



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
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Attachment 6 – Delta Air Lines

A320 Topics of Consideration – A321 Differences

OPERATIONAL FACTORS

DCA17LA145

Takeoff Tailstrike Prevention

Per the FCTM, the pilot should use a "smooth continuous rotation at VR" to the target pitch attitude with a rotation rate from 2.5° - 3° per second. A more rapid rotation might be acceptable in a lightweight A319 at sea level in cold temperatures, but could result in a tailstrike with a heavy A321 at high altitude and high temperatures. Pilots should consider the aircraft type, weight, and ambient conditions and should tailor their rotation accordingly. They should also be cautious about not initiating the rotation prior to VR. The Airbus FCTM offers the following guidance:

Avoid aggressive and sharp inputs. If the established pitch rate is not satisfactory, the pilot must make smooth corrections on the stick. He must avoid rapid and large corrections, which cause sharp reaction in pitch from the aircraft.

Okay, it does lose something in translation, but there are some good points. Another possibility for a tailstrike is if the pilot decides to increase the rotation rate just after "unstick" (liftoff). The Airbus FCTM discusses this below:

If, to increase the rotation rate, a further and late aft sidestick input is made around the time of lift-off, the possibility of tailstrike increases significantly on A321. During rotation, the crew must not chase the FD pitch bar, since it does not give any pitch rate order, and might lead to overreaction.

Avoid an increase in aft sidestick input immediately after becoming airborne. Recall that during rotation the tail is actually moving downwards (i.e. closer to the runway surface) even as the flight deck rises well above it. Wait until well airborne to increase the pitch attitude, or just accept a slightly shallower pitch attitude and higher climb-out speed.

Landing Tailstrike Prevention

Airbus states that most tailstrikes occur within 2-5 seconds following initial landing touchdown, either due to spoiler deployment resulting in a pitch-up or following a landing bounce. This is again in line with previous Delta experience. Both of the last two A320 tailstrikes occurred following a bounced landing (both coincidentally also happened on runway 16L at DEN). The OE Guide offers the following discussion about tailstrikes on landing (Ref. OE.3.143):

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 limits for the aircraft with the upper wing struts extended and the lower number indicating struts compressed. Ad



A321 Considerations (Part 1)

- The average touchdown pitch attitude is 7.6 degrees for the A319/320 as compared to 6.6 degrees for the 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.



Aircraft	Tail Strike Pitch Attitude (x)	Typical Pitch Attitude at Touchdown (y)	Difference [i.e., available "slop"] (x - y)
A320	13.5°	7.6°	5.9°
A321	11.2°	6.6°	4.6°

The above chart depicts tail strike pitch attitudes for the A320 and A321. It also displays the typical landing attitude at touchdown. Note that the A321's landing pitch attitude is one degree lower than the A320's. This is due to the A321's double slotted flap system, which reduces the pitch attitude on final by about a degree. Other carriers that operate the A321 say a simple landing flare of around 2 degrees results in a smooth landing, well within the runway's touchdown zone. Comments by pilots of other carriers that fly the 321 indicate that many prefer landing it to the 320.

A321 Preflight Differences

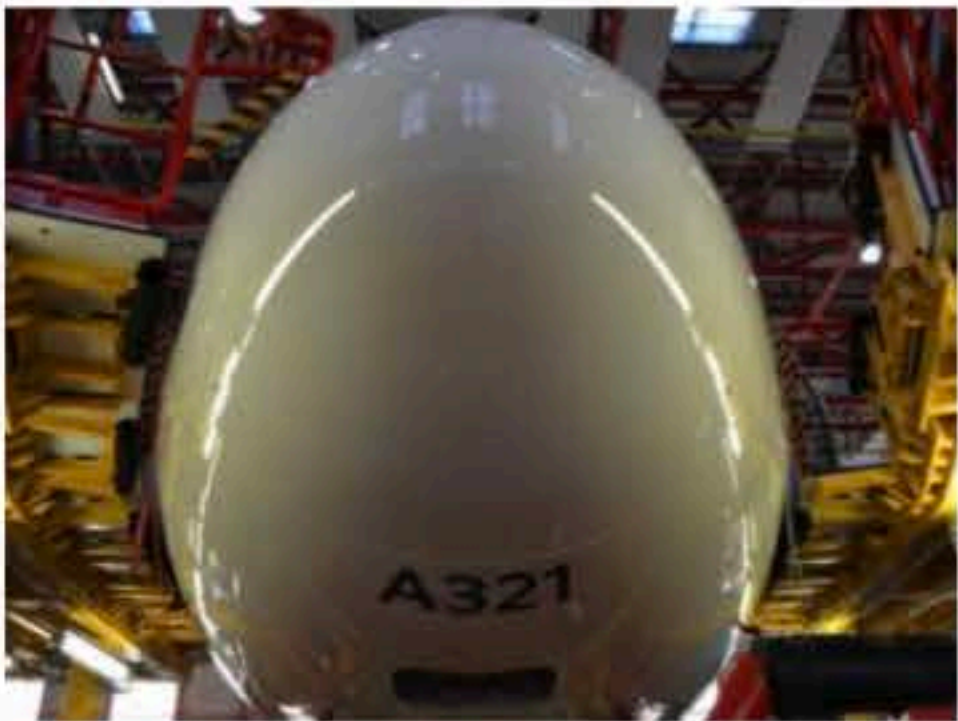
Let's switch to a bit of a lighter topic by discussing some of the things that look different on Delta's A321s. We'll go through these in the exterior preflight order.

Note: These pictures are of ship 3001 in final assembly at Hamburg and most were taken by Patrick Guerin, Airbus Training Manager. It's a very nice looking aircraft indeed!

Radome

Aside from the "A321" painted below it, the difference here is that the static diverter strips are now installed internally within the radome, and so are not visible during preflight.

Note: All of the exterior lights (not shown) are LEDs (including the landing lights) and are quite a bit brighter than incandescent lighting.



wheels are fully on the runway. Other landing considerations include:

- **Flaps 3 vs. FULL:** This has been a discussion item within the fleet and with other carriers. One other carrier in particular that has operated A321s for quite some time, strongly encourages pilots to use Flaps 3 for landing with the A321. Other carriers don't make a recommendation. In discussion with Airbus and in our own experiences with the aircraft, either flap setting works well for landing. Just like with the A319/320, the choice of landing flap setting should be based on the circumstances.
- **Crosswinds:** With the longer fuselage, a strong crosswind will align the nose further toward the upwind side of the runway. This isn't to the extent of a 757-300 or wide body aircraft, but it's more noticeable than with an A320 or A319. Use the FDs and ILS to ensure the center of the aircraft is aligned with the runway centerline prior to the "de-crab" maneuver. During the "de-crab", you may feel the sideways motion slightly more as the nose (where we sit) swings to align with the runway.
- **Stopping Capability:** The aircraft really slows well with MAX reverse. This is due in part to the higher engine thrust. Another interesting factor is that the LAF system deflects the ailerons fully up with spoiler deployment. These act as extra spoilers and increase drag and braking efficiency.
- **Landing Sight Picture:** During approach, the sight picture is nearly the same as for the A319/320. The A321's pitch attitude will be very slightly lower when initiating the flare maneuver. Sidestick landing inputs are exactly the same for both aircraft (i.e. amount of pitch change to flare).

Taxi-In

Okay, you've completed your first A321 flight and can now relax. Not so fast! The taxi-in phase is historically the most dangerous from an aircraft damage standpoint. This is especially a threat with a longer aircraft and larger wingspan. To taxi safely, A321 pilots must maintain continual awareness of the additional length, wingspan, and greater distance between nose and main gear.

Shut Down

All 8 slides must be disarmed following gate arrival, including those at the emergency exits. Again, expect a little more time for the FAs to disarm the doors as they each have two apiece.

Summary

So you've finished your first A321 flight- congratulations! In all likelihood your experience will be similar to other pilots who've flown the aircraft. It has some differences, but it's still an Airbus and flies just like one. That's a testament to the "fly-through-computer" control system and basic Airbus design philosophy.

Resources

- **Fleet Bulletins:** A321 Mid-Cabin Doors (16-07), A321 FCB (16-06), Flaps 2 Takeoff (16-05), Auto Callouts (16-03), and ACARS 602 (16-02) all include A321 related information.
- **Vol. 1:** The Differences section is the temporary equivalent of Vol. 2 systems information. Additionally, A321 material has been included in the LIM, NP, NOI, and SP sections of the manual.
- **FCTM, FOM, MEL, and OE Guide:** A321 specific material has been added to all of these manuals.
- **ODM and QRH:** A321 specific ODMs and QRHs have been published and are available on the aircraft.
- **A321 Differences:** The former QCQ module is available from the Deltanet Fleet Page.
- **A321 Preview:** This aircraft overview is also available on the Fleet Page.
- **Topics of Interest and Newsletter:** In addition to the three "A321 Considerations" Topics of Interest, the fleet Newsletter has (and will continue to) contain additional A321 information.
- **Fleet Instructors, Line Check Pilots, and Line Validation Pilots:** These folks are excellent resources and will be up to date with t

