
Type Acceptance Report

TAR 11/21B/7

General Electric GE90-100 Series

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Executive Summary

New Zealand Type Acceptance has been granted to the General Electric GE90-100 Series turbofan engine based on validation of FAA Type Certificate number E00049EN. There are no special requirements for import.

Applicability is limited to the Models and/or serial numbers detailed in Appendix 1, which are now eligible for installation on a NZ-registered aircraft. 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).

1. Introduction

This report details the basis on which Type Acceptance Certificate No. 11/21B/7 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.

2. ICAO Type Certificate Details

Manufacturer: General Electric Company
(FAA Production Certificate No.108)

Type Certificate: E00049EN
Issued by: Federal Aviation Administration

Models: GE90-110B1
GE90-113B
GE90-115B

Environmental Standard: FAR Part 34 (ICAO Annex 16)

3. Type Acceptance Details

The application for New Zealand type acceptance of the GE90-100 Series was from the manufacturer, General Electric Company, dated 9 September 2010. The GE90 is a very high bypass ratio FADEC-controlled twin-shaft axial flow turbofan engine with thrusts in the 110-115k lb range. (The suffix number in the engine designation represents the type certificated maximum thrust for that variant in 1,000 lb.)

Type Acceptance Certificate No.11/21B/7 was granted on 21 October 2010 to the General Electric GE90-100 Series engines based on validation of FAA Type Certificate E00049NE. Specific applicability is limited to the coverage provided by the documentation supplied. There are no special requirements for import into New Zealand.

The GE90 is an all-new centreline design of high-thrust turbofan engine developed for installation on large twin Transport Category aircraft. The engine configuration comprises a 10-stage high pressure compressor driven by a 2-stage high pressure turbine, while a 6-stage low pressure turbine drives a single stage fan and 3-stage low pressure compressor. The initial variants were the GE90-76B and -85B intended for application on the Boeing 777-200. Further upgrades became the GE90-90B for the 777-200ER and the GE90-77B. The latest and last production variant was the GE90-94B which uses 3D aerodynamic flow design. All GE90 variants are essentially identical (same bill of materials for production) but thrust capability and hence model designation is determined by a Rating Plug.

The GE90-100 series are derivative growth versions intended as the sole powerplant option on the Boeing 777-200LR and 777-300ER. Changes include increased fan diameter and pressure ratio using swept blade technology; improved fan shaft material; modified booster with additional 4th stage; new 9-stage HP compressor incorporating a Stage 1 blisk; new combustor scaled from the current DAC II design; new HP and LP turbine blades/vanes (with lower solidity and improved cooling flow); “FBO” load reduction features; and new FADEC 3. All GE90-100 variants are exactly the same, except for the Rating Plug. Of the three variants available, so far only the -110B and -115B have been selected by customers.

As part of type acceptance of the GE90-100 engine a team of specialists from the CAA Aircraft Certification Unit visited the General Electric Company at West Chester, Ohio for a validation/familiarisation visit. (See Minutes of Meeting, reference GE90/CPF/028/10.)

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 E00049EN

FAA Type Certificate Data Sheet number E00049EN at Rev.16 dated July 28, 2010
– Model GE90-110B1 approved July 30, 2003
– Model GE90-113B approved July 30, 2003
– Model GE90-115B approved July 30, 2003

(2) Airworthiness design requirements:

(i) *Airworthiness Design Standards:*

The certification basis of the first GE90 Series engines is FAR Part 33, including Amendments 33-1 through 33-15, plus a Special Condition was applied relating to the composite fan. For the GE90-94B this was updated to FAR 33, including Amendment 33-19, while for the GE90-100 Series FAR 33 including Amendment 33-20 was added. The Special Condition was carried over and one exemption was granted, both of which have been reviewed and accepted by the CAA. This is an acceptable certification basis in accordance with NZCAR Part 21B paragraph §21.41 and Advisory Circular 21-1, as FAR Part 33 is the basic standard for aircraft engines 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) *Special Conditions:*

SC-33-ANE-08-NE – The FAA imposed special conditions on the GE90 because of the use of carbon graphite composite material for the first stage fan blades. This was to account for the unknown effects of manufacturing and material variations, in-service deterioration and environmental effects, plus a lightning strike. In addition for the GE90-100 blade out test the FAA agreed it would be more realistic if it was conducted with failure at the inner annulus flowpath line instead of the dovetail.

(iii) *Exemptions:*

No.7953 – FAR §33.73(b) Power or Thrust Response – The Model GE90-100 was exempted from the 5-second thrust response requirement to accommodate a control system enhancement made to optimise engine operability at high-corrected core airflow conditions. (In pursuing fuel efficiency GE contended there is a trade-off between durability, operational characteristics and engine acceleration times.) The exemption was granted on the basis of compliance by the aircraft with FAR §25.119 climb performance for installed thrust.)

The TCDS Note 22 also states an Exemption against FAR §21.19(a) was granted to the GE90-100 Series to allow it to be treated as a derivative model, despite the significant power increase and major design changes, subject to: compliance still being shown with FAR §21.17; conducting a large flocking bird test under §33.76; including an engine test to show compliance with §33.90; and any airframer must still treat the engine as if it was on a new type certificate.

(iv) *Equivalent Level of Safety Findings:*

Nil

(v) *Airworthiness Limitations:*

See Chapter 05.11 – Life Limits of the GE90-100 Engine Manual GEK 109993

(3) Aircraft Noise and Engine Emission Standards:

(i) *Environmental Standard:*

The GE90 Series has been type certificated under the environmental protection requirements of FAR Part 34, including Amendments 34-1 through 34-4. (This is compatible with ICAO Annex 16, CAEP 2)

(ii) *Compliance Listing:*

GE Certification Report 2002AE283 – GE90-100 Series – Smoke and Emissions;
GE Certification Report 2002AE284 – GE90-100 Series – Fuel Venting Emissions;
GE Certification Report 2003AE462 Rev.A – GE90-100 Series – Smoke and Emissions Compliance with Twenty-Eight P02 and Two P01 Fuel Nozzles.

For results see the ICAO Engine Exhaust Emissions Data Bank model page

(4) Certification Compliance Listing:

GE90-115B FAA Certification Compliance Checklist – Revision 7.x 8/1/2002

(5) Flight Manual: Not Applicable

(6) Operating Data for Engine:

(i) *Maintenance Manual:*

GE90-100 Engine Manual – Publication number GEK 109993

GE90-115B Workscope Planning Guide – Publication number GEK 112746

(ii) *Current service Information:*

Service Bulletins

Commercial Engines Safety Memorandum

(iii) *Illustrated Parts Catalogue:*

GE90-100 Engine IPC – Publication number GEK 110005

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

CAA 2171 Form from GE90 Program Manager G H Richards dated Sept 9, 2010

Access was also provided to the Customer Web Centre at www.cwcportal.geae.com

Attachments

The following documents form attachments to this report:

Copy of FAA Type Certificate Data Sheet Number E00049EN

Sign off

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David Gill
Team Leader Airworthiness

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Checked – Geoff Connor
Manager Aircraft Certification

Appendix 1

List of Type Accepted Variants:

<i>Model:</i>	<i>Applicant:</i>	<i>CAA Work Request:</i>	<i>Date Granted:</i>
GE90-110B1	General Electric Company	11/21B/7	21 October 2010
GE90-113B	General Electric Company	11/21B/7	21 October 2010
GE90-115B	General Electric Company	11/21B/7	21 October 2010