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I LEARN SOMETHING NEW EVERY DAY. . . . IT MAY NOT HAVE BEEN ON MY AGENDA BUT READY OR NOT IT WAS THERE. For example this week I learned that a *rudder load limiter* may not keep you from overstressing your aircraft's tail nor keep you from busting your own (tail) ─ that flying below the *maneuvering speed* when you manhandled the flight controls was like *safe sex* (they are both "oxymorons") ─ that NTSB Accident Investigations don't always contain "all the facts".

For example . . . . **During a recent Airbus A300 records review we ran across two Airworthiness Directives (A/Ds) that were related to the loss of the vertical stabilizer, and other parts (both engines) on AMERICAN AIRLINES ─ FLIGHT 587 during departure from JFK Airport ─ 260 lives were lost. Returning home I decided to re-visit the accident and compare them to the NTSB Report.**

EXAMPLE 1 ─ A/D 99-16-14 was effective August 24, 1999; it stated ─ *The Direction Generale de l'Aviation Civile (DGAC), which is the airworthiness authority for France, recently notified the FAA that an unsafe condition may exist on all Airbus Model A300, A310, and A300-600 series airplanes. One operator of an Airbus Model A300-600 reported high rudder forces and uncommanded rudder inputs during final approach. The uncommanded rudder inputs caused deflections of the rudder control surface resulting in yawing of the airplane. Investigation of the incident is ongoing, but preliminary results indicate that failure of both the main valve and the clutch valve of the autopilot yaw actuator can lead to the actuator generating uncommanded rudder deflections. The DGAC advises that the same autopilot actuator is used for roll and pitch control during autopilot operation, and this failure scenario can result in uncommanded deflections of the aileron and elevator control surfaces.*

Preliminary results of the investigation of the incident airplane's autopilot yaw actuator indicate that the electrical connectors between the actuator's two main valves and the airplane's two flight control computers (FCC) were crossed between side 1 and side 2. This hidden failure in combination with a failure of the clutch valve resulted in the autopilot yaw actuator remaining engaged when the crew disconnected the autopilot, allowing the actuator to remain hydraulically pressurized and provide inputs to the rudder and the rudder pedals.

This condition, if not corrected, could result in uncommanded deflections of the ailerons, elevator, and/or rudder, which could result in reduced controllability of the airplane. **This was a one-time inspection BUT this A/D wasn't even referenced in THE NTSB REPORT.**

EXAMPLE 2 ─ The second A/D ─ 2002-06-09 issued after AA587's accident stated ─ *On November 12, 2001, an Airbus Model A300 B4-600R series airplane was involved in an accident shortly after takeoff from John F. Kennedy Airport, Jamaica, New York. During the accident event, the*

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vertical stabilizer and rudder departed the airplane. The cause of this accident is under investigation by the National Transportation Safety Board (NTSB), and, although the NTSB has not determined the cause of the accident, information to date indicates that the vertical stabilizer was subjected to large aerodynamic structural loading during the accident event.

A recent review of Airbus fleet data indicated that another Airbus Model A300-600 series airplane was involved in an upset event in ***1997***[1] *that may have subjected the airplane to lateral loads on the vertical stabilizer similar to those experienced on the airplane involved in the November 12, 2001, accident. The vertical stabilizer was recently removed from the airplane involved in the 1997 event, and the composite attachment lugs were subjected to ultrasonic nondestructive inspections (NDIs). The results of the NDI yielded indications consistent with composite delamination of the right-hand aft attachment lug. This type of delamination is characteristic of extreme lateral loading conditions.* **NOTE: The fin was scrapped.**

Following the event, the operator performed the inspections of the airplane specified in the Airplane Maintenance Manual (AMM) that are deemed necessary by the manufacturer after an in-flight incident.

However, the AMM did not include inspections for damage of the vertical stabilizer caused by extreme lateral loading. Extreme lateral load factors can occur as a consequence of severe turbulence, loss of control of the airplane involving yaw and/or roll maneuvers, hazardous system failures or other rare flight conditions. Review of service history indicates that these events only occur rarely. Such conditions, if not corrected, could result in reduced structural integrity of the airplane. . . . . Since an unsafe condition has been identified that is likely to exist or develop on other airplanes of the same type design, this AD is being issued to detect and correct reduced structural integrity of the airplane following an in-flight incident resulting in extreme lateral loading. This AD requires certain inspections of the airplane (including the vertical stabilizer, horizontal stabilizer, pylons, wing, and fuselage areas), immediately following such an incident.

This AD requires inspections for extreme lateral loads exceeding 0.3g. Because no such inspection methods were defined previously, these inspections must be approved by the Manager, International Branch, ANM-116, FAA, Transport Airplane Directorate.

This AD also requires reporting of these inspection results to the manufacturer, including information regarding the extreme lateral loading event. Based on this information, the manufacturer will develop any appropriate additional inspections. Upon FAA approval, these inspections are also required. (Note: I haven't found any Federal Aviation Regulation that refers to *Lateral Load Determinations* [as defined in this A/D] nor any reference to 0.3g for any restriction or limitation). Back to the *investigation!*

EXAMPLE 3 ─ The NTSB issued a Safety Recommendation based on the Flt 587 accident on February 8, 2002 which cites *14 CFR 25.351, titled "Yaw maneuver conditions" which requires that the airplane be designed for loads resulting from the following series of maneuvers in unaccelerated flight, beginning at zero yaw: (1) full rudder input resulting in a full rudder deflection (or as limited by the rudder limiter system): (2) holding this full deflection input throughout the resulting over-swing*[2] *and steady-state sideslip angles: and (3) while the airplane is at the steady-state sideslip angle, a release of the rudder input and return the rudder to neutral. The A300 was certified as having met this regulatory standard. In other words, the airplane must be designed to withstand the results of a full*

[1] American Airlines Flight 903. NOTE: There are 45 references to "flight 903" in the NTSB Report for flight 587. It is unfortunate that no one "learned anything from "903" . . . . "587" may not have crashed had the NTSB performed the in-depth review of flight "903"'s data **before** "587" crashed!

[2] *Over-swing refers to the maximum sideslip angle resulting from the airplane's momentum as it yaws in response to the rudder's movement; the over-swing sideslip angle will always be greater than the subsequent steady-state sideslip angle.*

rudder input in one direction followed by (after the airplane reaches equilibrium) a release of that rudder input.

It is noteworthy these certification requirements do not consider a return of the rudder to neutral from the over-swing sideslip, nor do they consider a full movement in one direction followed by a movement in the opposite direction. But that isn't what 14 CFR 25.351 sez! And, since the manner that the rudder was moved on Flt 587 appears to be the basis for the NTSB arguments (and their declaration of the *probable cause*) why were the words omitted? Did the pilot *wag the tail* or did the yaw damper *wag the tail?* The Flight Data Recorder should have indicated that the rudder petals were pressed but it could have been in response to the tail *wagging.* **NOTE: This entire event lasted 6.5 seconds – including three complete left-right rudder sequences.**

§ 25.351 Yaw maneuver conditions.
The airplane must be designed for loads resulting from the yaw maneuver conditions specified in paragraphs (a) through (d) of this section at speeds from V_{MC} to V_D. Unbalanced aerodynamic moments about the center of gravity must be reacted in a rational or conservative manner considering the airplane inertia forces. In computing the tail loads the yawing velocity may be assumed to be zero.
*(a) With the airplane in unaccelerated flight at zero yaw, it is assumed that the cockpit rudder control is **suddenly** (emp added) displaced to achieve the resulting rudder deflection, as limited by* (NOTE: This use of the word "suddenly" has been in the regulations since CAR 4b was published in 1953.)
(1) The control system on control surface stops; or
(2) A limit pilot force of 300 pounds from V_{MC} to V_A and 200 pounds from V_C/M_C to V_D/M_D, with a linear variation between V_A and V_C/M_C.
(b) With the cockpit rudder control deflected so as always to maintain the maximum rudder deflection available within the limitations specified in paragraph (a) of this section, it is assumed that the airplane yaws to the overswing sideslip angle.
(c) With the airplane yawed to the static equilibrium sideslip angle, it is assumed that the cockpit rudder control is held so as to achieve the maximum rudder deflection available within the limitations specified in paragraph (a) of this section.
*(d) With the airplane yawed to the static equilibrium sideslip angle of paragraph (c) of this section, it is assumed that the cockpit rudder control is **suddenly**[3] (emp added) returned to neutral.* NOTE: The words "suddenly" were in NTSB's final Report.

EXAMPLE 4 ─ One of the most "enlightening" statements (certainly enforcing the great understanding, knowledge and wisdom of some NTSB staff ─ *According to investigators, co-pilot Sten Molin tried to steady the aircraft using pedals that control the rudder, a large flap on a plane's tail. When his initial movement failed, Molin tried again and again. His actions placed enormous stress on the tail. Within seconds, the tail broke off and the plane crashed.*

The NTSB staff concluded that his use of the rudder was "unnecessary and aggressive." NTSB investigator David Ivie said the only time pilots should use the rudder is when they're landing or taking off in a crosswind, which was not the case for Flight 587. "The rest of the time, your feet should be on the floor," he said.

[3] This "suddenly" was added in 1997 it had stated *is allowed to return to neutral.* Let me tell you Charlie Brown ─ when you start to release the 200 to 300 pounds of foot pressure on the rudder pedal the result may not be a gentle motion.

The *yaw damper* on the A300-600 can move the rudder without the rudder petals moving. If the pilot sensed (by the seat of his pants moving on his seat cushion) that the airplane yawing was caused by the wake turbulence of a 747 that departed ahead of them and the *yaw damper* had failed, as it did when **its circuit breaker tripped less than a hour before ─ during the pre-departure flight controls check ─** it would be a natural reaction to alleviate it by applying rudder pressure.

In several transport aircraft accidents during the past 5 to 6 years the NTSB critized the crew because they had developed a habit of flying with their feet flat on the floor. We covered the "problem" in a March 1999 issue of the NEWSLETTER..

EPILOGUE

On 06 March 2005, Air Transat Flight 961, an Airbus 310-308, Canadian registration C-GPAT, serial number 597, lost the major part of its rudder while in flight from Varadero, Cuba, to Québec City, Canada. The flight returned to Varadero where an uneventful landing was carried out.

Factual Information

The A310-308, operated by Air Transat, was on a charter flight from Varadero, Cuba, to Québec City, Canada, with a crew of 9 and 261 passengers on board. While at an altitude of 35 000 feet, the flight crew heard a loud bang with simultaneous vibrations that lasted a few seconds. The aircraft entered a periodic rolling and yawing motion known as /dutch roll/ that decreased as the aircraft descended to a lower altitude. Once the aircraft reached about 19 000 feet, the flight crew had no indication of any abnormalities from systems monitoring. The flight crew considered landing at Fort Lauderdale, Florida, but elected to return to Varadero where an uneventful landing was carried out. It is only once on the ground that the flight crew noted during a visual inspection that a major part of the rudder was missing. There were no fatalities. One flight attendant sustained minor injuries.

The investigation team observed that only the lower rudder spar and the base rib of the rudder were remaining. Less than five per cent of the total rudder surface actually remained attached to the spar. The rudder is attached to the vertical fin through seven A-frame hinges, numbered one to seven, starting from the bottom. The remaining parts of the rudder were attached to the vertical fin's rear spar by the actuators and the four lower rudder hinges. Hinges five and six were were still in place on the fin spar, but only the attachment fittings of the rudder were attached to them. The rudder position sensor was still attached to the remaining piece of the rudder. Rudder hinge number seven was torn off from the fin spar[4].

QUIZ . . . . WHAT IS THE LARGEST 787 COMPONENT THAT WILL BE BUILT BY BOEING? If the report we saw is correct it will be the *vertical stabilizer!*

Jim Helms, President

[4] Source ─ Canadian Transportation Safety Board