



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

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Attachment 8 – Delta Air Lines – A319/320/321 Operating Experience Guide

OPERATIONAL FACTORS

DCA17LA145

Stabilized Approach

(Refer to FCTM chapter 5)

Avoiding unstable approaches is a continuing challenge for the fleet. The fact is; it is impossible to have 100% stable approaches. What we have to commit ourselves to as aircrew is to go-around when the approach is unstable.

Think of it this way. We've all gone around because of a controller's error in not providing enough spacing with traffic. It's not the end of the world, and in all likelihood we realize they are doing the best they can do to manage traffic. In the same way, if we end up unstable because of trying to save fuel, cooperate with ATC, or a mental lapse, it's not an admission of failure.

Some points to consider:

- We all want to operate efficiently and save fuel, however, delaying the gear and flaps inordinately on the approach when below 2,000 feet is not the time to do so.
- A go-around is required when either pilot calls for it.
- A configuration warning below 1,000 feet should result in an automatic go-around response.
- Mentally “chair fly” a go-around occasionally so that you'll be prepared when you do one. If in a tight situation where a stable approach is in question, verbalizing a go-around plan is a way to confirm expectations.
- The “High Energy Approach” guidance (FCTM Chapter 5) provides a methodology on how to manage a poor situation, **after** you've gotten yourself in one. Just as discretion is the better part of valor, early intervention to avoid a high-energy situation is a better plan.
- Don't allow ATC to trap you into an unstable approach. As much as we want to accommodate the flow of traffic, sometimes an “Unable 180 to the marker, we can give you 170” or “we'd like to intercept final a few miles outside of the FAF”, will yield a better outcome.

- With a light aircraft, gear down, Flaps 3, and a slight tailwind, it's not uncommon to see A/THR momentarily reduce to Flight Idle* during final approach. As long as all stable approach criteria are met, this is acceptable. Airbus describes this as follows:

The thrust is stabilized, usually above idle, to maintain the target approach speed along the desired final approach path.

*Flight Idle is 6-7% (N1) higher than "normal" idle and meets certification requirements for rapid engine response to TOGA when required.

- With the Airbus GS Mini function, if GS Mini has been commanding a higher speed during the approach, it will gradually decrease to V_{APP} below 500 feet. As the target speed reduces, thrust may momentarily decrease to approach idle (this is more noticeable when landing flaps 3 due to lower drag). As long as the aircraft meets all other stabilized criteria (i.e. on GS, V/S not excessive, and on the magenta target speed), this is normal behavior.

Note: For additional discussion of GS Mini, see fleet Topics of Interest (TOI) article 'Ground Speed Mini'.

- Unstable approaches have been cited in numerous landing accidents and runway overruns. Don't be a statistic!

ASAP: *"High close base turn to final for runway 22 at LGA. Though configured at 1000, was unable to meet stabilized approach criteria. Executed go-around. Second approach and landing were normal."*

Best Practice: To avoid an unstable approach adopt the following "best practices":

- Do not accept a final of less than 5 NM or inside the FAF.
- Avoid cross-cockpit approaches (e.g. FO circling left or captain circling right).
- Do not initiate descent until reaching a 3-1 glidepath.

Landing Clearance

ASAP reports have been received indicating landings have occurred without a landing clearance. Typically, the crew neglected to switch to the Tower frequency when on final approach (e.g. "Contact Tower at AJAAY"). KATL is our most common ASAP offender in this regard.

Best Practice: Most pilots use the NOSE light switch as a reminder. When the landing clearance is received, the switch is placed to 'T.O.' When the LANDING MEMO is checked at 1000', the NOSE light switch is also verified in the 'T.O.' position.

ASAP: “ATL approach control told first officer to switch to tower. First officer acknowledged. Captain then called for gear, flaps, and landing checklist. First officer configured and ran checklist without switching to tower. Because of congestion on the radio and traffic in the area including an aircraft on the runway, we got distracted and did not call tower or get a clearance to land. We realized the mistake after landing.”

Crosswind Landings

A good crosswind landing begins with a good approach. The pilot should align the center of the aircraft with the extended centerline of the runway, with the flight deck aligned slightly on the upwind side. If the runway has an ILS, simply keeping the FD crossbars centered ensures the aircraft is properly aligned and on the proper glideslope.

If hand flying and a roll oscillation develops, relax, take a deep breath, and loosen your grip on the sidestick. In all likelihood **you** are the cause, when left alone the aircraft will quickly settle down.

Technique: Manual thrust can provide a “smoother” approach and landing experience for passengers in gusty wind conditions. Why? The A/THR has a tendency to chase after small speed excursions, resulting in thrust fluctuations that can be heard in the cabin. Good manual piloting technique will adjust thrust to account for trends, while allowing some airspeed variation in gusts. This benefit should be weighed against the higher workload associated with manual thrust. Because of this, the pilot should practice manual thrust control in benign conditions prior to attempting it in strong, gusty crosswinds.

Note: Managed speed should still be used whenever possible, as GS Mini provides gust compensation.

Using manual thrust also prevents an unwanted A/THR “burst” of thrust in the landing flare, which can result in a float and possible drift downwind. This A/THR increase appears to occur in response to the higher drag associated with control displacement during the de-crab maneuver.

Crosswind Landing Flare

The objective of the landing flare is to safely land in the touchdown zone of the runway, on the centerline, and with minimal loads on the landing gear.

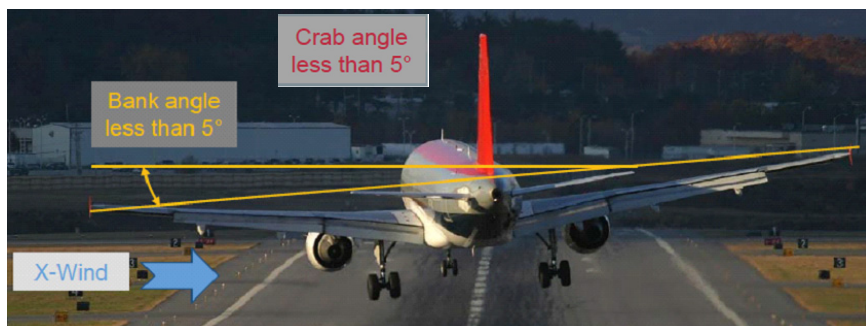
During the flare, rudder should be applied as required to align the aircraft with the runway heading. Any tendency to roll downwind should be counteracted by an appropriate momentary input on the sidestick. Many pilots refer to these lateral sidestick inputs as “bumps”, as the deflection is not usually held for any length of time. With a crosswind from the left, the rudder is applied to the right to align with the runway. As the nose swings to the right, the upwind wing moves forward and the downwind wing aft. This results in the upwind wing gaining lift and rising. A left sidestick lateral “bump” compensates for this tendency.

Q: How did Airbus design the landing flare/de-crab maneuver to be flown?

A: The way the airplane does it itself! When you observe how the airplane performs an autoland in a crosswind, you’ll see the proper technique. At slightly below 20 feet, the aircraft increases the pitch attitude by 1 to 2 degrees while simultaneously de-crabbing, using momentary roll inputs to keep the upwind wing from rising, and reducing thrust to idle. This provides a landing in the touchdown zone with little time for the aircraft to drift.

Crosswind Landing Techniques

The landing gear is designed for landing with some crab (recommended maximum 5°) and some wing down (recommended maximum 5°). In crosswinds exceeding 30 knots, landing with some crab and some wing down into the wind will be required (as shown below).



- If in moderate winds the de-crab maneuver does not fully align with the runway, accepting some crab at touchdown is preferable to attempting a last second alignment maneuver and possible PIO.
- Perform the de-crab maneuver simultaneously with the landing flare, not earlier. Ensure thrust is promptly reduced to idle to prevent floating.

CAUTION: The thrust levers must be at IDLE at touchdown to ensure spoiler deployment and prevent a bounce.

Crosswind Landing Rollout

Any lateral sidestick input should be neutralized after touchdown and reverse IDLE selected immediately to ensure spoiler deployment. Directional control is maintained via rudder input opposite the wind direction. Reverse above IDLE can blank the rudder somewhat, complicating directional control. Additionally, the reverse thrust vector produces a side force component if the aircraft weathervanes into the wind (Ref. FCTM 6.24). To regain directional control in this case, reverse IDLE may be selected and the brakes disengaged or released. However, pilots are cautioned that doing so increases the required stopping distance.

Crosswind Landing Rollout Techniques

- Use the A/BRKs to provide braking until a low speed (40-60 knots) is achieved. This allows the pilot to concentrate on direction control with the rudders and generally reduces veering on the runway.
- FO Landings: Captains allow the FO to control the aircraft until taxi speed, avoiding a high-speed transfer of controls with a large rudder input still applied.
- If conditions permit, IDLE reverse simplifies directional control in strong crosswinds. However, while brake temperatures are not typically a problem with strong winds, Airbus does not recommend IDLE reverse combined with a Flaps 3 landing when moderate braking is applied (through A/BRKs or manually).

Note: For additional information on crosswind takeoffs and landings, see fleet Topics of Interest (TOI) article ‘Crosswind Takeoffs and Landings’.

Flare Maneuver

During a normal approach at VAPP, the pitch attitude is approximately 3 degrees at Flaps FULL and 4 degrees for a Flaps 3 landing. Note: The A321 is about 1 degree lower due to the double slotted flap design.

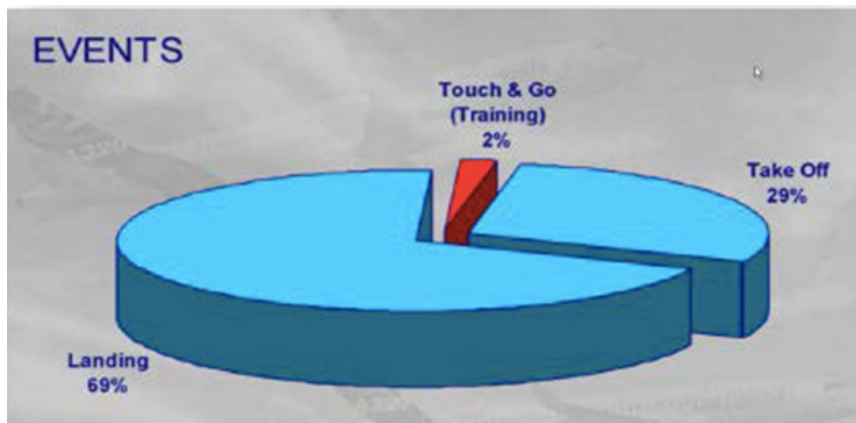
- When the “thirty” call out is heard, raise the pitch attitude slightly (approximately 2°) to slow the rate of descent. This should be done smoothly and slowly to prevent the aircraft from inadvertently leveling off or climbing.

- By the “retard” callout at 20 feet, smoothly and promptly bring the thrust levers to the IDLE detent.
Technique: The “retard” callout is not a command, but rather a reminder. The pilot should determine when to retard the thrust.
- The pilot is permitted to finesse the landing with a few more degrees of pitch up command but must not allow the aircraft speed to decay appreciably or pitch attitude from increasing above approximately 8° pitch up.
- An autoland is illustrative of a simple, but effective flare. The autoland system flares the aircraft approximately 2 degrees (e.g. 5° to 6° at touchdown). This ensures an acceptable landing within the normal touchdown zone.

Tailstrike Avoidance

Tailstrikes are twice as prevalent on landing as during takeoff. In most cases, the tailstrike has occurred 2-5 seconds following initial touchdown. Ground spoiler deployment results in a pitch up tendency. Tailstrike occurrences are more prevalent in the A321 as compared to the A319/320.





In the A320 family of aircraft most tailstrikes have occurred from one of two scenarios:

1. Following a bounce: Airbus indicates most tailstrikes have occurred in the subsequent touchdown following a bounce. The situation begins with the pilot perceiving a high sink rate prior to the initial touchdown. Due to this high sink rate, the pilot hesitates in retarding the thrust levers (TLs). With the TLs not in the idle range at touchdown, the spoilers don't deploy. This, combined with the high sink rate, results in a bounce. If the pilot then retards the TLs to IDLE, all the requirements are met for the spoilers to deploy and the aircraft sinks rapidly, striking tail first. Ways to prevent this:
 - Ensure the TLs are at IDLE at touchdown, as the spoilers will not deploy otherwise.
 - If the aircraft bounces, a pitch attitude of 5 to 6 degrees allows for an acceptable landing without too much float. Pilots should avoid an excessive flare following a bounce as a tailstrike may result. A go-around should be conducted following a high bounce.

2. The pilot attempts to prolong the flare by continuing to increase aft stick, or does not release aft stick pressure following touchdown, resulting in the aircraft exceeding its pitch limit. These pitch limits are shown at right, with the higher number indicating struts extended and the lower number indicating struts compressed. Additional notes:

A319	A320	A321
13.9°	11.7°	9.7°
15.5°	13.5°	11.2°

- The average touchdown pitch attitude is 7.6 degrees for an A319/320 as compared to 6.6 degrees for an A321 (double slotted flaps).
- The PM must make an awareness call when the pitch approaches 10°.
- A321s: A pitch limit indicator is displayed on the PFD below 400 feet AGL when the TLs are below the FLEX/MCT detent. Also, a “PITCH, PITCH” callout is annunciated when the pitch attitude approaches the limit and thrust is less than TOGA.
- Pilots are cautioned that sidestick summing may prevent the PM from overriding the PF’s sidestick input. Use of the takeover pushbutton may be necessary.

Touchdown

- At least IDLE REV should be selected immediately upon main gear touch down. This ensures spoiler deployment and activation of A/BRKs. MAX REV may be selected with main gear touchdown as there is no requirement to wait until the nose gear is on the ground.
- Neutralize the sidestick or push forward on the sidestick as required to achieve nosewheel touch down within 4-5 seconds of main gear touch down (1° per second de-rotation).
- Aerodynamic braking is not effective nor is it safe. Do not allow the aircraft to remain in a nose-up attitude in order to slow.
- Spoilers will deploy after wheel spin-up is sensed (as long as thrust levers are at idle) which provides a pitch up moment. The pilot must be prepared to immediately counteract the increase in pitch attitude. On rare occasions, aggressive forward stick forces may be required to prevent the nose from rotating upward depending on aircraft loading, braking, environmental factors, etc.

Landing Rollout

- It can take some time to develop a “feel” for the amount of pedal force required to disengage A/BRKs. This should be done symmetrically to avoid high brake temperatures on one side and “weaving” during rollout, which can be disconcerting to passengers. Initially allowing the A/BRKs to slow the aircraft to below 100 KT aides in a smooth transition.
- A common error is moving the thrust levers from MAX REV to forward thrust in one quick movement. When this occurs, the reverser doors stow prior to idle thrust being reached, resulting in high forward thrust being applied (Ref. FCTM chapter 6):

*Maintain reverse thrust as required, up to maximum, until 80 knots. At this point start reducing the reverse thrust so that the reverse thrust levers are moving down at a rate commensurate with the deceleration rate of the aircraft. The thrust levers should be positioned to **reverse idle by taxi speed, then to full down after the engines have decelerated to idle**. Reverse thrust is reduced to idle between 80 knots and taxi speed, unless required for adverse conditions, to prevent engine exhaust re-ingestion and to reduce the risk of FOD. It also helps the pilot maintain directional control in the event a reverser becomes inoperative. The use of high levels of reverse thrust at low airspeeds and/or the rapid forward movement of reverse thrust levers when deselecting reverse thrust may cause engine stalls (surges).*

- Don't assume braking action is uniform across the length of the runway. Often, when braking is compromised, it is worse at the departure end than the arrival. Plan your rollout accordingly!

High Altitude Landing

- Be careful of the use of brakes at high altitude airports when the ambient temperatures are high. Higher landing speeds, hot ambient conditions, aggressive use of brakes, and excessive use of brakes during long taxi-ins have resulted in melted fuse plugs.
- Techniques to avoid brake overtemps under these conditions:
 - Select 'LO' autobrakes.
 - Use REV MAX until 80 KT, then REV IDLE until taxi speed is reached to alleviate as much braking as possible.
 - Allow the autobrakes to work, avoid the temptation of jumping on the brakes to make an earlier turn off the runway.
 - Plan the taxi to minimize braking. If one side is cooler than the other, use the cooler side brakes when possible.