Type Acceptance Report

TAR 13/21B/13 – Revision 4

BOEING 787 Series

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Executive Summary

New Zealand Type Acceptance has been granted to the Boeing Models 787-8 and 787-9 (Rolls-Royce powered) based on validation of FAA Type Certificate number T00021SE. There are no special requirements for import.

Applicability is currently limited to the Models and/or serial numbers detailed in Section 2 of this report, which are now eligible for the issue of an Airworthiness Certificate in the Standard Category in accordance with NZCAR §21.191, subject to any outstanding New Zealand operational requirements being met. (See Section 5 of this report for a review of compliance of the basic type design with the operating Rules.) Additional variants or serial numbers approved under the foreign type certificate can become type accepted after supply of the applicable documentation, in accordance with the provisions of NZCAR §21.43(c).

NOTE: The information in this report was correct as at the date of issue. The report is generally only updated when an application is received to revise the Type Acceptance Certificate. For details on the current type certificate holder and any specific technical data, refer to the latest revision of the State-of-Design Type Certificate Data Sheet referenced herein.

1. Introduction

This report details the basis on which Type Acceptance Certificate No. 13/21B/13 was granted in the Standard Category in accordance with NZCAR Part 21 Subpart B.

Specifically the report aims to:

(a) Specify the foreign type certificate and associated airworthiness design standard used for type acceptance of the model(s) in New Zealand; and

(b) Identify any special conditions for import applicable to any model(s) covered by the Type Acceptance Certificate; and

(c) Identify any additional requirements which must be complied with prior to the issue of a NZ Airworthiness Certificate or for any subsequent operations.

The report notes the status of all models included under the State-of-Design type certificate which have been granted type acceptance in New Zealand, which are listed in Section 2. The history of the 787 model type acceptance in New Zealand under FAA type certificate T00021SE is listed in Appendix 1.

2. Aircraft Certification Details

(a) State-of-Design Type and Production Certificates:

Manufacturer: The Boeing Company

Type Certificate: T00021SE
Issued by: Federal Aviation Administration

Production Approval: FAA PC700

Note: ZK-NZC, NZD and NZE were produced under TC

(b) Models Covered by the Part 21B Type Acceptance Certificate:

(i) **Model:** 787-8

MCTOW: 484,000 lb. [219,540 kg]
502,500 lb. [227,930 kg] LN20 Mission Improvement Block Point

Max. No. of Seats: 381 (Depending on exit arrangement)

Noise Standard: FAR 36 Stage 4/ICAO Annex 16 Chapter 4

Engine: Rolls-Royce Trent 1000-A, -A2, -AE3, -C, -C2, -CE3, -D, -D2 -D3, -E, -G, -G2, -G3, -H, -H2, -H3, -L2

Type Certificate: E.036
Issued by: European Aviation Safety Agency

(ii) **Model:** 787-9

MCTOW: 561,500 lb. [254,692 kg]
557,000 lb. [252,651 kg] – up to LN365

Max. No. of Seats: 420 (Depending on exit arrangement)

Noise Standard: FAR 36 Stage 4/ICAO Annex 16 Chapter 4

Engine: Rolls-Royce Trent 1000-A2, -AE3, -D2, -D3, -J2, -J3, -K2, -K3

Type Certificate: E.036
Issued by: European Aviation Safety Agency

3. Application Details and Background Information

The application for New Zealand type acceptance of the 787-9 was from the manufacturer, dated 3 December 2012. This was subsequently extended to include the Model 787-8 by application from Boeing dated 30 April 2013. The Boeing 787 is an all-composite twin-turbofan long-range twin-aisle airliner. As part of the Type Acceptance process a team from the CAA Aircraft Certification Unit visited Boeing for a series of Technical Visits.

Type Acceptance Certificate Number 13/21B/13 was granted on 26 March 2014 to the Boeing Model 787-8 (Rolls-Royce powered) based on validation of FAA Type Certificate T00021SE. (The Rolls Royce Trent 1000 Series engine is covered by CAA Type Acceptance Certificate number 14/21B/6.) Specific applicability is limited to the coverage provided by the operating documentation supplied. There are no special requirements for import into New Zealand.

The Boeing 787 "Dreamliner" was the first large airliner to be produced with all-composite construction for the complete primary structure, including fuselage and wing. Composite structure allows a higher pressure differential, with a lower cabin altitude, and larger window apertures compared to conventional aircraft. The aircraft also uses a number of other novel or advanced features, including: extensive use of advanced electrical systems architecture, with no bleed air used and minimal use of high pressure (5000 psi) hydraulics; advanced aerodynamics (smooth wing, load alleviation system) with fly-by-wire controls with an integrated p-beta system; common-core avionics utilising synthetic airspeed and dual HUD as standard; and a pulse oxygen system.

The 787-8 was the initial Minor Model and had a protracted development and certification history. Following entry into service there were some incidents due to overheating of the lithium-ion batteries, and the fleet was temporarily grounded while Boeing re-designed the battery installation with additional fire protection measures. Since then there have been a number of production enhancements incorporated as standard, as follows:

- LN7 Weight Reduction Block Point – reduction in Operating Empty Mass
- LN20 Mission Improvement Block Point – increase in MCTOW
- LN127 Design Optimization Block Point – changes to optimize airframe structure and incorporate 787-9 production improvements. These include: new monolithic flight deck window frame; wing fuel access door design; Section 41 skin/stringer improvements; nose wheel well structure; Section 49 Wing to Body Fairing Panel 4 Optimization; and Sections 41, 46, and 47 Bulk and Access Doors Revision.

This report was raised to Revision 1 to include the 787-9, which is the second Minor Model and is intended for long-range operations. Air New Zealand was the launch airline customer, with an initial order of eight aircraft (Variable numbers ZB001 through ZB008). The first-of-type was actually ZB003 (Line number LN169 and MSN 34334) registered ZK-NZE. Type acceptance of the Boeing 787-9 was granted on 27 June 2014.

The 787-9 is a stretched version with a 5-frame (10 feet) fuselage extension fore and aft of the wing (around 16% more passengers), higher operating weight and increased thrust engines. The 787-8 usually has a passenger arrangement in the range 210-250 seats, while the 787-9 will typically accommodate 250-290. (The Air NZ cabin layout has three classes seating 18/21/263 for a total of 302 passengers.) Range increases from 7650-8200 nautical miles on the 787-8 to 8000-8500 nm on the 787-9. All design changes were driven by either increased loads due to the higher MAUW and longer fuselage or by optimisation and design improvements. The only all-new technical feature introduced on the 787-9 is a Hybrid Laminar Flow Control system for the vertical and horizontal stabilisers, which is used for mission performance (non-certified cruise). Other detailed differences include:

- Structural (Advanced composite floor beams, door surrounds and one-piece fuselage frames; integral wing fuel vent stringers; advanced wheel well bulkhead; side-of-body redesigned; revised vertical and horizontal tail structural architecture [centreline splice]);
- The 787-9 introduced three additional takeoff flap detent settings;
- Undercarriage (Wider and longer main landing gear truck; larger MLG wheels, tires, and brakes; wheel well pressure deck raised and architecture revised);
- Flight Controls (Changes to actuators and software, including implementation of Nacelle Gust Load Alleviation);

Under the FAA Type certification process the 787-9 was initially approved under TCDS Revision 9 for zero occupancy. Following first-of-model certification of serial number 34334 the 787-9 was approved for full passenger capacity under TCDS Revision 10.

Revision 2 of this report was raised to cover the Rolls-Royce-Trent-1000-TEN engine option and update the type acceptance certificate with any changes to the 787 certification basis since it was first issued. The applicant was the manufacturer, The Boeing Company. The first Rolls Royce Trent-1000-TEN powered aircraft was ZB011/MSN38180 registered ZK-NZM. Type acceptance was granted on 21 November 2017.

The Trent 1000-TEN engine is a derivative engine based upon the Trent 1000 Package C1 with modifications to improve fuel consumption, increase thrust capability and increase structural load capability. Although the basic ratings are unchanged, the TEN series includes some additional thrust ratings. The TEN upgrade includes these main changes:

- Changes to the engine core (IP and HP Compressors, HP, IP and LP Turbines)
- Reconfigured external engine dressings
- New Electronic Engine Control (EEC) hardware and software
- Upgrade to the engine secondary Modulated Air System (MAS) for performance benefit with corresponding avionics indications
- Modification of Variable Frequency Starter Generator (VFSG) matrix Air Oil Heat Exchangers (AOHE) to surface cooler architecture
- Removal of AOHE air exhaust ducts on the fan cowls as a result of the VSG change
- Revised fan cowls with AOHE exhaust ducts covered with blanking plates

The TEN will become the basic Rolls Royce engine on the 787. It was first installed on the 787-8 on Line Number 627 and first installed on the 787-9 on Line Number 608. This design change also provides for future engine intermix capability by Service Bulletin approval for operation of the 787-8 or 787-9 with a combination of Trent 1000-TEN engines and Trent 1000 Package B or Package C Engines.

This report was raised to Revision 3 to add the Equivalent Level of Safety (ELOS) Finding for Early Extended Operations (ETOPS) Airplane Demonstration Tests on Boeing Model 787-8, -9, and -10 airplanes powered by Trent 1000-TEN engines (FAA Project No. PS18-0046), and the latest Special Condition 25-745-SC applied to seats with inertia locking devices. The application was from the manufacturer, dated February 19, 2019, and was assessed under CAA Work Request 19/21B/23.

Revision 4 was issued to validate the 787-9 Maximum Takeoff Weight and Expanded Center of Gravity Grid Improvement approved under FAA Project Number PS19-0270 (the Maximum Certificated Take-off Weight (MCTOW) increased from 560,000 pounds to 561,500 pounds) which was introduced at TCDS Revision 33; and the Equivalent Level of Safety Finding for the Display of Powerplant Instruments Rule, FAA Memo Number PS13-0546-P-36, which was retrospectively applied to the 787-8 and -9 at Revision 26. The application was from the manufacturer, dated May 4, 2020, and was assessed under CAA Work Request 20/21B/18.

4. NZCAR §21.43 Data Requirements

The type data requirements of NZCAR Part 21B Para §21.43 have been satisfied by supply of the following documents, or were already held by the CAA:

(1) ICAO Type certificate:

FAA Type Certificate Number T00021SE

FAA Type Certificate Data Sheet T00021SE at Revision 33 dated March 23, 2020
– Model 787-8 approved August 26, 2011
– Model 787-9 approved June 13, 2014

(2) Airworthiness design requirements:

(i) Airworthiness Design Standards:
The certification basis of the Boeing 787-8 is FAR Part 25, including through Amendment 25-120 (except for one paragraph at 25-119), and 25-124, 25-125 and 25-128; plus FAR Part 26 including through Amendment 26-5 for the specified paragraphs as noted on the TCDS. Seven exemptions were granted, fourteen special conditions applied, and a large number of equivalent level of safety findings (ELOS) made, as detailed below.

For the Model 787-9 the certification basis was updated to compliance with FAR Part 25 at all Amendments up to 25-128, except for five paragraphs still at an earlier amendment level as noted on the TCDS, and one paragraph at a later amendment level. Most exemptions, special conditions and ELOS were carried over, except where they were time-limited, or superseded by the later certification basis. One new time-limited exemption was granted.

This is an acceptable certification basis in accordance with NZCAR Part 21B Para §21.41, because FAR Part 25 is the basic standard for Transport Category Airplanes called up under Part 21 Appendix C. There are no non-compliances and no additional special conditions have been prescribed by the Director under §21.23.

(ii) Exemptions:
Models 787-8 and 787-9
Exemption No. 9486 §25.562(b)(2) – Relief from the floor warpage testing requirements for flightdeck seats on the Boeing 787 series airplanes. Dynamic seat testing makes no distinction between passenger and crew seats, while the evidence mentioned in the preamble is based on passenger seats only. There is evidence showing that floor warpage has not been a significant factor in flight deck seat failures during survivable crash conditions. In addition the ten degree of track misalignment could give unrealistic indications of head injuries in a cockpit.

Exemption No. 10114 §25.809(a) – Relief from requirement flightcrew emergency exits have a means to view outside conditions under all lighting situations. While the outside viewing capability provided by the flightdeck windows on the 787 should be sufficient for the overhead escape hatch, the flightdeck geometry (fuselage curvature) results in a viewing area from the windows which does not meet the literal language of the rule. Some portable illumination in the form of a flashlight was also required.

Exemptions (Partial) No. 8857 [787-8] and No. 10962 [787-9] §25.841(a)(2)(i)(ii) – Relief from the requirement that, during a decompression caused by failures of the engines, airplane cabin pressure altitude not exceed 25,000 feet for more than 2 minutes or exceed 40,000 feet for any duration. When operating above FL390 if an uncontained rotor burst event occurred it is likely cabin pressure could exceed limits because it would take more than 2 minutes to descend to FL250, and could exceed 40,000 feet if the failure occurred above that level. Boeing believes, based on fleet service experience, that uncontained failures are rare events and this was supported by FAA analysis. Boeing observes that neither the JAA nor EASA has implemented similar restrictions. Robust structural and systems design and the ability to descend rapidly are key to assuring the safety of airplane occupants and are an inherent part of the 787 design. Other threat minimization philosophies include an automatic pressure demand mask for the pilots, separation and redundancy of key systems such as electrical power, passenger oxygen, cabin pressure control and spoiler actuation. Boeing also submitted an analysis of the Decompression Exposure Integral to show the Severity Indicator for passengers was less than the critical values recommended by the Mechanical Systems Harmonization Working Group report, which the FAA has adopted as Interim Policy.

Exemption No. 9801 §25.1447(c)(1) – Relief from the requirement for passenger oxygen masks to be automatically presented before the cabin pressure altitude exceeds 15,000 feet. Automatic activation occurs as the cabin pressure altitude approaches the greater of 15,000 ft. or 2,000 ft. above take-off or landing altitude in the event of depressurization. Therefore, when operating into and out of an airport with an altitude in excess of 13,000 ft., the automatic activation of the passenger oxygen system will exceed 15,000 ft. This feature is necessary to allow a margin between the airport altitude and the automatic deployment altitude, thus reducing the occurrence of inadvertent oxygen mask deployment. The maximum cabin pressure altitude for the baseline passenger oxygen system mask deployment will be limited to 16,000 ft. This exemption is consistent with EASA policy and has been previously granted to many other types.

Exemption No. 10868A § 25.853(d) and condition 1 of 25-370-SC relief from the flammability requirements for large surface areas on seats in the Boeing 787-9. This was granted to permit installation of a delethalization pad on Zodiac UK 'USC3' seats, which does not meet FAA heat release and smoke emissions requirements specified by SC-370-SC. The pad will enhance passenger safety by mitigating occupant injury during an emergency landing or during turbulence, which will also add to the survivability of a post-crash fire and an occupant's ability to safely evacuate the aircraft. (Similar Exemption 10156 was granted to the 777-300.)

Exemption No. 17319 § 25.901(c) to allow type certification of new propulsion control system designs for the Model 787 airplanes without an exact showing of compliance with the "no single failure" requirement of § 25.901(c). This relates to single elements controlling fuel flow, failure of which can result in Uncommanded High Thrust (UHT). Historically it had been assumed that the crew can recognise and deal with UHT, but the validity of this was questioned following an accident in 1997. Engineering simulations have shown there is a potential for loss of control with UHT in combination with high crosswinds in certain take-off and approach-and-landing scenarios. The exemption was granted based on the low failure rate leading to UHT, and the limited exposure time when the failure is potentially uncontrollable.

Exemption No. 17613 (Time Limited) – Installation of Exempt engines. This allows the installation of Rolls Royce Trent-1000-TEN engines which do not meet emission requirements in all situations (Smoke Number). See Type Acceptance Report 14/21B/6 for full details.

Exemption No.10879B §25.813(e) – No door may be installed between any passenger seats that is occupiable for takeoff and landing and any passenger emergency exit, such that it crosses any egress path (including aisles, cross-aisles and passageways). This exemption only applies to the installation of privacy doors on mini-suites. These were permitted subject to numerous conditions related to the retention mechanism, procedures and placarding, dual egress provisions, additional crewmembers and limitations on numbers fitted.

Model 787-8

Exemption No. 10235A (Time Limited) §25.809(a) – Relief for a limited number of Boeing 787 series airplanes from the requirement that passenger emergency exits have a means to view outside conditions under all lighting situations. This requirement to view outside the exit prior to opening was introduced to FAR 25.809(a) at Amendment 25-116. It was not part of the original 787 certification basis, but was added after production started due to the delays in the program. The exemption was granted on the grounds the rule was a safety improvement and not designed to address any known problem, and gave time for Boeing to develop and certify a new external lighting system, which will be incorporated at LN127 Block Point and on all 787-9 aircraft. The original exemption was applicable only to aircraft delivered prior to December 31, 2013. The exemption was subsequently amended to be applicable by line number up to 126 only.

Exemption No. 10199/A (Time Limited) §25.1309(c) – Temporary relief from the requirement to provide indication of anticipated fuel system contamination to the flightcrew of Boeing Model 787-8 airplanes powered by Rolls-Royce Trent 1000 engines. The Trent 1000 is the first engine to incorporate a bypass in the fuel oil heat exchanger (FOHE). The bypass was added to address the condition of a transient high concentration of ice in fuel which could potentially block the FOHE and result in significant loss of thrust. The FOHE bypass did not provide any indication of an impending or actual bypass condition. Some recent incidents of unexpected FOD contamination led FAA to realise the original design was non-compliant. Because there have been no in-flight shutdowns due to FOHE blockage, the FAA granted the exemption until June 30, 2014 for new engines, and December 31, 2016 for retrofit action.

Model 787-9

Exemption (Time Limited) No. 11002 §25.1301(a)(1) – Relief from requirements that the airplane must function properly when installed and be designed appropriate to its intended function for Ram Air Turbine (RAT) Generator Control Unit (GCU); and §25.1301(a)(4), §25.1309(a) and §25.1309(b)(2), Relief from the requirements that Systems and equipment must perform intended function and Hazardous effects must be improbable for the Altitude-Select knob on the Autoflight Mode Control Panel (MCP). This relates to two technical issues found during the certification program and gives Boeing time to develop and install a fleet-wide rectification program. (1) A different capacitor needs to be fitted to the RAT GCU after a failure during a flight test. The time-limited exemption was granted on the basis the probability of failure of the capacitor in conjunction with the other failures which would have to occur to create a hazardous condition is extremely improbable. (2) It was found when using the Altitude-Select knob on the MCP that it could be unintentionally rotated when being pushed to activate, due to low resistance torque, which could change the selected altitude without the crew being aware. Pending a design update the FAA accepted use of an FCOM Advisory Bulletin.

(iii) Special Conditions:

Models 787-8 and 787-9

25-348-SC Composite Wing Fuel Tank Structure — Fire Protection Requirements – The 787 is the first large Transport Category aircraft not built mainly with aluminium for the fuel tank structure, using instead chiefly composite materials. To be consistent with existing capability and related requirements, the 787 must demonstrate acceptable post-crash survivability in the event the wings and fuel tank are exposed to an external fuel-fed pool fire for at least 5 minutes.

25-354A-SC ARAC Standardised Requirements – Interaction of Systems and Structures; Electronic Flight Control System-Control Surface Awareness; High Intensity Radiated Fields (HIRF) Protection; Limit Engine Torque Loads for Sudden Engine Stoppage; and Design Roll Manoeuvre Requirement – These are detailed requirements related to improvements in aircraft technology which have been previously applied to other programs, including the Boeing 777.

25-356-SC Systems and Data Networks Security-Isolation or Protection From Unauthorized Passenger Domain Systems Access – The digital systems architecture for the 787 consists of several networks connected by electronics and embedded software, which is used for a diverse set of functions, including: 1. Flight-safety-related control and navigation and required systems (Aircraft Control Domain ACD); 2. Airline business and administrative support (Airline Information Domain AID); 3. Passenger entertainment, information, and Internet services (Passenger Information and Entertainment Domain PIED). Because of this new passenger connectivity, the proposed data network design and integration may result in security vulnerabilities from corruption of data and critical systems. Special conditions were imposed to ensure that security, integrity, and availability are not compromised by certain wired or wireless electronic connections. The design shall prevent all inadvertent or malicious changes to, and all adverse impacts upon, all systems, networks, hardware, software, and data in the ACD and in the AID from all points within the PIED.

25-357-SC Systems and Data Networks Security-Protection of Airplane Systems and Data Networks from Unauthorized External Access – For exactly the same reasons as in 25-356-SC above, this special condition established requirements for: 1. Protection of ACD and AID systems, hardware, software, and databases from unauthorized access; 2. Protection of field-loadable software (FLS) applications and databases that are electronically transmitted; 3. Test and evaluation of security protection means and change control procedures. Specifically the applicant must ensure system security protection for the ACD and AID from access by unauthorized external sources, including those possibly caused by maintenance activity. They must also ensure that security threats are identified and assessed, and risk mitigation strategies are implemented to protect the aircraft from all adverse impacts on safety, functionality, and continued airworthiness.

25-359-SC Lithium Ion Battery Installation – The 787 will use high capacity lithium ion battery technology in on-board systems. This type has certain failure, operational, and maintenance characteristics that differ significantly from those of the nickel-cadmium and lead-acid rechargeable batteries currently approved. Other users have noted safety problems including: overcharging; over-discharging; and flammability of cell components. This special condition requires lithium ion batteries to be designed and installed such that:

(1) Safe cell temperatures and pressures must be kept during any foreseeable charging or discharging condition, and explosion precluded, after any likely failure of the charging or monitoring system;

(2) The design must preclude any self-sustaining, uncontrolled increases in temperature or pressure;

(3) There must be no explosive or toxic gases emitted after any failure that is not extremely remote;

(4) Installations of lithium ion batteries must meet the requirements of FAR 25.863(a) through (d);

(5) No corrosive fluids or gases that may escape may damage surrounding structure or any adjacent systems, equipment, or electrical wiring such as to cause a major or more severe failure condition;

(6) There must be means to prevent any hazardous effect on structure or essential systems caused by the maximum heat that can be generated during a short circuit of the battery or its individual cells.

(7) The charging rate must be controlled automatically, to prevent overheating or overcharging, and warning systems fitted with automatically disconnection in the event of an adverse failure condition.

(8) Any installation which is required for safe operation must incorporate a monitoring and warning feature to indicate to the flightcrew if the state-of-charge falls below acceptable levels for dispatch.

(9) The Instructions for Continued Airworthiness must contain detailed maintenance requirements and procedures to ensure the continued safe operation of the batteries, including when in storage.

25-360-SC Composite Fuselage In-Flight Fire/Flammability Resistance – In-flight fires have originated in inaccessible areas of aircraft where thermal/acoustic insulation located adjacent to the aluminium skin has been the path for flame propagation and fire growth, often from small electrical sources. These special conditions required the 787 provide the same level of in-flight survivability as a conventional aluminium fuselage. This includes its thermal/acoustic insulation meeting the requirements of FAR 25.856(a). Resistance to flame propagation must be shown, and all products of combustion that may result must be evaluated for toxicity and found acceptable.

25-362-SC Crashworthiness Emergency Landing Conditions – The 787 fuselage is made with carbon fibre reinforced plastic (CFRP) semi-monocoque construction, consisting of skins with co-cured longitudinal stringers and mechanically fastened circumferential frames. CFRP may behave differently than metallic structure because of differences in material ductility, stiffness, failure modes, and energy absorption characteristics. The 787 must provide an equivalent level of occupant safety and survivability to that provided by previously certificated wide-body transports. This required meeting criteria for a range of airplane vertical descent velocities up to 30 ft/sec., including: 1. Retention of items of mass; 2. Maintenance of acceptable occupant acceleration and loads; 3. Maintenance of a survivable volume; 4. Maintenance of occupant emergency egress paths.

25-363-SC Tire Debris Penetration of Fuel Tank Structure – The 787 will use CFRP for most of the wing fuel tank structure. The resistance of this material to penetration or rupture when impacted by tire debris is unknown. These special conditions establish a standard for resistance to potential tire debris impacts to the wing surfaces and require consideration of possible secondary effects, such as an induced pressure wave. Some uncommon larger debris may also cause a fuel leak, and this may not result in hazardous quantities of fuel entering the engine, APU or cabin air inlets.

25-365-SC Operation without Normal Electrical Power – The 787 has numerous critical electrically-operated systems. In addition to an electronic flight control system, a number of systems that have traditionally been pneumatically or mechanically operated are now electrical. Examples include hydraulic power, equipment cooling, wing anti-ice, and APU and engine start systems. Boeing had to show by analysis and/or test that the aircraft is capable of continued safe flight and landing with all normal sources of engine- and APU-generated electrical power inoperative.

25-370-SC Seats with Non-Traditional, Large, Non-Metallic Panels – The current regulations do not require seats to meet the more stringent flammability requirements of large cabin interior panels. To provide the same level of passenger protection non-traditional, large, non-metallic panels fitted to aircraft seats in lieu of a traditional metal frame covered by fabric must meet FAR 25, Appendix F, Parts IV and V, heat release and smoke emission requirements. (A large panel is defined as a panel with exposed-surface areas greater than 1.5 square feet installed per seat place.)

25-414-SC Lightning Protection of Fuel Tank Structure to Prevent Fuel Tank Vapor Ignition – Providing multiple fault tolerance in the structural lightning protection design for some elements is deemed to be impractical. However it is accepted that a highly effective nitrogen gas inerting system (NGS) which meets Part 25 Appendix M makes it unnecessary to assume that the fuel tank is always flammable. The special condition detailed the level of design/analysis to show that fuel tank ignition prevention features provided fault tolerance where practical, or that a fuel tank vapor ignition event due to the non-fault-tolerant features is extremely improbable.

25-418-SC Overhead Flight Crew Rest Compartment Occupiable during TTL – To approve this for occupation during Taxi, Takeoff, and Landing the FAA imposed special conditions on the occupancy numbers, crew rest door design, placards and limitations. During TT&L the occupants are restricted to the crew rest seats which had met the requirements of FAR §25.562.

25-419-SC Overhead Crew Rest Compartment – The overhead crew rest compartments are required to have a maximum number of occupants, appropriate placards, ashtrays on entrances, two routes of emergency evacuation, and doors which preclude anyone from being trapped inside.

25-431-SC Seats with Inflatable Lapbelts – This Special Condition was issued to address the technology of inflatable lapbelts which are designed to limit occupant forward excursion in the event of an accident. The SC can be characterized as addressing either the safety performance of the system, or integrity against inadvertent activation, and included: performance requirements for a range of situations, including holding an infant, pregnancy and child occupation; occupant protection regardless of numbers seated; buckle integrity and activation confirmation; system functioning with power loss or HIRF and lightning effects; fire protection; interference with proximity lights; and protection from injury during normal or inadvertent deployment, including gas or particulate release.

25-458-SC Single-place Side-facing Seats with Inflatable Lapbelts – This Special Condition was imposed by the FAA similar to that first applied to the 777-219, which had the same type of Contour business-class seats installed at an angle of 40°. The SC included: Compliance with all existing criteria for HIC under FAR §25.562; Considerations for body-to-wall/furnishing contact; Thoracic Trauma Index injury criterion must be substantiated by testing with a Side Impact Dummy (SID); Pelvic lateral acceleration must be shown to not exceed 130g; Shoulder strap loads must not exceed 1750 lb (or 2000 lb for dual strap tension loads); and neck injury criteria. General Test Guidelines were provided, for one longitudinal test, and included pass/fail injury assessments.

25-682-SC Non-Rechargeable Lithium Battery Installations – These batteries and battery systems introduce higher energy density levels through new chemical compositions, and are used in various avionics systems and displays. The SC requires that each installation must: 1. Be designed to maintain safe cell temperatures and pressures under all foreseeable operating conditions to prevent fire and explosion; 2. Be designed to prevent the occurrence of self-sustaining, uncontrollable increases in temperature or pressure; 3. Not emit explosive or toxic gases in hazardous quantities within the airplane; 4. Meet the requirements of § 25.863; 5. Not damage surrounding areas from corrosive fluids or gases that may escape; 6. Have provisions to prevent any hazardous effect on aircraft structure or systems caused by heat; 7. Have a failure sensing and warning system; 8. Have a means to determine the battery charge state if the battery's function is required for safe operation.

25-745-SC Seats with Inertia Locking Devices (ILD) – This applies to certain passenger seats which use an electric actuator attached to the seat primary structure to move fore and aft. When subject to emergency landing loads the seat is restrained by a motor internal brake which functions as an ILD. A seat using ILD technology may involve a step change in protection for impacts above and below that at which it activates. To ensure the same level of protection as conventional seats the FAA prescribed a series of conditions to ensure the ILD activates when intended, and specify additional maintenance and reliability aspects.

Model 787-8

25-355-SC Reinforced Flightdeck Bulkhead – A flightdeck door must be designed to resist forcible intrusion by unauthorized persons and penetration by small arms fire and fragmentation devices. Originally this was limited to the door to expedite retrofit of existing aircraft. These special conditions require that a reinforced flightdeck bulkhead meet the same standards as those for doors.

Model 787-9

25-552-SC Dynamic Test Requirements for Multiple Occupant Side-Facing Seats with Inflatable Restraints – These Special Conditions apply to single-place sideways facing seats (defined as an angle greater than 18° from the centreline) equipped with inflatable lapbelts. They include requirements covering: Compliance with all existing criteria under §25.562(c); Body-to-Wall/Furnishing Contact clearance; Thoracic Trauma Index injury criteria; limit on lateral pelvic acceleration; Shoulder Strap Loads; and Neck Injury Criteria. Test guidelines were also specified.

(iv) *Equivalent Level of Safety Findings:*

Models 787-8 and 787-9

TC6918SE-T-A-9 §§25.341, 25.343, 25.345, 25.371, 25.373, 25.391 ELOS for Gust and Continuous Turbulence Design Loads – Provides for use of the gust design methodology proposed by ARAC (Aviation Rule Making Committee) which recommended that a continuous turbulence criterion be utilized. This method accounts for aircraft response to realistic, atmospheric characteristics, including provision for treatment of non-linearities.

TC6918SE-T-A-10 §25.335(b) ELOS Finding for Design Airspeeds – The 787-8 has an electronic flight control system (EFCS) which provides positive warning and control inputs at speeds above V_C/M_C, and if the bank angle exceeds a threshold which is a function of speed. Boeing demonstrated that the reduced upset margin coupled with the envelope protection function (Hardened Overspeed Protection HOSP) provided equivalent safety, and that loss of compensating features (inhibit of airplane-nose-down trim, automatic nose-up elevator) was extremely improbable.

TC6918SE-T-A-11 §§25.391, 25.393, 25.415 ELOS Finding for the Ground Gust Requirements – There have been several incidents and accidents caused by hidden damage that had previously occurred in ground gust conditions. Although many of these events were for airplanes that had used lower wind speeds from the earlier rules, analysis indicates that the most significant contributor to the damage was the dynamic load effect. Based on these events, additional factors have been defined in recommendations that have been agreed upon and accepted by the ARAC Loads and Dynamics Harmonization Working Group, and already incorporated by EASA in CS-25. This ELOS was agreed in accordance with FAA policy that allows use of a mature ARAC proposal.

TC6918SE-T-A-12 §25.331(c) ELOS for Symmetric Maneuvering Conditions – Current FAR design rules specify pitching accelerations without regard to the size, configuration or characteristics of the airplane type. This ELOS was accepted based on an ARAC proposal that relates the frequency of the control motion to the frequency of the short-period rigid body mode of the airplane, thereby accounting for particular characteristics. It also provides adequate criteria to account for the characteristics of advanced electronic flight control systems in which the achievable manoeuvring load factors are governed by special computer control laws.

TC6918SE-T-A-13 §25.629 ELOS Finding for Aeroelastic Stability – For this ELOS, Boeing highlighted all significant latent failures in the safety analysis that could leave the airplane one failure away from a catastrophic condition, with review by the FAA. Boeing documented that in the presence of any single failure in the flight control system (excluding jams), any additional failure states that could prevent continued safe flight and landing have a combined probability of less than 1 in 1000. This proposal is similar to material agreed in several Harmonization Working Groups.

TC6918SE-T-CS-12 §25.791(a) ELOS Finding Lighted "No Smoking" Signs in Lieu of Placards – The FAA determined that "No Smoking" placards required by §25.791 at Amendment 25-72 may be replaced with lighted signs, provided that as a compensating feature the signs are continuously illuminated for the occupants without the flight or cabin crew having to turn the signs on, and without adversely impacting essential bus loads, isolation requirements, etc.

TC6918SE-T-CS-1 §25.810(a)(1)(ii) ELOS Finding for Escape Slide Inflation Times – The requirement that emergency exit assist means (i.e. slide/rafts) must be "automatically erected within 10 seconds after deployment is begun" was introduced at Amendment 25-15. At Amendment 25-88, it was changed from ten seconds to six seconds for all assist means except those at Type C exits. For derivative models using the same equipment the FAA has previously accepted compliance based on a 10 second overall system performance. This was continued for the 787.

TC6918SE-T-CS-2 §25.811(f) ELOS Finding for Emergency Exit Markings and Door Sill Reflectance – The FAA accepted an alternative compliance than that specified in Policy Memorandum PS-ANM100-2003-115-04. If the reflectance difference between the coloured band and the metal door sill is 25 percent or greater, then the contrast is acceptable, regardless of the reflectance value of the darker colour. If the reflectance difference is less than 25 percent, then the metal door sill can be ignored and the reflectance evaluation can be conducted between the coloured band and the fuselage surface below the metal door sill. In this case, a reflectance difference of 30 percent or greater is acceptable, regardless of the reflectance value of the darker colour.

PS07-0585-CS-10 §§25.811(d), 25.811(g), 25.812(b)(1)(i), and 25.812(b)(1)(ii) ELOS Finding for Graphical Exit Signs – Boeing proposed use of graphical exit signs currently permitted by EASA rules (a white figure running to a white rectangle within a green background), instead of the conventional red text-based exit signs required by the existing FAA regulations. This can increase safety by providing an exit symbol that will be understood by all passengers, regardless of their native language. The FAA required special emphasis briefings, which must include reference to an information card containing the text meaning of the signs.

TC6918SE-T-CS-14 §25.856(b), ELOS Finding Associated to Post-Crash Fire Survivability – This was granted based on testing which showed the Model 787 series composite fuselage skin and associated structural/system components provide a survivable cabin environment for five minutes, or equivalent to traditional aluminium with compliant thermal acoustic insulation.

PS07-0585-CS-18 §25.811(e)(4)(i), (ii), and (iii) ELOS Finding for the Passenger Door Operational Arrow Location and Color – On the Model 787 series the projected tip of the door handle marking arrow is more than one inch from the centerline when the handle has reached full travel. In addition, the proposed arrow and "OPEN" text on the emergency exit doors is green in lieu of red. This was accepted based on compensating features, including: the instructions are clear; the arrows shows the full 180° motion instead of the required 70°; the door has an emergency power assist system; there is a special emphasis briefing in the Flight Manual; and there is an FAA-accepted Implementation Plan to ensure appropriate procedures in the Cabin Attendant Training Manual, and correct details on the passenger briefing card.

PS06-0413-CS-25 §25.783(e)(2) ELOS Finding for Passenger and Large Cargo Door Indication – The rule intent is based on the dark flightdeck approach that the light comes on and indicates when the door is *not* secure. Boeing uses the opposite philosophy where the operator must see a green light after every closing to assure the door is closed, latched and locked. If power is lost or the bulb falls, there is no such indication. This compensates for not literally meeting the rule.

TC6918SE-T-ES-5 §25.831(g) ELOS Finding for Acceptable High Temperature Physiological Environment During Failure Conditions – The intent of §25.831(g) was to limit the exposure time to high temperatures in the crew and passenger compartments to prevent a hazard to continued safe flight and landing. The regulation also includes a requirement to maintain humidity below 27 mbar. Based on a recommendation from the Mechanical Systems Harmonization Working Group the FAA now finds it acceptable to provide human physiological limits (rather than temperature/humidity exposure limits), as proposed in a draft revision to AC 25-20.

PS13-1000-C-5 §25.853(a)(d) Part 25 Appendix F Parts I and IV Flammability Testing Hierarchy – This Multi-model ELOS streamlines flammability testing, and is listed to allow applicants to recognize these efficiencies. Currently heat release and Bunsen burner testing of compartment materials and finishes are required. Data from over 2700 configurations supports the conclusion that meeting heat release ensures robust Bunsen burner results. This is supported by the ARAC Working Group recommendation. (No 787 items have yet been certified using this method.)

TC6918SE-T-ES-16 §25.1443(c) ELOS Finding for the Passenger Oxygen System – The pulse system delivers an initial high concentration of oxygen to each passenger at the start of the inhalation cycle followed by ambient air for the rest of the cycle. This will not deliver oxygen per the minimum mass flow performance parameters specified in §25.1443(c). The FAA found an equivalent level of safety could be provided by the pulse system with the criteria that approved testing was performed to measure oxygen saturation levels for a variety of masks/subjects/altitudes.

TC6918SE-T-ES-18 §25.1441(c) ELOS Finding for Pulse Oxygen System for Passengers – The FAA recognised that the small, sealed, one-time oxygen bottles used on the Boeing 787 are similar in concept to chemical oxygen generators. Neither provides the oxygen quantity indication required by § 25.1441(c) but an equivalent level of safety is established for the bottles by testing and maintenance procedures to ensure they continue to contain adequate oxygen quantity throughout their lifetime.

TC6918SE-T-ES-19 §25.841(b)(6) ELOS Finding on Cabin Altitude Warning System for Operations into High Altitude Airports – To allow operation into airports up to 14,500ft, the visual and aural warning that would normally be required above 10,000ft cabin altitude is held off until a maximum of 15,650ft (depending on destination airport altitude). A “high cabin alt mode” message is displayed when operating at the higher setting. In addition, the flight crew are required to don oxygen masks for high altitude operations.

TC6918SE-T-ES-20 §25.1443(d) ELOS Finding for Portable Pulse Oxygen System – Boeing proposed the use of portable first aid oxygen equipment that uses pulse technology which does not meet the flow rate requirements. Boeing contended that providing a high concentration of oxygen at the start of inhalation with a pulse system provides a level of protection equivalent to that given by previously certified constant flow oxygen systems because the pulse system only supplies oxygen during the phase in the respiratory cycle when it is most effectively used by the body. Comparative testing, measuring oxygen saturation levels at altitude, was used to show equivalency.

TC6918SE-T-F-4 §25.1517 ELOS Finding for Rough Air Speed (V_{RA}) – ELOS was granted to use the harmonised §25.1517 rule which has been published under EASA CS §25.1517 but has not yet been published by the FAA.

TC6918SE-T-F-14 §25.677(b) ELOS Finding for Trim Displays – §25.677(b) requires the trim indication be displayed full time and near the trim control. The Boeing 787 uses the EICAS display to indicate trim and it is automatically displayed for specific conditions (on ground, take-off, non-normal operation) or is pilot selectable. FAA AC25-11 paragraph 7(h) addresses full-time verses part-time displays and was used to justify the ELOS finding.

TC6918SE-T-F-17 §25.255 ELOS Finding for Out-of-Trim Characteristics – Due to the Boeing 787 control law, there are no scenarios where the pilot has to "hold" column force against a mis-trim. As such the design does not allow testing to §25.255. In addition, automatic overspeed protection is provided to return the aircraft below V_{mo}/M_{mo} without pilot input. The design of the primary control law in addition to the numerous and redundant safety features of the stabilizer control system provide a wide range of compensating features that justify an ELOS finding.

PS06-0496-F-18 §25.1555(d)(1) ELOS Finding for Engine and Auxiliary Power Unit (APU) Fire Handle Design – The handles are black, consistent with the quiet, dark flight deck philosophy. However under an annunciated fire condition in an engine or APU compartment, the fire handles are brightly illuminated red to allow users to quickly identify the controls. As an additional safety feature they also have a mechanical lock to prevent inadvertent operation.

PS06-0413-F-20 [787-8] and PS06-496-F-21 [787-9] §25.1325(e) ELOS Finding for the Standby Air Data System (SADS) – During flight testing it was discovered the SADS exceeded the minimum error allowed. This is caused by the simplicity of the design (no angle of attack input) driven by reliability requirements, which would be counter-productive to correct. Compensating factors were the accuracies are only outside limits for some flap configuration and airspeed combinations, and a non-normal procedure and correction tables are provided in the AFM.

PS12-0038-SE-11 §25.1713(c) Electrical Wiring Interconnection System (EWIS) - This gives credit for Part 33 engine wiring testing. (Part 33 requirements are different than Part 25 and require additional consideration of a severe operating environment and installation within fire zones. However, they do not specifically address the flammability of electrical wire.) The compensating features were similar to the equivalency granted on the 737-8 engines and the issue paper was revised to include the RR Trent 1000-TEN engines on the 787-9. (The 787-8 did not have the EWIS rules in its certification basis and did not require this ELOS, but the designs are identical.)

TC6918SE-T-G-8 §§25.1529, 25.1729, Appendix H25.4(a) and (b) ELOS Finding for Formatting of Boeing ICA Manuals – Airworthiness Limitations on Models 787 – Boeing uses a format for the AL section of the ICA which does not literally meet the rule which requires them to be provided as part of the "principle manual". ALS data is provided in Section 9 of the MPD, and is contained in a single electronic repository available on the myBoeingFleet website.

PS05-0177-P-2 §25.981(b)(2) ELOS Finding for the Fuel Tank Flammability Rule (FTFR) – Boeing requested FAA accept their Monte Carlo model developed for incorporation of the Nitrogen Gas System on Boeing 737, 747-400, 747-8, 757, 767, 777 and 787 series airplanes that included differences in modelling techniques and parameters from the FAA model defined in the

User's Manual. This was justified because the airworthiness limitations incorporated as a condition of this ELOS produce an overall flammability that meets the exposure required by §25.981(b). The conditions require Boeing to monitor the descent rates of a representative fleet of operators to determine if changes to the ATC system to improve fuel efficiency and reduce greenhouse gas emissions result in increased fuel tank flammability.

TC6918SE-T-P-2 §25.933(a)(1)(i) and §25.933(a)(1)(ii) ELOS Finding for Flight Critical Thrust Reverser (TR) – Because assuring adequate control margins is not practical for all transport airplane types, the FAA accepts improved safeguards against the occurrence of unwanted inadvertent inflight TR deployment using both "reliability" and "controllability" criteria. Boeing used the former, involving a rigorous qualitative safety analysis to show that no single failure or malfunction, regardless of the probability, can result in a catastrophic inflight TR deployment.

TC6918SE-T-P-3 §25.1182(a) ELOS Finding for Fire Safety Requirements for the Aft Strut Fairing Compartment – In nacelle areas behind the firewall and engine pod attaching structures each component carrying flammable fluid must be fire resistant. The 787-8 aft fairing compartment design contains several hydraulic system components which have not been shown to meet their respective fire resistance/proof requirements. An ELOS was granted based on the compensating features that the engine pod attaching structure design provides isolation of the aft fairing compartment from the engine fire zones by use of intervening compartments and physical distance with a consequent reduced risk of progression or heating from an engine fire.

TC6918SE-T-P-13R1 Part 25 Subparts E, F, and G ELOS Finding for the Auxiliary Power Unit (APU) Installation – Using the proposed FAR 25 new Appendix K requirements (harmonized with the proposed JAR 25 subpart J) for the Model 787-8 APU installation inherently represents a more stringent set of APU installation requirements than the current regulations.

TC6918SE-T-P-17 §25.934 ELOS Finding for the Engine and Thrust Reverser System Testing – An ELOS was granted to allow use of a slave thrust reverser duct during engine endurance calibration, operation, and vibration testing based on in-service experience of similar designs and use of production thrust reverser for the thrust reverser cycling tests.

TC6918SE-T-P-19 §§25.1023(b) and 25.1121(c) ELOS Finding for Auxiliary Power System – As it applies to the 787 APU installation, normal openings in the eductor-type oil cooling design could allow an APU compartment fire to impinge directly upon the oil radiator. Boeing proposed an alternate fire test of the oil cooler to demonstrate no hazardous failure as opposed to showing it fireproof. The APU, including the oil system, is shut down in the event of a fire detection or oil over-temperature.

TC6918SE-T-P-20 §§25.997 and 25.1305(c)(6) ELOS Finding for Warning Means for Engine Fuel Filter Contamination – For the strainer and filter combination, the strainer alone does not meet the capacity requirement of 25.997; whereas the filter does but is located downstream of the engine driven pump. Since the pump is expected to operate pumping strained fuel without damage and both strainer and filter have bypass and pressure sensing capability, an equivalent level of safety is provided.

TC6918SE-T-P-27 §25.1145(a) Engine Igniter Flight-deck Switch Configuration – The rule requires ignition switches that control each engine ignition circuit on each engine. The Boeing 787 does not provide individual flight deck switches but an equivalent level of safety is provided for by the electronic engine control system which provides automatic relight, switching, and igniter health monitoring.

TC6918SE-T-SA-7 [787-8] and PS06-0496-T-SA-31 [787-9] ELOS Finding for use of ARAC Recommended Revision to §§ 25.1301, 25.1309, and 25.1310 – An ELOS was granted to allow use of these ARAC recommended revised rules with the exception of cargo fire protection systems, which is to comply with FAR §25.1309 at Amendment 117.

TC6918SE-T-SA-10 §25.1459(a)(2) ELOS Finding for Flight Recorders – Boeing requested to use the Earth Reference System (ERS) accelerometers in lieu of the centre of gravity mounted Flight Data Recorder (FDR) accelerometers required by § 25.1459(a)(2). The ERS sensors will be located slightly outside the longitudinal limits permitted by the rule. Validation of the accelerometers is accomplished by flight test. The system is similar to that used on the Boeing 777.

TC6918SE-T-SA-11 §25.1303(c)(1) ELOS Finding for Overspeed Aural Warning – The overspeed warning on previous Boeing models, an independent clacker, has been replaced with a siren. The Rule requires the aural warning for a speed warning device be different "distinctively from aural warnings used for other purposes." This ELOS concluded that using an aural warning common to other warnings is acceptable when it is accompanied by an EICAS message.

TC6918SE-T-SA-29 § 25.1333(a) ELOS Finding for Instrument Systems – It was agreed, based upon the 787 integrated architecture, that the high integrity and availability of critical signals meets the equivalent integrity and availability that would otherwise be provided by independent signal sources for each pilot station r\red by FAR §25.1333(a).

TC6918SE-T-SE-14 §25.1351(b)(5) ELOS Finding for Flight Control Electronics DC Power System – The permanent magnet generators that are dedicated to the flight control electronics are accepted as not requiring a means, accessible in flight, for their disconnection since they have a limited in power output capability, no connection to aircraft structure and redundant protection is incorporated the flight control electronic system.

TC6918SE-T-SF-1 §25.671(c)(2) ELOS Finding for Flight Control System Failure Criteria – An ELOS was raised to enable use of the draft harmonised rule §25.671(c) and AC/AMJ 25.671 from the Flight Controls Harmonisation working group ARAC which provides guidance on what is an acceptable risk level after occurrence of a single failure of the control system. The FAA accepted the risk level but identified additional steps in the safety analysis to document all combined failures with a probability of less than 1 in 1000; highlight all significant latent failures that could leave the aircraft one failure from a catastrophic failure; and discuss all significant latent failures with FAA/EASA as soon as they have been identified.

TC6918SE-T-SF-5 §25.777(e) ELOS Finding on the Wing Flap Control Lever – The FAA accepted that the flap control lever position is not 'aft of the throttles' as required by §25.777 but is located on the same axis of rotation. An equivalent level of safety is provided by being a similar layout to previous Boeing models; having more than the required separation between flap and throttle controls; having a different action of operation; and with the provision of flap/slat position awareness that exceeds the minimum requirements.

PS06-496-SF-7 §25.675 ELOS for Seal Krueger Flap Stops – It was found during improper use of the LE system in the factory that there were no stops on the Seal Krueger Flap. This was accepted as equivalently safe on the basis that an overtravel event was unlikely; the system is common to the leading edge slats which do have compliant stops and an overdrive condition on the slats would occur before the seal Krueger flap; and the kinematic properties of the Seal Krueger flap linkage make it impossible for the actuator to overextend. In the retract direction the Seal Krueger flap motion is limited by the fixed-wing structure.

PS14-0470-P-15 Part 25 Appendix K25.2.2(d) ETOPS Ground Test – Boeing proposed propulsion validation testing without a complete airplane nacelle package, and also not to directly comply with the requirement to completely disassemble and inspect the EBU hardware after completion of the test. Boeing showed that the installation environment with respect to loads, temperature exposure and vibration is equivalent and the slave C-Duct used had similar mass and stiffness properties. All components used must undergo a full visual inspection and acceptance test.

PS18-0046-EE-10 §25.1535 and Part 25 Appendix K25.2.2(g) Flight Test – To prove the ETOPS capability of the revised TEN configuration Boeing advised the engine does not directly comply because a worst-case flight condition(s) involving a cracked blade in a "propped" state is not practical to set up and test. (The proposed type design includes potentially cracked stage 1 and/or stage 2 IPC blades that have an increased potential for failure during an ETOPS diversion.) Instead compliance was based on five compensating factors and required in-service blade inspection actions. These include: demonstrating conservative crack growth prediction and detection; demonstrating ETOPS capability with undetected cracks present; including the maintenance program in the Airworthiness Limitations (AWL) Section of the engine Time Limits Manual (TLM) and the Boeing Model 787 CMP document; and limiting ETOPS maximum length diversion time to 180 minutes.

PS13-0546-P-36 §25.1549(b) ELOS Finding for Display of Powerplant Instruments – In line with their "dark cockpit" philosophy Boeing did not want to display the normal operating range with green arcs. With FADEC, the primary means of assuring operation within safe limits is by automated protection features and the crew is no longer the primary means of preventing an exceedance. Thus need for crew awareness is greatly diminished, and the concept of only utilizing conspicuous indications for non-normal conditions actually improves effectiveness of detection.

Model 787-8

PS08-0670-C-1 §25.853(a) ELOS Finding for Adhesives Used in Interior Panel Joint Potting Applications – Interior panels made of traditional aerospace materials use small quantities of adhesives. Boeing proposed specific test methods (heat release per Appendix F Part IV or radiant panel per Appendix F Part IV) in conjunction with compensating design features (isolation from ignition sources, flame resistant barrier, accessible with a hand-held fire extinguisher) to show equivalent safety. While listed on the Model 787 TCDS this ELOS is applicable to all current Boeing production aircraft. However Boeing advised this means of compliance was not used for the 787 because potting compounds used on that model allow direct compliance to the regulation.

PS09-0987-CS-28 §25.562 and §25.785 ELOS Finding on Dynamic Test Requirements for Single Occupant Side-Facing Seats – This is only applicable to aircraft with B/E Aerospace Super-Diamond model side-facing business class seats, which can be installed without a side support wall/structure, because of the mitigating factors of the shallow installation angle (24°) and that the occupant is free to orient to the longitudinal axis of the airplane during the application of emergency landing loads. The armrests do no inhibit the passenger from aligning with the centreline, and there are no aspects of the design which could entrap the occupant's feet.

PS12-1032-CS-31 §§25.562 and 25.785 ELOS Dynamic Test Requirements for Single Occupant Oblique Seats with Inflatable Restraints – The same ELOS for equivalency to a normal forward facing seat as CS-28 above was issued for B/E Aerospace Super-Diamond seats installed at an angle of 30°.

PS12-1033-C-32 §§25.562 and 25.785 ELOS Dynamic Test Requirements for Single Occupant Side-Facing Seats – The same ELOS for equivalency to a normal forward facing seat as CS-28 was issued applicable to Zodiac U.S. Cirrus seats installed at an angle of 28°.

TC6918SE-T-F-6 §25.107(e)(1)(iv) ELOS Finding for Minimum Unstick (V_{MU}) Speed Margin – ELOS to use the harmonised §25.107 rule which has been published under EASA CS §25.107 but has not yet been published by the FAA.

PS14-0452-F-23 §25.251(b) Vibration/Buffeting Compliance Criteria, Panasonic Ku-Band Radome Antenna – This provides for demonstration by means other than flight testing of freedom from excessive vibration under any appropriate speed and power conditions up to V_{DF}/M_{DF}. In this case the applicant chose to conduct a flowfield analysis using a validated Navier/Stokes computational fluid dynamics (CFD) tool, and flight testing to V_{FC}/M_{FC}.

Model 787-9

PS06-0496-F-22 §25.123(a) and (b) Speed for En Route Flight Paths – FAR Part 25 Amendment 121 introduced new Icing requirements, including minimum speeds with respect to en route engine failure for terrain clearance with ice. The 787-9 does not literally comply in two cases, but meets the intent of the rule by ensuring that the en route climb speed provides the margin to stall speed in non-icing and icing conditions, and manoeuvre capability to stick shaker or initial buffet.

PS06-0496-T-SE-15 §25.1317(b) High Intensity Radiated Fields (HIRF) – Boeing proposed the use of alternate test levels and modulations which have been historically accepted by industry as equivalent, though not identical, to the test levels and modulations referenced in the Rule.

(v) Airworthiness Limitations:

D011Z009-03-01 – Boeing 787 Airworthiness Limitations (AWLs)

D011Z009-03-02 – Boeing 787 Airworthiness Limitations – Line Number Specific

D011Z009-03-03 – Boeing 787 Certification Maintenance Requirements (CMRs)

D011Z009-03-04 – Boeing 787 Special Compliance Items (SCIs)

(vi) Additional Design Requirements and Conditions:

The 787 TCDS lists a number of areas where "design details or information must be maintained to ensure that an unsafe design condition is not present". (The FAA has determined there are certain considerations that are taken into account during the finding of compliance to the certification basis that makes the airplane compliant, but could be compromised by modifications, repair, or STC work done after the airplane is delivered. Under the Changed Product Rule, many large changes can be categorized as minor, and therefore would only need to meet the original airplane certification basis. The ADRL communicates these considerations to all applicants who propose changes to the described model.) These include:

In-flight Engine Restart – Because some features of the advanced engines fitted had the potential to decrease engine in-flight starting performance appropriate procedures for restarting the engines in three specifies cases were required to be provided in the AFM.

Uncontrollable High Engine Thrust or Power – Because for some anticipated engine control system failure conditions the flight crew cannot be relied upon to recognize and mitigate the failures before they become hazardous or catastrophic, three design features were required with respect to the FADEC system to ensure there was no unsafe loss of the normal means to control engine thrust (power).

Engine Rotor-Lock Evaluation – The engine design must be free from engine rotor lock following an in-flight shut-down from power settings ranging from high power to idle.

Fuel Feed System Icing Threats – Each aircraft/engine and aircraft/auxiliary power system (APS) fuel feed system must either be designed to prevent an accumulation of ice anywhere in the tanks or feed being released into the fuel system, or be designed so that no loss of engine thrust occurs due to release of any ice accumulation anywhere within the airplane/engine operating envelope.

Return Landing Capability – The 787 fuel jettison system must be installed, with a rate such that there is adequate return to landing capability when considering six specified criteria, including failures and exceedences, in a 30-minute flight with 15 minutes of active fuel jettisoning in conjunction with operational procedures.

Security Conditions – The 787-9 was granted an exception under 14 CFR 21.101(b) for §§25.795(b)(1), (c)(2) and (c)(3) based on design features similar to but not equivalent to their intent. These security features must be considered in any subsequent type design change, or repair to ensure the level of safety is maintained. Modifications that reduce flight critical system separation or adversely impact flight deck smoke prevention protection, system separation and protections for searching above the overhead stowage compartments are not acceptable.

(3) Aircraft Noise and Engine Emission Standards:

(i) Environmental Standard:
The Model 787 has been certificated under FAR Part 34, including Amendments 34-1 through 34-4 (includes compliance to ICAO Annex 16, Vol.II at Amendment 6), and FAR Part 36, including Amendments 36-1 through 36-28 [Stage 4] (includes compliance to ICAO Annex 16 Vol.I [Chapter 4] at Amendment 9).

(ii) Compliance Listing:
787-8 – Report D015Z010-31 – Certification Noise Levels for Model 787−8 Airplanes Equipped with Trent 1000 Pkg B Engines – Rev C dated May 20, 2013

MODEL 787 Trent 1000 Pkg B	Certification Weight 1000 lb.		EPNL (EPNdB)						
			Flyover 6500 m		Peak Lateral 450 m	Approach 2000 M		Stage 3 / Chapter 3 Limits	Cumulative Margin to Stage 3 / Chapter 3 Limits
	BRGW	LDW	Without Cutback	With Cutback		Flap30	Flap25	FO/LA/AP	
-E Thrust Rating (53k lb)	379.1	379.1	84.9	82.1	87.3	94.9	94.1	96.3/99.9/103.4	35.3
	425.4	380.0	87.3	85.3	86.8	94.9	94.1	97.0/100.3/103.7	34.0
-C Thrust Rating (70k lb)	440.0	345.0	87.2	82.2	90.9	94.5	93.7	97.2/100.4/103.9	33.9
	502.5	380.0	89.7	85.7	90.5	94.9	94.1	98.0/100.9/104.3	32.1

787-9 – Report D015Z010-50 – Certification Noise Levels for Model 787−9 Airplanes Equipped with Trent 1000 Pkg C1 Engines – New dated April 15, 2014

MODEL 787 Trent 1000 Pkg C	Certification Weight 1000 lb.		EPNL (EPNdB)						
			Flyover 6500 m		Peak Lateral 450 m	Approach 2000 M		Stage 3 / Chapter 3 Limits	Cumulative Margin to Stage 3 / Chapter 3 Limits
	BRGW	LDW	Without Cutback	With Cutback		Flap30	Flap25	FO/LA/AP	
-J Thrust Rating (74k lb)	415.0	415.0	86.7	80.6	92.2	95.6	94.8	96.9/100.2/103.7	32.4
	475.0	395.0	88.8	83.5	91.8	95.3	94.5	97.6/100.7/104.1	31.8
	525.0	425.0	90.7	86.2	91.5	95.8	95.0	98.2/101.1/104.5	30.3
	557.0	425.0	92.1	88.0	91.3	95.8	95.0	98.6/101.3/104.7	29.5

Report D015Z010-52 – Certification Noise Levels for Model 787−9 Airplanes Equipped with Trent 1000-TEN Engines – New dated August 1, 2017

787 Trent 1000 TEN Rating:	Certification Weight 1000 lb.		EPNL (EPNdB)						
			Flyover 6500 m		Peak Lateral 450 m	Approach 2000 M		Stage 3 / Chapter 3 Limits	Cumulative Margin to Stage 3 / Chapter 3 Limits
	BRGW	LDW	Without Cutback	With Cutback		Flap30	Flap25	FO/LA/AP	
AE	511.2	425.0	91.4	88.6	89.7	96.4	95.6	98.1/101.0/104.4	28.8
D	560.0	425.0	93.6	90.3	90.7	96.4	95.6	98.6/101.3/104.7	27.2
J	560.0	425.0	93.0	88.9	91.8	96.4	95.6	98.6/101.3/104.7	27.5
K	560.0	425.0	93.0	88.9	91.8	96.4	95.6	98.6/101.3/104.7	27.5

(4) Certification Compliance Listing:

D015Z021-01 – 787-8 Compliance Checklist – FAA – Rev B March 15, 2012

D015Z024-01 – 787-9 Amended Type Certificate – Compliance Checklist – FAA New Release – June 12, 2014

COMPLIANCE CHECKLIST: 787-8/-9 Rolls-Royce Trent 1000-TEN Engine – Hardware Changes (ODA Project PS14-0470, Certification Plan 15361 Rev. W, Phase 2 (787-9) and Phase 5 (Flight Test))

Summary Report and Deliverables Matrix for Project PS19-0270, Enclosure B to RA-20-01516, plus FAA 8100-11 for PS19-0270 and CP-23434 dated 2020.01.21

(5) Flight Manual: FAA-Approved Boeing 787 Airplane Flight Manual *
Document D631Z003.8xx – CAA Accepted as AIR 3xxx

Notes:
1. See Airplane Serial Number and Appendix Effectivity specified in the AFM Front Matter. (The same flight manual is used for both the 787-8 and 787-9 minor models.)
2. The CAA AIR number will be issued for the specific AFM when a 787 AFM becomes applicable to a NZ-registered aircraft. (The AIR number assigned to the AFM for a particular registration mark can be found on the CAA website.)
3. AIR 3274 is the number assigned to Document D631Z003.919 applicable to the Air New Zealand fleet.

(6) Operating Data for Aircraft:

(i) Maintenance Manual:

D011Z009-03 – Boeing 787 Maintenance Planning Document *

D011Z009-02 – Boeing 787 Maintenance Review Board Report

B787-81205-Z0210-00 – 787-8 Structural Repair Manual

B787-81205-Z0310-00 – 787-9 Structural Repair Manual

(ii) Current service Information:
Service Bulletins

(iii) Illustrated Parts Catalogue:
See the “Parts” module of the Maintenance Performance Toolbox – 787

(7) Agreement from manufacturer to supply updates of data in (5), and (6):

Boeing provides CAA access to www.myboeingfleet.com

(8) Other information:

D615Z003 – 787-8 Flight Crew Operations Manual

D043Z580-XXX1 – 787-8 Weight and Balance Control and Loading Manual

D043Z590-XXX1 – 787-9 Weight and Balance Control and Loading Manual

D021Z002-01 – Model 787 ETOPS Configuration, Maintenance and Procedures

787B1-4102 – 787 Airplane Configuration Specification – Rev M, January 2014

787B1-0227 – 787 Airplane Description and Selections – Rev Z, January 2014

D924E110-2 – 787 Dreamliner Standard Selections – May 2014

D019E001ANZ89P-1-34334 – Detail Specification – Air New Zealand (ANZ) Model 787-9 (ZB003) – NEW April 18, 2014

D661Z007- TC000 – Electrical Load Analysis – Model 787-8 TC000

D661Z007- GA000 – Electrical Load Analysis TST – Model 787-9 GA000

CIR-CP13044-9 – ANZ ZB003 Interior Compliance Inspection Report – 6-19-2014

*Note: Operating documentation is customised to the fleet operator and/or aircraft serial number. General applicability of Type Acceptance Certificate number 13/21B/13 is therefore conditional on continued access to the aircraft-specific technical publications through myboeingfleet.

5. New Zealand Operational Rule Requirements

Compliance with the retrospective airworthiness requirements of NZCAR Part 26 has been assessed as they are a prerequisite for the grant of an airworthiness certificate.

CAR Part 26 – Subpart B – Additional Airworthiness Requirements

Appendix B – All Aircraft

PARA:	REQUIREMENT:	MEANS OF COMPLIANCE:
B.1	Marking of Doors and Emergency Exits	FAR Part §25.811(a)(e) & (f) at Amendment 25-120
B.2	Crew Protection Requirements – CAM 8 Appdx. B # .35	Not Applicable – Agricultural Aircraft only

Appendix C – Air Transport Aeroplanes – More than 9 Passengers Seating Capacity

PARA:	REQUIREMENT:	MEANS OF COMPLIANCE:
C.1	Doors and Exits	FAR Part 25 para §25.809(b) at Amendment 25-120
C.2.1	Additional Emergency Exits – per FAR 23.807(b) @ 10.5.93	Meets FAR Part 25 Certification requirements dated 2007
C.2.2	Emergency Exit Evacuation Equipment – Descent means	FAR Part 25 para §25.810(a) at Amendment 25-120
C.2.3	Emergency Exit Interior Marking – Size/self-illuminating	FAR Part 25 para §25.811(e) and §25.812(b) **NON-COMPLIANCE – See ELOS finding below**
C.3.1	Landing Gear Aural Warning – Automatic Flap Linking	FAR Part 25 para §25.729(e) at Amendment 25-120

Appendix D – Air Transport Aeroplanes – More than 19 Passengers Seating Capacity

PARA:	REQUIREMENT:	MEANS OF COMPLIANCE:
D.1.1	Exit Types – Shall be per FAR 25.807 @ 29.03.93	FAR Part 25 para §25.807 at Amendment 25-120
D.1.2	Floor Level Exits – Definition	FAR Part 25 para §25.807(a) at Amendment 25-120
D.2.1	Additional Emergency Exits – Must meet requirements	(a) Complies (b) Not Applicable – no ventral/tailcone exits
D.2.2	Emergency Exit Access – All Required Exits must have: Passageway unobstructed 500m wide between areas/leading to a Type I or II Exit; Crew assist space; Access to Type III or IV Exit is unobstructed. Internal doors must be able to be latched open – placarded	FAR Part 25 para §25.813 at Amendment 25-120 Not Applicable – No internal doors
D.2.3	Emergency Exit Operating Handles – Markings/Lighting	FAR Part 25 para §25.811(e) at Amendment 25-120 **NON-COMPLIANCE – See FAA ELOS Number PS07-0585-CS-10 – The 787 uses a green arrow for the door markings. ELOS reviewed and accepted by CAA.**
D.2.4	Emergency Exit Evacuation Equipment – Descent means	FAR Part 25 para §25.810(c) at Amendment 25-120
D.2.5	Emergency Exit Escape Route – Must be slip resistant	FAR Part 25 para §25.810(c) at Amendment 25-120
D.2.6	Emergency Lightning (a) Switch Provisions; Uninterrupted Power; Last 10 min. (b) Descent Illumination – Automatic and Independent	 FAR Part 25 para §25.812(f) & (i) at Amendment 25-120 FAR Part 25 para §25.812(h) at Amendment 25-120
D.2.7	Emergency Interior Lighting – independent supply; min. Illumination; incl. Floor proximity escape path markings	FAR Part 25 para §25.812(c) & (e) at Amendment 25-120
D.2.8	Emergency Exterior Lighting – in effect 30.04.72 or later	Meets FAR Part 25 certification requirements after 1-5-72
D.2.9	Emergency Exit Interior Marking – Clear; instructions Location signs above routes, by exits, on bulkheads Meet provisions in effect 30 April 1972, or later Minimum brightness 250 microlamberts	FAR Part 25 para §25.811(b) & (d) at Amendment 25-120 Meets FAR Part 25 certification requirements at Amendment 25-120 dated 15 February 2007. **NON-COMPLIANCE – See ELOS PS07-0585-CS-10 Graphical Exit Signs – Approves use of the "green running man" symbol. This has been accepted in NZ for the Airbus A320 – See CRI C-1 dated 13-Jan-2011.**
D.2.10	Emergency Exit Exterior Markings – 2" contrasting band; opening instructions in red or bright chrome yellow;	FAR Part 25 para §25.811(f) (See Equivalent Levels of Safety finding TC6918SE-T-CS-2)
D.3	Lavatory Fire Protection – Placards; Exterior ashtray; Waste Bin – Sealed door; built-in fire extinguisher; smoke detector system with external warning	FAR Part 25 para §25.791(d) at Amendment 25-120 FAR Part 25 para 25.853(d) & (e) at Amendment 25-120
D.4	Materials for Compartment Interiors – T/C after 1.01.58: (b) Manufactured 20/8/88 – 20/8/90 – Meet heat release requirements of FAR 25 at 20.08.86 increased to 100/100 Manufactured after 20/8/90 – Meet heat release rate and smoke tests of FAR Part 25 in effect 26.09.88 (c) Seat cushions (except flightdeck) must be fireblocked	 FAR Part 25 para §25.853(c) at Amendment 25-120 FAR Part 25 para §25.853(b) at Amendment 25-120
D.5	Cargo and Baggage Compartments – T/C after 1.01.58: (a) Each C or D compartment greater than 200 cu ft shall have liners of GFRS or meet FAR 25 in effect 29.03.93 (c) Liners shall be separate from the aircraft structure	Meets FAR Part 25 certification requirements at Amendment 25-120 dated 15 February 2007. FAR Part 25 para §25.855(b) at Amendment 25-120

Compliance with the following additional NZ operating requirements has been reviewed and were found to be covered by either the original certification requirements or the basic build standard of the aircraft, except as noted:

CAR Part 91 – Subpart F – Instrument and Equipment Requirements

PARA:	REQUIREMENT:		MEANS OF COMPLIANCE:	
91.505	Seating and Restraints – Safety belt/Shoulder Harness		FAR Part 25 para §25.785 at Amendment 25-120	
91.507	Pax Information Signs – Smoking, safety belts fastened		FAR Part 25 para §25.791 at Amendment 25-120	
91.509 Min. VFR	(1) ASI (2) Machmeter (3) Altimeter (4) Magnetic Compass (5) Fuel Contents (6) Engine RPM (7) Oil Pressure	FAR §25.1303(b)(1) FAR §25.1303(b)(1) FAR §25.1303(b)(2) FAR §25.1303(a)(3) FAR §25.1305(a)(2) FAR §25.1305(c)(3) FAR §25.1305(a)(4)	(8) Coolant Temp (9) Oil Temperature (10) Manifold Pressure (11) Cylinder Head Temp. (12) Flap Position (13) U/c Position (14) Ammeter/Voltmeter	N/A – Turbofan FAR §25.1305(a)(6) Not Applicable – Turbofan Not Applicable – Turbofan FAR §25.699(a) FAR §25.729(e) FAR §25.1351(6)
91.511 Night	(1)Turn and Slip (2) Position Lights	FAR §25.1303(b)(4) FAR §25.1389	(3) Anti-collision Lights (4) Instrument Lighting	FAR §25.1401 FAR §25.1381
91.513	VFR Communication Equipment		FAR Part 25 para §25.1307(d) at Amendment 25-120	
	The Boeing 787 is equipped as standard with a dual high-frequency (HF – Typically HFS-900D) communication system; triple very high-frequency (VHF – Typically VHF-2100) radios, and a single SATCOM (Aero-H+ – Typically SRT-2100). These are all integrated into a Data Communications Management System (DCMS).			
91.517 IFR	(1) Gyroscopic AH (2) Gyroscopic DI (3) Gyro Power Supply (4) Sensitive Altimeter	FAR 25.1303(b)(5) FAR 25.1303(b)(6) FAR 25.1331(a)(1) FAR 25.1303(b)(2)	(5) OAT (6) Time in hr/min/sec (7) ASI/Heated Pitot (8) Rate of Climb/Descent	FAR §25.1303(a)(1) FAR §25.1303(a)(2) FAR §25.1323(h)(1) FAR §25.1303(b)(3)
91.519	IFR Communication and Navigation Equipment		FAR Part 25 para §25.1307(e) at Amendment 25-120	
	The 787 is equipped as standard with Dual integrated navigation radio (INR) systems (Honeywell P/N 940-2001-004), which incorporate the following navigation functions: Global navigation satellite system (GNSS); GLS; Instrument landing system (ILS); VHF omnidirectional radio (VOR) system; and Marker beacon (MB) system. The aircraft also has provision for dual distance measuring equipment (DME – Typically DMA-37B) systems.			
91.523	Emergency Equipment (a) More than 9 pax – First Aid Kits per Table 7 – Fire Extinguishers per Table 8 (b) More than 20 pax – Axe readily accessible to crew (c) More than 61 pax – Portable Megaphones per Table 9		***Operating Rule – Compliance to be shown by Operator*** FAR Part 25 para §25.851 at Amendment 25-120 Part of the flight deck detachable emergency equipment provided as baseline to the airplane. ACR Electronic fitted under Option 2564D104D90	
91.529	ELT – TSO C126 406 MHz after 22/11/2007		RESCU 406AFN fitted under Option 2324C512A29	
91.531	Oxygen Indicators - Volume/Pressure/Delivery		FAR Part 25 paragraphs §25.1441(c) and (d) – (See ELOS)	
91.535	Oxygen for Pressurised Aircraft: (1) Flight Crew Member On-Demand Mask; (2) Pax mask, Portable oxygen equipment (3) Crew Member – Pax Oxygen Mask and Portable (4) Minimal Supplemental Oxygen Quantity (5) Specified Supplemental/Therapeutic Oxygen Quantity Above FL250 (1) Quick-Donning Crew On-Demand Mask (2) Supplemental O_2 Masks for all Pax/Crew and Toilets (3) 15 Minutes Therapeutic Supply Above FL300 (1) Total Outlets Exceed Pax Seats by 10% (2) Extra Units Uniformly Distributed throughout Aircraft (3) Automatically Presented if Cabin Altitude ≥ 14000 ft. (4) Manual Means of Deploying Pax Masks Available ** Exemption 14/EXE/80 granted against the §91.535(e)(3) requirement for automatic pax mask deployment		***Operating Rule – Compliance to be shown by Operator*** A gaseous crew oxygen system has a standard 115 cu.ft. cylinder sized for FAA requirements for four crew members. Second cylinder fitted under Option 3510C513A06 Passenger oxygen is a distributed gaseous system with bottles installed in the PSUs, lavatories, crew rests, and attendant stations. Electronically controlled pulses are delivered to the pax masks from small, sealed cylinders. The baseline airplane is equipped with partial provisions, and selections are provided for a small, medium, or large capacity system: • small capacity = terrain clearance descent capability (tcdc) equivalent to a route system with a descent profile (dp) similar to Europe and North America • medium capacity = tcdc equivalent to a route system with a dp similar to South America and some Himalayan routes • large capacity = tcdc equivalent to a route system with a dp similar to high, long routes over the Himalayas Medium capacity selected under Option 3520C513A10 Masks deploy either manually or automatically when the cabin altitude approaches 15,000 feet. ** Maximum Operating Altitude is 43,100 feet.	
91.541	SSR Transponder and Altitude Reporting Equipment		An air traffic control transponder (ATC) /Mode S system is incorporated into each Integrated Surveillance System (ISS).	
91.543	Altitude Alerting Device – Turbojet or Turbofan		The Honeywell auto flight function (AFF) provides the autopilot and flight director altitude acquire/hold operations.	
91.545	Assigned Altitude Indicator		Not Applicable – Altitude Alerting Device fitted	
A.15	ELT Installation Requirements		The Boeing installation meets NZCAR Part 91 Appendix A.15 (b)(iii) and (iv) by inspection	

CAR Part 121 – Subpart F – Instrument and Equipment Requirements

PARA:	REQUIREMENT:		MEANS OF COMPLIANCE:
121.355	Additional Instruments (Powerplant and propeller)		FAR Part 25 is a Part 21 Appendix C standard
121.357	Additional Eqpt – Windscreen Wiper, Door, Key, Placard		Fitted as Standard
121.359	Night Flight – Landing Light, Light in each pax cabin		Fitted as Standard
121.361	IFR Operations	Speed, Alt, spare bulbs/fuses	Fitted as Standard
121.363	Flights over water	Liferafts	Air Cruisers Escape Slide Raft Assembly P/N 66572-XXX Fitted as Standard
121.365	Emergency Equipment	Per §91.523 and EROPS kit	***Operating Rule – Compliance to be shown by Operator***
121.367	PBE	TSO C99 cockpit equipment TSO C115 cabin equipment	FAR Part 25 para §25.1439 Zodiac P/N MLD20-626-1 Fixed PBE fitted as standard ESSEX PB&R P/N MR-10022N – Portable PBE fitted under Customer Option 2564D783B09
121.369	Pax Address, Intercom	Meets FAR § 121.318 and 319.	FAR §25.1423 – A Flight Interphone System is part of the communications system, and permits contact between flight crew on the flight deck and the flight crew and ground crew.
121.371	Cockpit Voice Recorder Appendix B.5 requires TSO C84/C123		FAR §25.1457 - A dual redundant ED-112 compliant CVR is installed as part of the integrated recording system (IRS).
121.373	Flight Data Recorder Appendix B.6 requires TSO C124	FAR Part 25 para §25.1459 – The airplane is equipped with a combination IRS that records flight deck voice, parametric flight data and data link messages, and stores the data in crash-protected memories. Two enhanced airborne flight recorders (Rockwell Collins EAFR-2100 meeting TSOs C123b, C124b and C177) are installed. These provide an Integrated Flight Data Acquisition Function (25 Hr Solid State FDR; 2 Hr SS CVR; and 2 Hr SS Data Link Recorder.) Boeing advise the EAFR meets FAR §121.344 at Amendment 121-338 and FAR §25.1459 at Amendment 25-124. The 787 EAFR System also is in compliance with NZCAR Part 121 Appendix B and records the minimum (applicable) 88 parameters under Table 1 required for aircraft manufactured after August 19, 2002. (See Boeing Letter of Compliance RA-14-02934.)	
121.375	Additional Attitude Indicator		Thales Integrated Standby Flight Display (ISFD) Fitted as Std
121.377	Weather Radar – Appendix B.8 requires TSO C63		Incorporated in Integrated Surveillance System (ISS) Fitted as Standard. (Rockwell Collins ISS-2100 meeting TSOs C63c, C92c, C112, C117A, C119C, C151b and C166a
121.379	GPWS – Appendix B.9 requires TSO C92		Not Applicable – TAWS fitted
121.381	Terrain Awareness and Warning System (TAWS) Appendix B.10 requires TSO C151a or b		Dual Rockwell Collins ISSs are installed. The ISS integrates the following functions: Weather radar (WXR)/predictive windshear (PWS); Mode S transponder; Traffic alert and collision avoidance system (TCAS); Terrain awareness and warning system (TAWS)/reactive windshear (RWS)
121.383	Airborne Collision Avoidance System (ACAS II) Appendix B.11 requires TSO C119b		

NOTES:

(i) The airplane is approved for both day and night VFR and IFR operations and Flight in Icing Conditions, provided the required equipment is installed and approved.

(ii) The 787 has been approved to operate in RVSM airspace.

(iii) The 787 has been evaluated per FAR §25.1535 and found suitable for 180-minute ETOPS when operated and maintained per the CMP document.

(iv) The FMCS has been shown to meet the following requirements:

- Supplemental RNAV operations (per FAA AC 20-130A, AC 90-96A, AC 90-100A, AC 90-105, EASA AMC 20-4)
- FAA AC 20-130A for a multi-sensor area navigation system when operated with radio or Global Positioning System (INR-GPS) updating.
- FAA AC 20-129 for vertical navigation (VNAV) for enroute, terminal area operations and instrument approaches (excluding ILS, GLS or MLS glideslope approach procedures).
- FAA AC 90-101A Appendix 2 and AC 120-29A Appendix 2 for RNP and RNAV instrument approaches (excluding ILS, GLS or MLS glideslope approach procedures) using LNAV, VNAV or FAC, G/P guidance coupled with the autopilot or flight director and using the ND map with the Primary Flight Display (PFD) Navigation Performance Scale (NPS) lateral and vertical deviations.
- Primary means RNP and RNAV operations (per FAA AC 20-130A, AC 90-96A, AC 90-100A, AC 90-101A Appendix 2, AC 90-105, AC 120-29A Appendix 2, and JAA TGL-10)

Certification Issues

Type Design Definition:

The 787 Airplane Configuration Specification (ACS), document number 787B1-4102, documents the baseline aircraft configuration. The customer utilizes the 787 Standard Selections Document, document number D924E110-2, to customize the baseline aircraft configuration by selecting catalog options. The final customer airplane configuration is the sum of the ACS plus catalog options plus any customer unique, non-catalog options. The total customer configuration is captured in the Configuration Specific Option Selection (CSOS) file. Once the airplane implements into the production firing order at about 16 months prior to delivery, the airplane definition is defined by the accepted options in the CSOS in addition to the ACS, and revisions to the ACS. Any configuration changes made post implementation are then captured as master changes (MCs). At time of delivery, the ACS plus revisions, accepted options in the CSOS, and master change list are combined to create a Detail Specification for each airplane.

In the Boeing production system the aircraft is defined by the "Airplane Applicability List", which references the "Airplane Product Spec ID".

Attachments

The following documents form attachments to this report:

Three-view drawing Boeing Models 787-8 and 787-9
Copy of FAA Type Certificate Data Sheet Number T00021SE

Sign off

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David Gill
Team Leader Airworthiness

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Checked – Tim Dutton
Senior Technical Specialist – Flight Test Engineering

Appendix 1

List of Type Accepted Variants:

Model:	*Applicant:*	*CAA Work Request:*	*Date Granted:*
787-8 (RR-powered)	The Boeing Company	13/21B/26	26 March 2014
787-9 (RR-powered)	The Boeing Company	13/21B/13	27 June 2014
787-9 (RR TEN-powered)	The Boeing Company	18/21B/2	21 November 2017
787 (25-745-SC)	The Boeing Company	19/21B/23	16 August 2019
787 (TCDS Rev33)	The Boeing Company	20/21B/18	19 June 2020

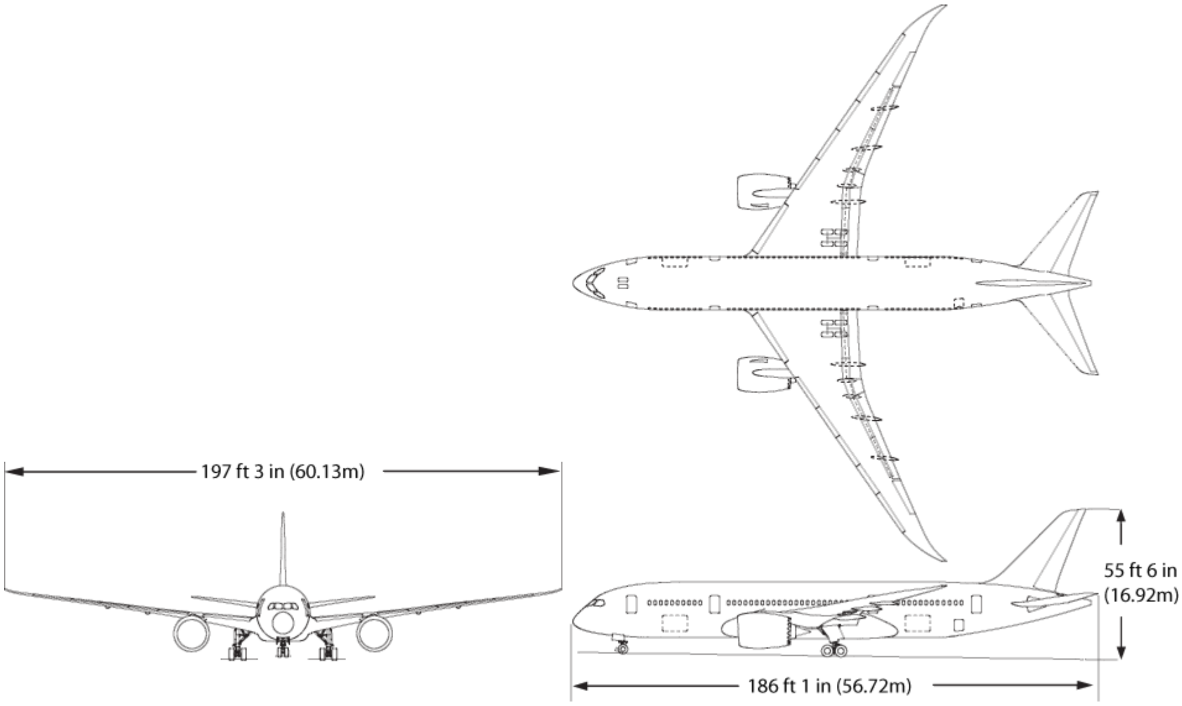

Fig.1 – Boeing 787-8 Three-view Drawing

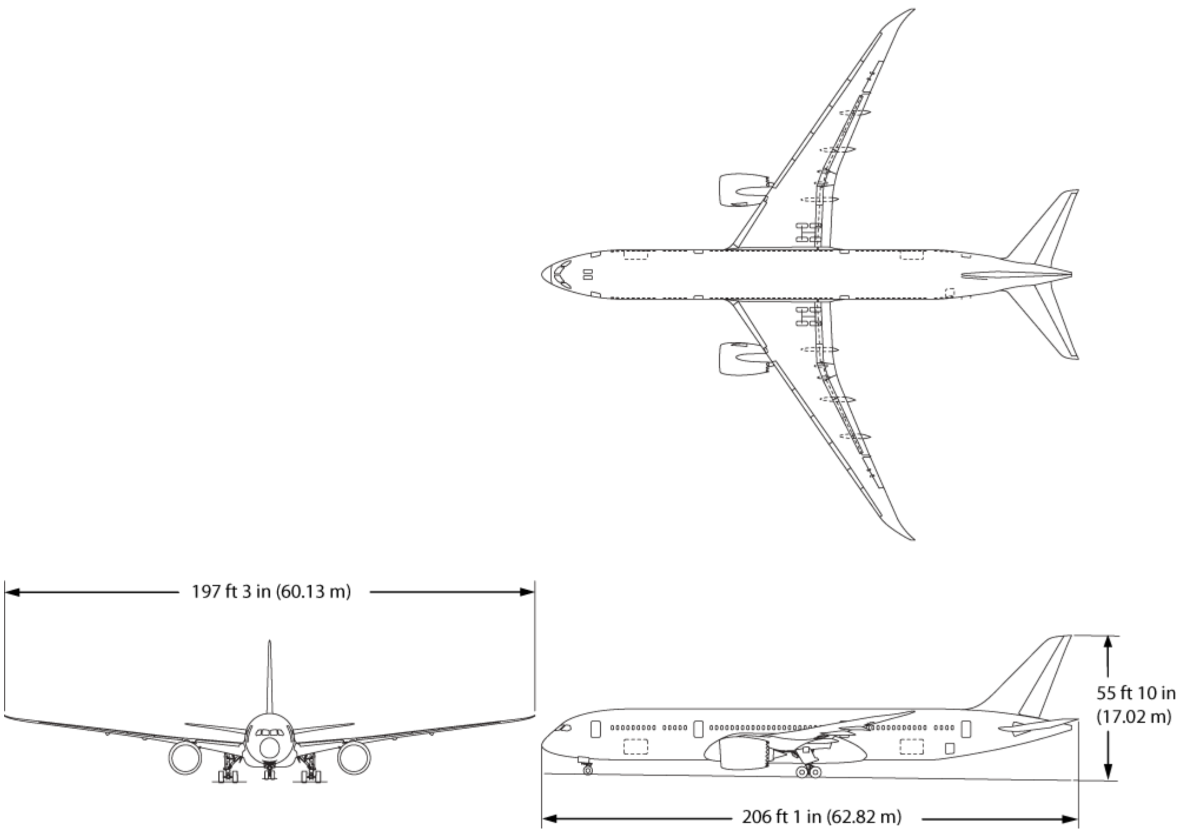

Fig.2 – Boeing 787-9 Three-view Drawing