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"The world is a dangerous place, not because of those who do evil, but because of those who look on and do nothing."

Albert Einstein

PROLOGUE

Boeing has been designing, certifying and manufacturing commercial jet transport aircraft since the mid-1950s, but you'd never know it by the current status of their latest product, the 787 Dreamliner. They appear to have forgotten how to comply with the various Federal Aviation Regulations, Advisory Circulars, and FAA Orders (info only). It has been 16 years (1992) since they began the Model 777 program and 13 years since it was certified (370 days after it was "rolled out"—see the August 2007 issue). They have been encouraging senior engineers and managers (and two most senior executives) to retire (they make too much money, their health care costs too much, ***or they misbehaved****). They have Californicated their management with folks transferred from the McDonnell Douglas (MCD) merger, and perhaps made some mistakes in applying Affirmative Action Programs (by placing inexperienced people in management positions). The former MCD guys haven't certified anything new, except some worn out DC-9 and DC-10 ideas dating back (thru FAA "grandfathered" approvals) to the 1960s. For one of the saddest stories of aircraft certification, followed by the deaths of 346 people when a DC-10 fell into a forest near Paris in March 1974, we encourage you to read* Destination Disaster *– I recently bought another copy from Amazon.com.*

Boeing has formed "alliances" with domestic and foreign partners, who have little or no experience in working with the FAA, to design and certify their work and build some complicated structural components -- with very little oversight. Sure, they can monitor the drawings these folks are working on via the Internet, but the workmanship and quality of production paperwork needs to be looked at once in a while.

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What you can't monitor is the differences in the culture (yes, there are cultural differences in the United States) of their partners (and the subcontractors they may have chosen).

It appears to some of our friends in Seattle that The Big Airplane Company is *"hell bent" on getting away from the labor unions in Seattle. It will be interesting to see what happens when the first labor contract (machinists) expires on September 3rd, followed shortly thereafter by the "white collar" union contract. The unions don't have much to lose because some management folks are still pushing to "get out of Washington State – we can't afford it".*

Add to the above problems the Seattle FAA's apparent lack of resources to monitor Boeing, and you have an "interesting situation"! The first 787 structural accident will keep the trial lawyers (and their children) busy for many billable years of work. These comments and opinions are based on conversations and correspondence with various non-Boeing friends in Seattle (and from two responses to the FAA's NPRM for the 787 Special Conditions. . . . one by a now retired -- 46 years at Boeing – engineer, and another engineer -- unrelated to the first commenter-- (he has almost 50 years experience working with "plastic airplanes"). Note: The 787 Special Conditions are an interesting story all by themselves will be covered in the next issue of the NEWSLETTER.

The "good news" from the July 24 Wall Street Journal . . . . ." McNerney said Boeing's game-changing 787 Dreamliner is on schedule for its first flight in the fourth quarter of this year, after experiencing production delays due to problems with suppliers. The first planes are set to be delivered to customers in 2009. The 787 is the first aircraft to be made mostly with lightweight composite materials, which are even stronger than Boeing had expected, McNerney said".

"Despite the challenges, the hydraulic system on the first 787 was tested this past weekend, and the control surfaces were moved, McNerney said. And Boeing's 787 partners are making progress, he added."

For the fastest way to review what the "media" has been reporting for the past twelve months, we encourage you to go to the "open" Air Transport World Internet site. Enter "Dreamliner" in their search box and you will get a list of (and access to) more than 90 articles. ENJOY!

TIME FLYS . . . . IT HAS BEEN A YEAR[1] SINCE THE ROLLOUT OF THE 787, BUT THINGS HAVEN'T GONE AS PROMISED! NO AIRPLANES HAVE BEEN DELIVERED, NO AIRPLANES HAVE BEEN CERTIFIED, NO AIPLANES HAVE BEEN FLOWN, FULL SCALE LOAD & FATIGUE TESTS HAVE NOT BEEN COMPLETED, TAXI TESTS HAVE NOT BEEN ACCOMPLISHED, MANY SYSTEMS TESTS HAVE NOT BEEN ACCOMPLISHED, NOR HAVE THE ENGINES BEEN INSTALLED AND RUN (we haven't even mentioned the rumored increased empty weight). The schedule to do all those tasks, like the access to the airplane itself, is well guarded.

INFORMATION . . . . Never before has there been an aircraft certification program like this. . . We receive, – 24/7-- e-mail articles re Boeing, from the Seattle PI and the Seattle Times, FAA related articles from the Wall Street Journal (an excellent source for aviation news), The Financial Times (of London) and don't let me overlook reports from two Texas newspapers that monitor in-service and FAA Problems at Southwest and American.

I learned from one report earlier this week, for example, that before No. 1 (787) can fly, No. 2 must be completed for ground certification tests that are a prerequisite for first flight (of No. 1). The brake-monitoring system (software) doesn't have complete development documentation that's needed to be certified. From these two problems, allow me to move to along to several related concerns.

DOCUMENTATION . . . . The biggest "pain-in-the-rear end" for innovative aircraft designers I have worked with, such as Ed Swearingen and Bill Lear (who worked together on the LearStar program 50 years ago in Santa Monica), has been FAA required documentation. But don't let me get ahead of myself . . . . The first step in the Certification process is to contact the FAA's Certification Service guys and tell them what you are planning to do. They will establish the ground rules, including the Documentation they expect to receive from you. They will also discuss the names of the Designated Engineering (DERs) and Airworthiness (DARs) Representatives you are planning on using. NOTE: Boeing had established the 727-100 series configuration before the FAA review. At "the meeting" the FEDs asked about *the exit(s) located as far aft in the passenger area as practicable in the side of the fuselage at floor level?* The applicant responded . . . . *"We have a large mid-cabin galley door and the tail cone airstair"*. Not enuf' responded the FEDs. The compromise, an alternative means of compliance to Part 4b.462(b)(1), was the installation of escape ropes at the two overwing escape hatches and a 119 passenger limit. (A "basher kit" — hydraulic rams to push the airstair down, thus creating a crawl-thru escape space — allowed the passenger capacity to be increased to 129 and the installation of the 727-200 aft cabin service doors on the -100s allowed up to 149 passengers (but no room for their legs.)

Another noteworthy "goof" was the fabrication of 25 sets of new underwing wing mounted aux tanks for the 731-Jetstar that didn't meet the requirement to *"withstand, without failure . . . . . structural loads that it may be subject to in operation"* (like performing a main landing gear up landing) – no problem, scrap the tanks and start over!

The product (aircraft, engine or propeller) design must comply with the appropriate DESIGN STANDARDS. For example, you go thru Part 25 for a Transport Category Aircraft and at each Section answer the question – "do I have to comply with this?" in order to determine the standards you have to meet. (Your "checklist" forms the basis for your Compliance Document.)

[1] **The time from roll out to first flight and subsequent Certification of the 777 was 370 days.**

You design each part to meet the Standards, but before you make it, you have an FAA Designated Person (DER) review your list, drawings and data and concur with you, then certify that the design meets the Standards; i.e., performs the required function, has the required load carrying ability, is damage tolerant, conforms to flammability requirements and all of the several hundred other Sections.

Then you build (or have the lowest bidder do it) the part and have another Designated Person (DAR-MANUFACTURING) compare EACH PART and the Material Certification to the Approved Drawing – this is called Conformity. Each conformity must be recorded and the record of conformity sent with the part to the installer. (We have said for many years, that when the weight of the required documents – including the Material Certification from the person who produced the material that the material conforms to the drawings -- the aircraft is ready to be released for ground tests. Normally no official ground tests can be performed until all of the units to be tested are Approved and the SYSTEM has been CONFORMED.

You don't fly it until your FAA required ground tests and any ADDITIONAL tests specified by the FAA, are performed and witnessed by the FAA Designated Person or the FAA itself. The FAA will tell you what flight tests their pilot will perform and which ones can be performed by a Flight Test DER

WHY ARE WE CONCERNED? Well, on or about the day after the 787 roll out the GICs (guys in charge) started admitting that some parts weren't installed by the sub-contractors before the various sections were airlifted to Everett, and “by the way, temporary fasteners were installed in certain holes (we don't have the documentation that tells you which holes -- maybe the temporary fastener heads were painted RED and now they are painted either white or blue) they are installed in. In fact we don't have conformity “tags” (FAA FORM 8130-3) for all the parts and we aren't certain we have all the Statements of Compliance (FAA Form 8100-9) either!” NOTE: An airplane or an “outhouse” without paperwork is sorta', well you know, hard to close-up.

Federal Aviation Regulations allow for subcontracting of design and manufacturing, but the Applicant for FAA (certification) Approval has to maintain oversight, and in all cases actually perform the required inspections. The manufacturer, in this case, has been accused of “roller stamping” – not actually looking at the parts – at even Seattle locations – and who knows what has been inspected overseas!

In reviewing “history” for the next topic – *load and fatigue testing* – I came across the following . . . . *The engineers and designers -- who, at the time, had no computers and calculators -- were facing totally new problems in relation with concepts, materials and production methods. Nearly all components of the new aircraft were designed in the De Havilland offices. Those were the engines, the landing gear, the seats and many other smaller components.* Our industry has come a long way, but are we ready for risk *sharing* without *OVERSIGHT?*

Number two on our concern list is the pressure testing of the fuselage. Air Transport World's Friday, February 29, 2008 issue had an interesting “squib” re Boeing 'successfully' completes testing on 787 composite fuselage.

The trials were performed on a 787 test section and are part of the manufacturer's certification efforts for the Dreamliner, which have been delayed owing to problems assembling the first aircraft. "The tests . . . couldn't have gone any better," Kevin Davis, 787 fuselage authorized representative and leader of the testing, said. We noted reference to two tests performed on 737NG fuselage sections in 1999/2000 – one was on an inverted aft cargo compartment area section where they appear to have been testing to

determine the fuselage load carrying ability of the area under the aux fuel tanks on BBJs (see 14 CFR 25.963 (d). *Fuel tanks within the fuselage contour must be able to resist rupture and to retain fuel, under the inertia forces prescribed for the emergency landing conditions in § 25.561.* In addition, these tanks must be in a protected position so that exposure of the tanks to scraping action with the ground is unlikely). The 787 composite fuselage load tests had to be compared to an aluminum fuselage test, and the 1999 data was all they had. (We will cover the 787 Special Conditions in the next issue of the NEWSLETTER.)

Boeing said engineers first took the barrel to "limit load, a test condition that simulates the most extreme conditions expected to be experienced in the life of the airplane." That was followed by tests at 150% of limit load, "a condition called 'ultimate load' [and] the level required for certification," the company said. Finally, the composite section was pushed "well beyond ultimate load to a destruct-condition maneuver beyond two-and-a-half-times the force of gravity."

Engineers now are performing an extensive inspection of the barrel and analysis of test results. The manufacturer said that while some testing on the composite barrel section will continue, "it is at Boeing's option for additional learning" and is not required. "Additional static testing is required and will be conducted on a full airplane structure prior to first flight," it said.

Let's travel in time back to 1952 . . . . The concept of full scale fatigue testing was not popular when de Havilland tested the Comet airliner fuselage. Fuselage segments were tested. (See items noted paragraphs 118 to 122 from the UK accident report for G-ALYP, included in the Addendum to this issue.)

The Comet fuselage "mandated *SAFE LIFE"*, based on tests of more than 18,000 cycles, was 10,000 flight hours. The *ACTUAL LIFE* of ship number 3 - G-ALYP, the first aircraft to enter passenger service, was **1,290 flights**, and ship number 8, G-ALYV, was **900 flights**. Both aircraft fell into the sea off Italy when they suffered explosive decompressions. You can *google* "G-ALYP" for the complete accident report and a *link* to the accident report for "G-ALYU". The FAA's Special Conditions for the 787 "left the type of tests to be performed *up to the applicant"*. The Applicant has spoken – they are satisfied with the *sections testing.* We will discuss this further in the next issue of the NEWSLETTER.

Comet Ship number 14, CF-CUN, on a delivery flight to Canadian Pacific Airlines, crashed along the way . . . . it stalled on takeoff (like the B-2 bomber on Guam earlier this year). . . . which brings us to another of our concerns . . . FIRE – SMOKE – TOXICITY.

THERE WERE TWO COMMENTERS TO THE 787 SPECIAL CONDITIONS NPRM . . . . one of them, an experienced composite aircraft materials engineer, expressed serious concern about burning composite materials and suggested full scale fuselage fire tests. The FEDs responded that the new cargo compartment liner requirements should provide all of the protection needed?

The USAF determined in their tests years ago that composites not only burn, but they *smolder like burning boxwood.* **The *unintended fire testing* on the B-2 bomber that crashed on takeoff on Guam in February proved them right . . . . *Six hours, 83,000 gallons of water and 2,500 gallons of foam later the $1.2 billion aircraft sat smoldering, but no longer on fire.***

The bomber crashed because of moisture in either the pitot or static port line. The airdata system signaled nose up and the nose went up . . . . until the aircraft stalled. Complex FAA aircraft systems are required by 14CFR 25.1309 to *be designed to insure that they perform their intended function under any*

foreseeable operating condition. Said another way, the aircraft systems are required to be like the aircraft structure -- "fail safe". NOTE: The Aerospace Recommended Practices that the designers use for insuring this happens are SAE ARP 4754 (88 pages) and ARP 4761(331 pages). The 787 folks are working their way thru the certification of *software related to the wheel brake system* -- "the brakes work but the vendor hasn't obtained the required FAA approval". We wonder how many of the required approvals for other parts or systems will show up *missing?*

SPEAKING OF INOVATIONS . . . . . The Dreamliner folks like to talk about their use of electricity vs. hydraulics for the landing gears and wing flaps. Every Boeing transport and bomber (307, 377 -- B-17, B-29, B-50, C/KC-97) built from the late 1930s to the early 1950s used electric motors for the landing gear and flaps. All of the airplanes listed here, except the B-17s, had electric heaters, and the 377 and some 707/720s had freon air-conditioning systems with electric motors to drive the freon compressors and re-circulating air. The pressurized air for the cabins (except the B-17) came from the engines, but we understand the 787 will have *electric aircompressors.*

The Dreamliner folks tell us about the fuel saved by using electricity, but pray tell Charlie Brown, where does the electricity come from (it takes power from the engines to drive generators). If they lose an engine half-way to no-where can the remaining generators carry the load? Oh, perhaps the real reason for using electrics on the gear and flaps? Many composite materials aren't compatible with today's hydraulic fluids (Skydrol). They tend to degrade the composites!

ANOTHER INNOVATION* IS *THE SMOOTHER RIDE IN TURBULANCE . . . . This sounds like *active ailerons,* a feature developed by Lockheed for the original *U-2* in the late 1950s and incorporated in the L-1011-500 tri-jet airliner and on the Lockheed C-5 military transport[2]. Turbulence Sensors installed in the aircraft command both outboard ailerons to lower, to reduce wing loading and thus a "smoother ride" (a by-product is that you can use lighter wing structure). The footnote pertains to the design of the C-5A aircraft, but it could apply to at least one large aircraft program. (NOTE: Airbus uses Active Ailerons on several of its aircraft.)

BACK TO CULTURE IN SEATTLE . . . . A large computer software company in the Seattle area is often accused of using the "innovations of others" in their products (some purchased and some not). It appears the airplane company is doing the same (with, as example, B-2 bomber composites and the aileron control systems).

Jim Helms, President

[2] According to the C5-A website. . . . "The wing, which was designed by a hastily organized group of unemployed engineers from the various cancelled British programmes. . . ."

ADDENDUM

The following items (paragraph numbers) are from the Accident Report for Comet “YP”.

118. During the design of the Comet de Havillands did not make use of calculations in an attempt to arrive at a close estimate of the stress distribution near the corners of the cabin windows. We have examined such of their calculations, as had a bearing on this question; these led to the stress of 28,000-lb./sq. in. mentioned by Mr. Harper. It is clear that this stress refers to an area of the skin in the neighborhood of the corners, and may fairly be said to be an average value over a width of 2 or 3 inches. de Havillands believed that their method was satisfactory for the purpose they had in mind, namely, the design of a test specimen. They did not consider that a closer estimate of the highest value of the stress could be made by any method which they would regard as reliable. They preferred to rely on tests of specimens designed on the basis of their calculations.

119. Since their estimate of the general level of stress in the region investigated was less than half the ultimate strength of the material (about 65,000 lb/sq. in.) they were confident that they could demonstrate by static test that there would be no failure at twice the working pressure, and that there would be a considerable reserve in hand. Their tests of panels about 3 ft. square, including, a window, substantiated this view.

120. We note, however, that in these tests the panel was supported on the face of a stiff steel "pressure box", and not in conditions truly representative of those which existed near the window in the pressure cabin itself. It is not possible to say what the effect of this would be. de Havillands were reassured by the results of the tests, in which the specimen withstood nearly 20 lb./sq. in. without failure.

121. de Havillands used the same approach to the design of the whole pressure cabin. The static tests which they made on the two parts of the pressure cabin, respectively 26 and 24 ft. long, gave them confidence in the integrity of the whole cabin. Since they believed, with general support from then current practice and opinion, including that of A.R.B., that this basis of design and static tests would give ample assurance against risk of failure under repeated applications of the working pressure, and other known causes of fatigue, they felt that the cabin was good for the life of the aircraft (say 10,000 pressurized flights, or 10 years).

122. Here again, however, we note that the test sections of the cabin differed from the cabin as fitted to the aircraft in several respects. In the first place, each was incomplete, and incapable of sustaining pressure if it had not been fitted with a stiff bulkhead at the open end or ends. It is not possible to say whether the constraint which these bulkheads imposed on the structure would make it stronger or weaker than when it formed part of a complete cabin. But it must be recognized that the stresses in the structure near the bulkheads would be appreciably affected by the constraint, and the reliability of deductions about the strength of the cabin would thereby be reduced. Secondly neither section was fitted with the complete number of windows, etc. Moreover, the windows of special interest in this Inquiry, which were in the front test section, were rather near the bulkhead mentioned, so that the stresses in the skin round them might have been appreciably different from those in similar places in the complete cabin.