, if we lose it, we lose it over water.

I decided that we would try one step at a time, using incremental flaps, verifying pitch control with each increment and attempting to establish a configuration of 22° flaps and an air speed of 165 knots for the approach and landing. At 4° flaps the aircraft pitched down slightly and I was able to recover about one-half inch of control column movement from the full forward limit. At 10° flaps the additional pitch-down gave me another half inch of control response. The aircraft was stabilized at 180 knots, 10° flaps, 12° pitch, and one inch of control movement was available. Even though we were still severely limited, this felt like a major accomplishment.

I tried the autopilot to determine if it had some trim authority we might utilize. The aircraft pitched up immediately and the autopilot was disengaged.

While maintaining 180 knots air speed and the 10° flap configuration, we were able to maneuver the aircraft reasonably well and follow radar vectors to position for a 6R instrument approach.

Instrument conditions were again encountered at approximately 9,000 feet during descent. We continued to 5,000 feet and intercepted 6R runway instrument localizer and glide slope 15 miles from the runway threshold. The approach was made with 10° flaps and 180 knots indicated air speed with a sink rate of 800 feet to 900 feet per minute. The pitch attitude was 10° to 12° nose up, and I recall thinking that we might experience a tail strike at touchdown. Autoground spoilers were disarmed to prevent any additional pitch-up tendency on landing.

Steve informed the flight attendants that we would be on the ground shortly and to be prepared for a possible emergency evacuation on our signal. Steve also made a reassuring announcement to the passengers.

We had it made—almost

The instrument approach was initiated and going very well. I was able to maintain the target air speed of 180 knots and control the sink rate to remain on glide slope with the limited pitch control and varying thrust. The approach checklist was completed and for the first time since departing San Diego I felt we more or less "had it made." All we had to do was extend the landing gear, make a flap change to 22°, break out, establish visual contact with the runway and land the aircraft.

Then, at 2,500 feet, when the landing gear was extended, the aircraft again pitched up. I shoved the control column full forward but the aircraft continued to climb while the air speed deteriorated, and we were going above the glide slope.

My first thought was: "Since we can't control the aircraft with the gear down, retract the gear, turn to a south heading and ditch in the ocean parallel to the coastline."

I felt that it would be impossible to control a missed approach or a go-

around and that this was a "one shot" attempt. We were so close and yet so far; again in serious difficulty and on the verge of disaster.

Once more I increased thrust on No. 2 engine, reduced thrust on engines 1 and 3. The aircraft responded slowly and I was able to maneuver back down to reestablish glide slope tracking. The flying was a little rough in this area, a major power change was required to stop the climb and get a descent restarted and to attempt to capture glide slope. I left the landing gear extended, selected 18° flaps, and the air speed stabilized at 170 knots.

Upon reaching 700 feet, we broke out of the overcast and visual contact with the runway was established. We were aligned with the runway and had a sink rate of 800 to 900 feet per minute, which was going to be perfect for my touchdown reference point. I was not going to attempt a flare—just fly the aircraft to touchdown. I abandoned the thought of using 22° flaps. Things were going so well, I thought, "Don't change a thing—just get it on the ground!"

Touchdown was made at approximately 165 to 170 knots indicated air speed in the first 1,000 feet of Runway 6R. After main gear contact, the nose did not come down, and I could not force the nose over with the control column full forward. It was necessary to apply main-wheel braking in order to force the nose wheel down.

After 55 minutes of airborne time, we were on the ground.

I applied reverse thrust on engines 1 and 3 and reverse idle on No. 2, since heavy reverse thrust on the No. 2 engine tends to pitch the nose up. I'd had enough pitch-ups for one day.

No tail strikes. No blown tires. We exited the runway at taxiway No. 47 and taxied to the ramp.

The malfunction was determined to be the left elevator jammed in the "up" position. Presumably the left elevator aft drive quadrant (Bell crank) and drive cable failed during the flight control check prior to takeoff. There is no cockpit indication for this type of failure on the L-1011.

An equipment substitution was provided, and the crew and passengers continued Flight 1080 without further incident. □

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