NEWSLETTER

GENTLEMEN . . . . START YOUR ENGINES, LET THE FLYING BEGIN!

The first ALL PLASTIC TRANSPORT AIRPLANE flew on December 15th, 939 days after the rollout ceremony on "7-8-7" (the average "days to first flight" for all Boeing Jet Transports has been 61 days). The 787 flight test program is to use six aircraft flying approximately 3,000 hours and ending with Aircraft Certification in the fourth quarter of this year or 1,304 days since "rollout" (the average "days from rollout to FAA Certification" for all Boeing Jet transports has been 349 days). The planned flight test activities would average approximately 8 hours per day. Only two aircraft have flown so far. . . a *slow starting* effort. What has Boeing been doing during these 1,304 days?

If you've read the COMMENTS posted on the Seattle Times *Boeing Digest* web site you'll note a misunderstanding of the role of *flight testing . . . It isn't like the Catholic Sacrament of Penance (Confession) . . . doesn't cure sins or guarantee Airworthiness. To the contrary it can result in the death of the crew and unfortunate folks on the ground that are hit by falling parts. Unfortunately the loss of the aircraft may not occur for a year or two after certification. [I TOOK THIS PHOTO ON BAHRAIN IN 1952]* Note: The first Comet crashed on 2 May 1953 after being in passenger service for approximately one year!

TYPES OF FLIGHT TESTS. There are three basic types of flight tests . . . The Initial Flight that you read about or saw on television. The aircraft had an Experimental Flight Certificate issued in accordance with 14 CFR § 21.191 and very limited "operations specifications" (training wheels).

For example, you take off, head for the Pacific Ocean, and climb to about 15,000' – keep the airspeed less than the Limit . . . perhaps 300 knots – maybe you will retract the landing gear. I don't know what they had planned for the flight, but I'd practice the approach I'd use in my visual landing at Boeing Field, like a few 90 degree turns, slowing to the final approach speed, simulate a go-around and *tease a stall* (come close) but save something for the *wedding night* (the formal initial stall test series on the second or third flight). By the time you land you will have evaluated the handling . . . *was it like the simulator* . . . and validated the operation of the primary aircraft systems. NOTE: The first flight was an hour less than scheduled - perhaps limited by the weather.

The second phase is company Testing. It too is controlled by FAA prepared Special Conditions or Operating Limitations. It will still have an Experimental Airworthiness Certificate which was issued under § 21.191 (a) -- Research and development, testing new aircraft design concepts, new aircraft equipment, new aircraft installations, new aircraft operating techniques, or new uses for aircraft.

The third type of flight tests are conducted under § 21.191 (b) . . . . flight tests and other operations to show compliance with the airworthiness regulations including flights to show compliance for issuance of type and supplemental type certificates, flights to substantiate major design changes, and flights to show compliance with the function and reliability requirements of the regulations (this includes those required to obtain data for the Airplane Flight Manual). The FAA reserves the right to fly the aircraft during these tests. (FAA protocol will be spelled out during the Type Inspection Authorization (TIA)).

This has been a greatly simplified discussion of Flight Testing. If one of our readers, Mark Goodrich, a forty year plus veteran of FAA and EAA flight tests of most of the active transport aircraft for manufacturers and STC applicants, responds, as he often does, I'll pass on his comments in the next NEWSLETTER. (Keep on eye on the attendee's NAME badges at the SMU AVIATION LAW SYMPOSIUM in Dallas in a few weeks. He will be the tall good looking guy with the full forehead holding court in the meeting area lobby. If you know and see John Eakins, the accident data guru guy from San Antonio, Mark will be nearby.)

The extended time from Rollout to The First Flight has kept the *rumor and fact verification* *gadflys* working overtime! Weekly *787 activity reports* published by the two major Seattle newspapers and perpetuated by some various reputable writers in their *blogs* has given *787 watchers* -- *GADFLYS* -- a lot to think about. Our feeling, or "polemic", is very similar to that expressed in December postings on the *Lonely Scientist* web page. You can "click on the page" or merely continue reading it here. I will provide the answers, based on the current Federal Aviation Regulations, to many of the questions at the end of the following comments.

"Boeing Dreamliner 787 validated for test flight – based on what?

Posted by Hans van der Zanden - 14 December 2009.

When lessons learned from history may provide any guideline there is something serious to worry about validation of Boeing's new all composite aircraft.

December 10th 2009, Boeing reported that *"the program has validated the airplane structure for the 787 Dreamliner"*, and announced that, subject to weather conditions, Dreamliner one is expected to make its first flight within a week or so. First flight will take place very careful, with sunny conditions and limited wind, and no problems are expected. For the moment the whole first flight exercise is to appease reporters and investors. Once the window is extended conditions get more severe and serious problems will undoubtedly surface, and one can only hope and pray that nobody gets killed. Not since the Comet has a civil aircraft been so badly prepared for flight testing.

Difficult to depict on what grounds the structure of the aircraft has been validated. As was argued in the previous post, the aircraft is without reliable model. All main structural tests performed so far – wing box, blow test and wing bending test – failed by wide margin from the modeled predictions. Each time the structure required comprehensive strengthening, provisionally applied, and only the wing box sustained ultimate load. The blow test has not even been repeated, nor has properly strengthening been performed leaving the planes with thousands of wrongly place fasteners. Remember that it took only a wrongly chosen O-ring to destroy the Challenger. The repeated wing bending test has been performed to limit load only, that is two third of the load required for specification. Validation cannot be described otherwise than based on wishful modeling.

Another aspect that has to be considered is that the test flight aircraft differ in significant way from the ground structures that have been tested so far, and are dissimilar. Each of these aircraft present a differing structure, that is with multiple specific modifications, redesigns and repairs, when Boeing and its partners slowly learned to deal with composites – the extend of which deviations is not clearly known to Boeing. It would be interesting just to learn about the weight of each basic structure and the numbers and types of fasteners applied in each of the flight test aircraft. This means that these aircraft will behave differently, for the better or the worse, leaving the models ineffective.

Remember that structural problems with the Comet surfaced once the planes were in service, as was also the case with for example the F111. So many were killed, so many tragic accidents could have been easily avoided given ample time for reasoning and development. The question is, why were they killed.

Management and engineers at Boeing – and for that part the FAA – are under immense pressure to deliver what is physically virtually impossible. Stakes have probably never been so high in corporate history. One can doubt the design rationale, that is argumentation and justification leading to the decision to validate the structure – sound reasoning cast in shadow by commercial interests. This went terribly wrong with the Comet, and played also havoc with the accident of the Columbia and when the Space shuttle Columbia was still in orbit. In hindsight, the causes that led to these accidents are similar, too much pressure leading to ignorance. All involved now at Boeing are undoubtedly well aware that with these past accidents nobody was convicted for such behavior, too much at stake. This may be poor comfort for those facing the rising sun, let the lessons learned therefore serve at least to avoid future ignorance.

Boeing is presently at crossroads to decide whether to proceed with their all composite adventure, now the advantage of lightweight has diminished . Be aware that it will take years and much more resources to develop a reliable and safe all composite aircraft – probably another thousand days to come if ever – so much unfinished business and issues that have not been properly approached and researched. Ignorance will inevitably lead to a repeat of the Comet.

Ignorance that led to the accidents with the Comet, Concorde and Columbia is further detailed in separate chapters that can be downloaded at this site"

You will find this comment on his web page . . .

"AIRWORTHY IS BASED ON A DESIGN THAT MEETS THE APPLICABLE AIRWORTHINESS STANDARD – IN THIS CASE, THE 787, THE STANDARD IS 14 CFR PART 25.
ONCE THE DESIGN IS APPROVED BY AN FAA DESIGNATED ENGINEERING REPRESENTATIVE (DER) AND THE DRAWINGS AND SUPPORTING REPORTS ARE COMPLETE PARTS CAN BE PRODUCED. EACH PART PRODUCED HAS TO BE INSPECTED BY ANOTHER FAA DESIGNATED PERSON – A DESIGNATED AIRWORTHINESS REPRESENTATIVE (DAR) TO VERIFY THE PART CONFORMS TO THE APPROVED DRAWINGS. THEN, AND ONLY THEN, SHOULD THE PARTS BE ASSEMBLED AND THE FULL SCALE GROUND AND FLIGHT TEST BEGIN.
CHANGES TO PARTS DURING THE ASSEMBLY AND TEST PROCESS MUST BE DER APPROVED, THE DRAWINGS REVISED AND THE MODIFIED PART MUST BE INSPECTED TO VERIFY CONFORMITY TO THE DRAWING OF THE PART BY A DAR BEFORE IT IS INSTALLED. TIME CONSUMING, YES. THE PROCESS IS DIFFICULT WHEN ALL OF THE PARTS UNDER CONTROL OF THE "ASSEMBLER". DOING IT ON A GLOBAL BASIS MORE DIFFICULT. BASED ON PUBLISHED PROBLEMS I DOUBT THAT THE PROCESS DESCRIBED ABOVE HAS BEEN FOLLOWED TO THE "LETTER OF THE LAW". FURTHER, I CAN'T UNDERSTAND HOW YOU CAN BYPASS LOAD AND FATIGUE TESTING AND STILL DESCRIBE THE PARTS AS "CONFORMING TO TYPE DESIGN AND IN CONDITION FOR SAFE OPERATION" – THE DEFINITION OF "AIRWORTHY".
MY COMMENT IS BASED ON MORE THAN FIFTY YEARS OF EXPERIENCE WITH LARGE AIRCRAFT – INCLUDING 25 YEARS AS A DAR.
JIM HELMS
1-650-212-2916"

I HAVE READ PUBLICATIONS THAT INCLUDE THE ABOVE ALLEGATIONS AND I AGREE WITH THE *LONELY SCIENTIST*. WHAT WOULD I RECOMMEND?

ABANDON THE COMPOSITE WING (As Mitsubishi, the co-designer and fabricator of the 787 wing has on its proposed "regional jet") AND FABRICATE A METALLIC WING.

THE REGULATIONS AS THEY PERTAIN TO THE LONELY SCIENTIST'S QUESTIONS. (I have made **bold or <u>underlined</u> text for emphasis. Significant sections are included in total)**

Civil Aircraft are FAA certified in accordance with Part 21 – Certification Procedures for Products and Parts.

The objective of the Boeing 787 team is to receive a Standard Airworthiness Certificate the transport category. . . . . Part 25. It will be issued in accordance with § 21.183 -- Issue of standard airworthiness certificates for normal, utility, acrobatic, commuter, and transport category aircraft; manned free balloons; and special classes of aircraft. Initial Certification will be in accordance with

(a) . . .

(b) New aircraft manufactured under type certificate only. An applicant for a standard airworthiness certificate for a new aircraft manufactured under a type certificate only is entitled to a standard airworthiness certificate upon presentation, by the holder or licensee of the type certificate, of the statement of conformity prescribed in § 21.130 if the Administrator finds after inspection that the aircraft conforms to the type design and is in condition for safe operation.

Subpart B - Type Certificates

§ 21.11 Applicability.

§ 21.13 Eligibility.

§ 21.15 Application for type certificate.

§ 21.16 Special conditions.

If the Administrator finds that the airworthiness regulations of this subchapter do not contain adequate or appropriate safety standards for an aircraft, aircraft engine, or propeller because of a novel or unusual design feature of the aircraft, aircraft engine or propeller, he prescribes special conditions and amendments thereto for the product. The special conditions are issued in accordance with Part 11 of this chapter and contain such safety standards for the aircraft, aircraft engine or propeller as the Administrator finds necessary to establish a level of safety equivalent to that established in the regulations.

[Amdt. 21-19, 32 FR 17851, Dec. 13, 1967; as amended by Amdt. 21-51, 45 FR 60170, Sept. 11, 1980]

§ 21.17 Designation of applicable regulations.

(a) Except as provided in § 23.2, § 25.2, § 27.2, § 29.2, and in parts 26, 34 and 36 of this subchapter, an applicant for a type certificate must show that the aircraft, aircraft engine, or propeller concerned meets--

(1) The applicable requirements of this subchapter that are effective on the date of application for that certificate unless -

(i) Otherwise specified by the Administrator; or

(ii) Compliance with later effective amendments is elected or required under this section; and

(2) Any special conditions prescribed by the Administrator.

(b) For special classes of aircraft, including the engines and propellers installed thereon (e.g., gliders, airships, and other nonconventional aircraft), for which airworthiness standards have not been issued under this subchapter, the applicable requirements will be the portions of those other airworthiness requirements contained in Parts 23, 25, 27, 29, 31, 33, and 35 found by the Administrator to be appropriate for the aircraft and applicable to a specific type design, or such airworthiness criteria as the Administrator may find provide an equivalent level of safety to those parts.

(c) An application for type certification of a transport category aircraft is effective for 5 years and an application for any other type certificate is effective for 3 years, unless an applicant shows at the time of application that his product requires a longer period of time for design, development, and testing, and the Administrator approves a longer period.

(d) In a case where a type certificate has not been issued, or it is clear that a type certificate will not be issued, within the time limit established under paragraph (c) of this section, the applicant may -
(1) File a new application for a type certificate and comply with all the provisions of paragraph (a) of this section applicable to an original application; or
(2) File for an extension of the original application and comply with the applicable airworthiness requirements of this subchapter that were effective on a date, to be selected by the applicant, not earlier than the date which precedes the date of issue of the type certificate by the time limit established under paragraph (c) of this section for the original application.
(e) If an applicant elects to comply with an amendment to this subchapter that is effective after the filing of the application for a type certificate, he must also comply with any other amendment that the Administrator finds is directly related.
(f) For primary category aircraft, the requirements are:
(1) The applicable airworthiness requirements contained in parts 23, 27, 31, 33, and 35 of this subchapter, or such other airworthiness criteria as the Administrator may find appropriate and applicable to the specific design and intended use and provide a level of safety acceptable to the Administrator.
(2) The noise standards of part 36 applicable to primary category aircraft.
[Doc. No. 5085, 29 FR 14564, Oct. 24, 1964, as amended by Amdt. 21-19, 32 FR 17851, Dec. 13, 1967; Amdt. 21-24, 34 FR 364, Jan. 10, 1969; Amdt. 21-42, 40 FR 1033, Jan. 6, 1975; Amdt. 21-58, 50 FR 46877, Nov. 13, 1985; Amdt. 21-60, 52 FR 8042, Mar. 13, 1987; Amdt. 21-68, 55 FR 32860, August 10, 1990; Amdt. 21-69, 56 FR 41051, Aug. 16, 1991; Amdt. 21-70, 57 FR 41367, Sept. 9, 1992; Amdt. 21-90, 72 FR 63363, November 8, 2007, effective December 10, 2007]

§ 21.19 Changes requiring a new type certificate.

§ 21.21 Issue of type certificate: normal, utility, acrobatic, commuter, and transport category aircraft; manned free balloons; special classes of aircraft; aircraft engines; propellers.

§ 21.23 [Reserved]

§ 21.24 Issuance of type certificate: primary category aircraft.

§ 21.25 Issue of type certificate: Restricted category aircraft.

§ 21.27 Issue of type certificate: surplus aircraft of the Armed Forces.

§ 21.29 Issue of type certificate: import products.

§ 21.31 Type design.

The type design consists of -
(a) The drawings and specifications, and a listing of those drawings and specifications, necessary to define the configuration and the design features of the product shown to comply with the requirements of that part of this subchapter applicable to the product;
(b) Information on dimensions, materials, and processes necessary to define the structural strength of the product; [Part 25 for the 787]

(NOTE: I have commented to some "friends" at FAA Renton that Part 25 does not include the word "composite". Their response is that any material used must meet the applicable standard. I continued my argument . . . The other Standards, Part 23, 28, 29, 33 and 35 do include the word "composite" with certain standards for the material. The FAA Scientists at the FAA Research facility at Atlantic City have recommended specific standards for "composites".

There is one section of Part 25 that I haven't seen addressed . . . . *§ 25.867 Fire protection: other components.*

(a) Surfaces to the rear of the nacelles, within one nacelle diameter of the nacelle centerline, ***must be at least fire resistant.*** **(Carbon fiber reinforced plastic is not "fire resistant" and there hasn't been any mention of metal used in the wing skin.)**

(b) Paragraph (a) of this section does not apply to tail surfaces to the rear of the nacelles that could not be readily affected by heat, flames, or sparks coming from a designated fire zone or engine compartment of any nacelle.)

[Amdt. 25-23, 35 FR 5676, Apr. 8, 1970]

(c) The Airworthiness Limitations section of the Instructions for Continued Airworthiness as required by parts 23, 25, 26, 27, 29, 31, 33, and 35 of this subchapter, or as otherwise required by the Administrator; and as specified in the applicable airworthiness criteria for special classes of aircraft defined in § 21.17(b); and

(d) For primary category aircraft, if desired, a special inspection and preventive maintenance program designed to be accomplished by an appropriately rated and trained pilot-owner.

(e) Any other data necessary to allow, by comparison, the determination of the airworthiness, noise characteristics, fuel venting, and exhaust emissions (where applicable) of later products of the same type.

[Doc. No. 5085, 29 FR 14564, Oct. 24, 1964, as amended by Amdt. 21-27, 34 FR 18363, Nov. 18, 1969; Amdt. 21-51, 45 FR 60170, Sept. 11, 1980; Amdt. 21-60, 52 FR 8042, Mar. 13, 1987; Amdt. 21-68, 55 FR 32860, August 10, 1990; Amdt. 21-70, 57 FR 41368, Sept. 9, 1992; Amdt. 21-90, 72 FR 63363, November 8, 2007, effective December 10, 2007]

§ 21.33 Inspection and tests. *(Before Flight Testing begins)*

(a) Each applicant must allow the Administrator to make any inspection and any flight and ground test necessary to determine compliance with the applicable requirements of the Federal Aviation Regulations. However, unless otherwise authorized by the Administrator -

(1) No aircraft, aircraft engine, propeller, or part thereof may be presented to the Administrator for test unless compliance with paragraphs (b)(2) through (b)(4) of this section has been shown for that aircraft, aircraft engine, propeller, or part thereof; and

(2) No change may be made to an aircraft, aircraft engine, propeller, or part thereof between the time that compliance with paragraphs (b)(2) through (b)(4) of this section is shown for that aircraft, aircraft engine, propeller, or part thereof and the time that it is presented to the Administrator for test.

(b) Each applicant must make all inspections and tests necessary to determine -

(1) Compliance with the applicable airworthiness, aircraft noise, fuel venting, and exhaust emission requirements;

(2) That materials and products conform to the specifications in the type design;

(3) That parts of the products conform to the drawings in the type design; and

(4) That the manufacturing processes, construction and assembly conform to those specified in the type design.

[Doc. No. 5085, 29 FR 14564, Oct. 24, 1964, as amended by Amdt. 21-17, 32 FR 14926, Oct. 28, 1967; Amdt. 21-27, 34 FR 18363, Nov. 18, 1969; Amdt. 21-44, 41 FR 55463, Dec. 20, 1976; Amdt. 21-68, 55 FR 32860, August 10, 1990]

§ 21.35 Flight tests. *(Before and during the certification flight tests.)*

(a) Each applicant for an aircraft type certificate (other than under §§ 21.24 through 21.29) must make the tests listed in paragraph (b) of this section. Before making the tests the applicant must show -

(1) Compliance with the applicable structural requirements of this subchapter;

§ 25.301 Loads.

(a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.

(b) Unless otherwise provided, the specified air, ground, and water loads must be placed in equilibrium with inertia forces, considering each item of mass in the airplane. These loads must be distributed to conservatively approximate or closely represent actual conditions. Methods used to determine load intensities and distribution must be validated by flight load measurement unless the methods used for determining those loading conditions are shown to be reliable.

(c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.

Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-23, 35 FR 5672, Apr. 8, 1970]

§ 25.303 Factor of safety.

Unless otherwise specified, a factor of safety of 1.5 must be applied to the prescribed limit load which are considered external loads on the structure. When a loading condition is prescribed in terms of ultimate loads, a factor of safety need not be applied unless otherwise specified.

[Amdt. 25-23, 35 FR 5672, Apr. 8, 1970]

§ 25.305 Strength and deformation.

(a) The structure must be able to support limit loads without detrimental permanent deformation. At any load up to limit loads, the deformation may not interfere with safe operation.

(b) The structure must be able to support ultimate loads without failure for at least 3 seconds. However, when proof of strength is shown by dynamic tests simulating actual load conditions, the 3 second limit does not apply. Static tests conducted to ultimate load must include the ultimate deflections and ultimate deformation induced by the loading. When analytical methods are used to show compliance with the ultimate load strength requirements, it must be shown that -

(1) The effects of deformation are not significant;

(2) The deformations involved are fully accounted for in the analysis; or

(3) The methods and assumptions used are sufficient to cover the effects of these deformations.

(c) Where structural flexibility is such that any rate of load application likely to occur in the operating conditions might produce transient stresses appreciably higher than those corresponding to static loads, the effects of this rate of application must be considered.

(d) [Reserved]

. . . .

(2) Completion of necessary ground inspections and tests;

(3) That the aircraft conforms with the type design; and

(4) That the Administrator received a flight test report from the applicant (signed, in the case of aircraft to be certificated under Part 25 [New] of this chapter, by the applicant's test pilot) containing the results of his tests.

(b) Upon showing compliance with paragraph (a) of this section, the applicant must make all flight tests that the Administrator finds necessary -

(1) To determine compliance with the applicable requirements of this subchapter; and

(2) For aircraft to be certificated under this subchapter, except gliders and except airplanes of 6,000 lbs. or less maximum certificated weight that are to be certificated under Part 23 of this chapter, to determine whether there is reasonable assurance that the aircraft, its components, and its equipment are reliable and function properly.

(c) Each applicant must, if practicable, make the tests prescribed in paragraph (b)(2) of this section upon the aircraft that was used to show compliance with -

(1) Paragraph (b)(1) of this section; and

(2) For rotorcraft, the rotor drive endurance tests prescribed in § 27.923 or § 29.923 of this chapter, as applicable.

(d) Each applicant must show for each flight test (except in a glider or a manned free balloon) that adequate provision is made for the flight test crew for emergency egress and the use of parachutes.

(e) Except in gliders and manned free balloons, an applicant must discontinue flight tests under this section until he shows that corrective action has been taken, whenever -

(1) The applicant's test pilot is unable or unwilling to make any of the required flight tests; or

(2) Items of noncompliance with requirements are found that may make additional test data meaningless or that would make further testing unduly hazardous.

. . . .

[Doc. No. 5085, 29 FR 14564, Oct. 24, 1964, as amended by Amdt. No. 21-40, 39 FR 35459, Oct. 1, 1974; Amdt. 21-51, 45 FR 60170, Sept. 11, 1980; Amdt. 21-70, 57 FR 41368, Sept. 9, 1992]

§ 21.37 Flight test pilot.

§ 21.39 Flight test instrument calibration and correction report.

§ 21.41 Type certificate.

Each type certificate is considered to include the type design, the operating limitations, the certificate data sheet, the applicable regulations of this subchapter with which the Administrator records compliance, and any other conditions or limitations prescribed for the product in this subchapter.

§ 21.43 Location of manufacturing facilities.

§ 21.45 Privileges.

§ 21.47 Transferability.

§ 21.49 Availability.

§ 21.50 Instructions for continued airworthiness and manufacturer's maintenance manuals having airworthiness limitations sections.

§ 21.51 Duration.

§ 21.53 Statement of conformity.

(a) Each applicant must submit a statement of conformity (FAA Form 317) to the Administrator for each aircraft engine and propeller presented to the Administrator for type certification. This statement of conformity must include a statement that the aircraft engine or propeller conforms to the type design therefor.
(b) Each applicant must submit a statement of conformity to the Administrator for each aircraft or part thereof presented to the Administrator for tests. This statement of conformity must include a statement that the applicant has complied with § 21.33(a) (unless otherwise authorized under that paragraph).

§ 21.55 Responsibility of type certificate holders to provide written licensing agreements.

NEXT ISSUE . . . THE COMET 1A *REVISITED!*

E-MAIL IF YOU HAVE ANY QUESTIONS OR COMMENTS . . . . JIM

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