Type Acceptance Report

TAR 14/21B/6 – Revision 3

ROLLS ROYCE TRENT 1000 Series

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Executive Summary

New Zealand Type Acceptance has been granted to the Rolls Royce Trent 1000 Series turbofan engines based on validation of EASA Type Certificate number E.036. There are no special requirements for import.

This report covers all the engine Models currently listed on the EASA Type Certificate, which are now eligible for installation on a NZ-registered aircraft. Subsequent models approved under the EASA 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.14/21B/6 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 product in New Zealand; and

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

The report also notes the status of all models included under the State-of-Design type certificate which have been granted type acceptance in New Zealand. Models covered by the type acceptance certificate issued under Part 21B at Amendment 6 or later are listed in Section 2 of this report. Models which were accepted prior to that or under the Transitional Arrangements of Part 21 Appendix A are listed in Appendix 1 of this report.

2. Product Certification Details

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

TC Holder:	Rolls-Royce Deutschland Ltd & Co KG (Transferred from Rolls-Royce plc on 21 February 2019)
Manufacturer:	Rolls-Royce plc
Type Certificate:	E.036
Issued by:	European Aviation Safety Agency
Production Approval:	UK.21G.2003

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

(i) **Models:**

Trent 1000-A	Trent 1000-A2	Trent 1000-AE3
Trent 1000-C	Trent 1000-AE2	Trent 1000-CE3
Trent 1000-D	Trent 1000-C2	Trent 1000-D3
Trent 1000-E	Trent 1000-CE2	Trent 1000-G3
Trent 1000-G	Trent 1000-D2	Trent 1000-H3
Trent 1000-H	Trent 1000-E2	Trent 1000-J3
Trent 1000-AE	Trent 1000-G2	Trent 1000-K3
Trent 1000-CE	Trent 1000-H2	Trent 1000-L3
	Trent 1000-J2	Trent 1000-M3
	Trent 1000-K2	Trent 1000-N3
	Trent 1000-L2	Trent 1000-P3
		Trent 1000-Q3
		Trent 1000-R3

3. Application Details and Background Information

The application for New Zealand type acceptance of the Trent 1000 Series was from the manufacturer dated 19 August 2013. The Trent 1000 is a three-shaft high bypass-ratio axial flow turbofan with takeoff thrust ratings in the range 58-78K. As part of the type acceptance process a team from the CAA Aircraft Certification Unit visited Rolls Royce in Derby for a validation/familiarisation visits. (For details of the technical discussions see Minutes of Meeting Document No. EDNS01000239623.)

Type Acceptance Certificate Number 14/21B/6 was granted on 26 March 2014 to the Trent 1000 "Package B" Series turbofan based on validation of EASA Type Certificate number E.036. There are no special requirements for import into New Zealand.

The Trent 1000 uses the Rolls Royce three coaxial shaft engine layout originally pioneered by the RB211. It has a single stage Low Pressure (LP) compressor [with 112 inch diameter wide-chord swept fan blades] driven by a 6-stage LP turbine, 8-stage Intermediate Pressure compressor driven by a single-stage IP turbine, and a 6-stage High Pressure compressor with associated single stage HP turbine. The combustion system consists of a single annular combustor with 18 fuel spray nozzles. When viewed from the rear the LP and IP assemblies rotate independently in an anti-clockwise direction, while the HP assembly rotates clockwise. The engine control system utilises an EEC (Electronic Engine Controller) which has an airframe interface for digital bus communications. An EMU (Engine Monitor Unit) is fitted to provide engine parameters (health monitoring) to the aircraft. The engine has minimum provision for bleed air (for nacelle anti-ice), but has dual high capacity variable frequency starter-generators (VFSG) to support 787 power needs.

The Trent 1000 was a new engine developed specifically for the Boeing 787 aircraft, using technology derived from the previous Trent models. Rolls Royce defines their engines in a document known as a Drawing Introduction Sheet (DIS). The initial baseline certification versions were to the applicable DIS at Issue 2. With the delay in 787 certification and entry into service Rolls Royce developed a series of refinements known as Package A, which then became the minimum certification standard. These were defined by the DIS at Issue 3.

Following entry into service, to improve durability and performance (particularly fuel consumption), Rolls Royce designed a further series of modifications which are known as Package B. These changes were embodied in production under Service Bulletin 72-G319, and are identified on the dataplate by Build Standard "/01". All Package A engines have now been retired from service. The TCDS also notes that engines with SB 72-G893 (which blanks the now-deleted VFSG oil cooler heat exchanger fuel return-to-tank line) are identified by Build Standard "/01A". All engines in service will eventually have this SB incorporated, so BS /01A will then be the standard configuration for Package B engines.

Trent 1000 engines in a specific Package configuration all have essentially the same Bill of Materials, and differ only in their thrust ratings, which are varied by the Data Entry Plug (DEP) which is installed on the EEC.

This report was raised to Revision 1 to include the "Package C1" Series of new engine variants. Type Acceptance was granted on 9 June 2014.

The new Boeing 787-9 model required a higher thrust rating and increased engine structural load capabilities. The latter necessitated a redesign of the engine cases, and this

lead Rolls Royce to develop Package C. To control interchangeability, because the earlier Package B versions cannot be fitted to the 787-9, Package C versions were given new model designations. These have the same name and rating relationship as Package A/B, but with an extra suffix 2. In addition three new thrust ratings were developed.

Initial Package C certification was for engines defined by DIS Issue 2. Rolls Royce has subsequently developed further improvements, including some ETOPS enhancements. This new build standard comprises 3 major and 18 minor modifications and will be defined by the DIS at Issue 3, known as Package C1. There is no change to the engine operating limitations apart from the N3 maximum redline speed is increased from 100.8% to 101.0%, and a new engine oil type is introduced. As no engines have been produced to DIS Issue 2, Package C1 at DIS Issue 3 is the minimum certification standard.

Revision 2 of this report was issued to cover the Trent "TEN" engine package. The TEN engine was initially issued as DIS Issue 2 on 11 July 2016. A change from DIS Issue 2 to Issue 3 was accepted on 17 August 2017 to include ETOPS capacity, TLD, change of Minimum Fuel Temperature and change of Maximum Permissible Rotor Speeds for the TEN models. Trent TEN models are distinguished by the suffix 3. For type acceptance of the TEN the CAA again sent a certification team to Rolls Royce for a validation visit. Type Acceptance was granted on 20 November 2017.

The Trent TEN (Thrust, Efficiency and New Technology) incorporates technologies from the Trent XWB developed for the Airbus A350 and the Advance engine programs to deliver improved thrust and efficiency. Differences from Package C1 include increased take-off thrust rating; increased HP rotor TO redline speed; reduced TET limit; modified IP and HP compressor aerofoils; modified HPT front cover plate system; fully modulated HP3 air system with vortex amplifiers; new EEC hardware and modified FOGV aerofoils.

Also included in this Revision were the new Enhanced Ratings, which were introduced to address a contract specification thrust shortfall. This was caused by a mismatch in the methods used by Boeing to calculate aircraft performance relative to that used by Rolls-Royce to define the rated Turbofan Power Ratios (TPR). Enhanced Ratings became the baseline minimum specification for Package C engines, but were not initially distinguished in the model numbering. To remove confusion Rolls Royce introduced the new model designations AE and CE for Package B engines, and AE2 and CE2 for Package C1 engines under TCDS Issue 6.

The Trent 1000 Series engine has been type accepted based on the State of Design EASA type certificate, but is fitted to the Boeing 787 under an FAA Import type certificate. Rolls Royce has advised that the same engine Bill of Materials is specified under both type certificates. The certification basis is also essentially the same under both, except that while EASA accepted an equivalent level of safety for the HP Turbine Shaft Break requirement under CS-E 840 and 850, the FAA required an exemption under the similar FAR §33.27(f)(6) provision. Exemption number 10964 was granted by the FAA subject to the condition that the HP disc burst speed is greater than 100% rotor terminal speed due to HP shaft system failure, which must be shown for each individual Trent 1000 model.

During the Trent 1000-TEN validation by the FAA exemption number 10964 has been superseded by exemption number 17413 applicable to all Trent 1000 engines. This new exemption allows Rolls Royce to exclude the HP shaft from consideration in determining

the highest overspeed that would result from a complete loss of load on a turbine rotor, subject to end of life eddy current inspections to detect cracks in the HP shaft system; additional crack propagation assessment showing that potential flaws or anomalies in the HP shaft system will not propagate to a loss of load event before the next overhaul/piece part inspection; mandatory eddy current inspection of the HP shaft system critical features at piece part exposure; leading the fleet inspection of 6 HP shafts; additional laboratory inspection of inertia welds; re-evaluation of the HP shaft system parts declared safe cyclic lives in the event of significant findings; and declaring to the installer the excluded HP shaft system and speed capability to enable the airframer to minimise the risk to an aircraft.

For the Trent-1000-TEN engine an issue arose regarding Smoke Number (SN). The TEN engine was certificated by EASA as meeting the SN requirement of EASA CS-E 1020, by being compliant at the four landing and takeoff (LTO) thrust settings. (EASA CS-E 1020, incorporates by reference ICAO Annex 16 Environmental Protection, Volume II, Aircraft Engines Emissions, Third Edition July 2008.) However the FAA requires that the SN meet the limit at all thrust settings approved by the certifying authority. Rolls Royce initially felt this was a change of interpretation by the FAA. However further review of the U.S. Regulations in 40 CFR Part 87 (EPA) and in 14 CFR Part 34 Amendment 5 (FAA), determined they were not fully harmonised with all aspects of ICAO Annex 16 Volume II, specifically in the area of smoke number. (The FAA has subsequently formally filed a difference with ICAO.)

The smoke numbers were calculated using the applicable appendix of ICAO Annex 16 and plotted against T30, which is representative of the engine thrust setting. This showed that the TEN engine's family characteristic levels were below the limit at the four LTO cycle thrust settings, but some Trent 1000-TEN engine models exceeded the SN limit at a range of thrust settings between 30% Approach and 85% Climb-out thrust setting, particularly when applying the statistical correction according to Appendix 6 of ICAO Annex 16.

Because the Trent 1000-TEN engine exceeded the SN limits required by 14 CFR 34.21(e)(2) Rolls Royce applied for an exemption, which it said would be in the public interest. Rolls Royce contended that the TEN represented the latest in engine technology and that the Trent family of engines had been reliable and safe. Rolls Royce did not anticipate that smoke number test results would exceed limits at some thrust settings, and tests did not reveal the problem until late in the development process. Rolls Royce describes the nature of the changes needed to improve the SN as "complex" and tied to maintaining other positive engine emissions and performance attributes. As such no modification has yet been identified to solve the SN non-compliance.

Rolls Royce stated that allowing the TEN engine to be installed on new Boeing 787 aircraft will reduce operating costs, fuel burn and the release of other harmful emissions such as carbon dioxide and oxides of nitrogen (relative to engines in service on other aircraft.) Allowing the engines to be produced would increase the number of engine models available to US airlines ordering new aircraft, promoting the economic interest of the United States in the competitive large commercial aircraft market, as well as promoting US regulatory standards as a global benchmark. Rolls Royce also stated it would be in the U.S. public interest because approximately 30% of the engine value comes from U.S. supplied parts, supporting the U.S. economy.

The FAA found that the subject engines are not so far out of compliance that allowing a limited time for operation would have a significant effect on air quality overall, when balanced with the improvements in other emissions and operating efficiencies, plus the economic impact on Boeing and other parts of the U.S. economy. The FAA granted Rolls Royce a Time-Limited Exemption TLE No. 17550, dated 22 September 2017, which only applies to a maximum of 198 engines produced before 31 December 2018 for installation on the Boeing 787. The engines must be marked exempt, and must be modified to meet the smoke number requirements of FAR §34.21(e)(2) at the first shop visit after March 1, 2020, but no later than December 31, 2022. A similar TLE No. 17613, dated 25 October 2017 was granted to Boeing to allow them to install the engine.

Revision 3 was issued to note transfer of the type certificate from Rolls-Royce plc to Rolls-Royce Deutschland Ltd & Co KG, and was actioned under Work Request 19/21B/21.

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:

EASA Type Certificate Number E.036

EASA Type Certificate Data Sheet No. E.036 at Issue 14 dated 21 February 2019

- Trent 1000-A, C, D, E, G, H approved 7 August 2007
- Trent 1000-A, C, D, E, G, H (Package A) approved 14 March 2011
- Trent 1000-A, C, D, E, G, H (Package B) approved 11 November 2011
- Trent 1000-A2, C2, D2, E2, G2, H2, J2, K2, L2 (Package C1 at DIS Issue 2) approved 10 September 2013
- Trent 1000-A2, C2, D2, E2, G2, H2, J2, K2, L2 (Package C1 at DIS Issue 3) approved 27 March 2014
- Trent 1000-AE, -AE2, -CE, -CE2 (Package B and C1 Enhanced Ratings) approved 06 May 2015
- Trent 1000-AE3, -CE3, -D3, -G3, -H3, -J3, -K3, -L3, -M3, -N3, -P3, -Q3, -R3 (TEN at DIS Issue 2) approved 11 July 2016
- Trent 1000-AE3, -CE3, -D3, -G3, -H3, -J3, -K3, -L3, -M3, -N3, -P3, -Q3, -R3 (TEN at DIS Issue 3) approved 17 August 2017

(2) Airworthiness design requirements:

(i) Airworthiness Design Standards:

The certification basis of the Rolls Royce Trent 1000 series is CS-E at original issue dated 24 October 2003. Three equivalent safety findings (ELOS) were made. For Package C1 one additional ELOS was added. Two further ELOS were granted for the TEN family. These have been reviewed and accepted by the CAA. This is an acceptable certification basis in accordance with CAR Part 21B paragraph §21.41 and Advisory Circular 21-1A, because CS-E is equivalent to FAR Part 33, which is the design standard for aircraft engines called up under CAR Part 21 Appendix C.

The engine has been approved for ETOPS operations with a diversion time of up to 330 minutes in accordance with CS-E 1040 Amendment 3, and for Time Limited Dispatch per CS-E 1030 Amendment 3.

(ii) Special Conditions:

Nil

(iii) Equivalent Level of Safety Findings:

All Trent 1000 Series:

CS-E 740 150 Hour Endurance Test – This must be made in the order defined in the schedule and in suitable non-stop stages. An alternative schedule may be used if it is agreed as being at least as severe. In the event of a stop occurring during any stage, the stage must be repeated unless it is considered to be unnecessary. To achieve simultaneously the required conditions of speed and TET for Take-off (T/O) and Maximum Continuous (MC) thrusts in a three-rotor-shaft system design, various engine configuration changes are necessary for each rating, which could require many mid stage stoppages and be very time consuming. This was avoided by dividing the test into blocks, with defined criteria and permitted variations which ensured the severity of the test was not reduced.

CS-E 740(f) Non declaration or display of Maximum Continuous Speed Limitation – As is now common practice it was agreed that the maximum continuous speed is not declared as a limitation in the Flight Manual or displayed on the flight deck. This was accepted on the basis the limits demonstrated during the endurance test would not be exceeded on a fully deteriorated engine in service; and if so no hazard would arise; any assumptions made were substantiated during development, certification and flight testing; and Rolls-Royce periodically review the in-service performance deterioration to ensure that actual rates are not worse than those predicted.

CS-E 790 Ingestion of Rain and Hail – This requires engine test evidence to demonstrate it will not be affected by ingestion of large hailstones. An equivalent safety finding can be accepted for compliance based on appropriate rig test data and/or analysis. The Trent 1000 was substantiated by similarity and analysis, using the hailstone impact energies for the subject engine operating conditions, and test data available for similar/other engine types. It was shown that ingestion of 25 and 50 mm diameter hailstones would not cause unacceptable mechanical damage or thrust loss.

Trent 1000 Package C1 and TEN:

CS-E 840 and CS-E 850 HP Shaft Prime Reliability – After the QANTAS A380 event Rolls Royce re-assessed the consequence of a loss-of-load to the HP turbine and concluded that it may result in rapid over-speed to burst of the disc under the most extreme conditions of thrust and temperature. (HP rotor designs have traditionally been considered as intrinsically failsafe, assuming little acceleration following loss-of-load, thus easily satisfying the shaft rule. However recent service experience has shown this assumption may no longer be valid.) RR proposed meeting the overspeed requirements for all cases except the off-load condition and showing the likelihood of an off-load event is Extremely Remote. This was accepted on the HP core rotor shaft (as distinct from secondary and tertiary shafts) on the Trent 1000 because of its specific design, environment, and heritage.

Trent 1000 TEN:

CS-E 740(e) and (f)(4)(v) Oil System Limits – Engine 11012 build 1A provided supplementary endurance testing for the approval of higher HP shaft rotational speed limitations for the TEN DIS Issue 3 standard. The engine was fitted with blanked Internal Gearbox Front (IGB-F) scavenge lines, Package C1 External Gearbox (EGB) and Oil By-pass Valve (OBV), and several re-sized oil feed restrictors. Whilst this configuration is functionally representative of the oil system interaction with the germane hardware, testing to minimum oil pressure and maximum oil temperature limits would not provide results representative of the TEN oil system. Rolls-Royce proposed for DIS Issue 3 to demonstrate compliance with CS-E 740(e) and CS-E 740(f)(4)(v) by read-across from engine 11006 builds 1 and 1A testing, supported by an Oil Heat Management System (OHMS) analysis.

CS-E 740(f)(1) Supplementary Test for Higher Rotational N_3 Limitation – The increased HP speed RLS limit was demonstrated by supplementary test and analysis. Engine 10012/1A test started as a full 150 hour test to clear increased temperature and N3 limits for the existing type design, previous limits having been cleared by a full, successful 150 hour test on engine 10006/1A. Modifications were made to engine 10012/1A to achieve increased TET and N3, whilst maintaining the existing N1 and N2 limitations. These changes exceeded the effect intended, and resulted in the engine being subjected to much harsher conditions than needed. For a 3-shaft design, there is no means to adjust N3 speed at a TET once the engine is built, and so the N3 and TET values achieved were well above the target values throughout. As a result of exceeding the target conditions, RR contended that, when the HPT blade failure occurred at 113 hours, the engine had already completed testing of adequate severity and duration to meet the intent of the supplementary test, under AMC E 740(f)(1), for a reduced N3 increase of 1.6% at MTO, and 0.6% at MCT, and with no increase in TET. This assessment includes test periods which were not originally intended to demonstrate MCT and MTO operating limits, some of which were at conditions below the declared MCT conditions.

(iv) Exemptions:

Nil

(v) Airworthiness Limitations:

See Time Limits Manual:	– T-Trent-10RR	(Package A)
Section 5-10 Critical	– T-Trent-10RRB	(Package B)
Parts Mandatory Lives	– T-Trent-10RRC	(Package C1)
	– T-Trent-10RRT	(TEN)

(3) Environmental Certification:

(i) Environmental Standard:

The Trent 1000 has been shown to meet the engine emissions and fuel venting provisions of ICAO Annex 16, Volume II, Part III (3rd Edition, July 2008), at Amendment 6 for Package A/B, Amendment 7 dated 17 November 2011 for Package C1 [CAEP/8 NOx], and Amendment 8 dated 1 January 2015 for the TEN.

(ii) Compliance Listing:

Rolls Royce Report DNS 153936 – Issue 1 dated 18/12/09 – Post Certification Compliance Report – Emissions Compliance – Trent 1000-A, Trent 1000-C, Trent 1000-D, Trent 1000-E, Trent 1000-G, Trent 1000-H (Package A)

Rolls Royce Report DNS 170301 – Issue 3 dated 11 October 2011 – Post Certification Compliance Report – Emissions Compliance – Trent 1000-A, Trent 1000-C, Trent 1000-D, Trent 1000-E, Trent 1000-G, Trent 1000-H (Package B)

Rolls Royce Report DNS 183412 – Issue 3 dated 8 March 2013 – Certification Compliance Report – Emissions Compliance – Trent 1000-A2, Trent 1000-C2, Trent 1000-D2, Trent 1000-E2, Trent 1000-G2, Trent 1000-H2, Trent 1000-J2, Trent 1000-K2, Trent 1000-L2 (Package C1)

Rolls Royce Report DNS197369 – Issue 1 dated 26 August 2014 – Certification Compliance Report – Engine Emissions – Trent 1000-AE, Trent 1000-CE (Package B Enhanced Ratings)

Rolls Royce Report DNS197370 – Issue 1 dated 26 August 2014 – Certification Compliance Report – Engine Emissions – Trent 1000-AE2, Trent 1000-CE2 (Package C1 Enhanced Ratings)

Rolls Royce Report EDNS01000534789 – Issue 3 dated 7 August 2017 – Certification Compliance Report – Emissions Compliance – Trent 1000-AE3, Trent 1000-CE3, Trent 1000-D3, Trent 1000-G3, Trent 1000-H3, Trent 1000-J3, Trent 1000-K3, Trent 1000-L3, Trent 1000-M3, Trent 1000-N3, Trent 1000-P3, Trent 1000-Q3, Trent 1000-R3 (TEN)

(4) Certification Compliance Listing:

Rolls Royce Report DNS 175161 – Issue 2 dated 11 November 2011 – Compliance Summary (DIS issue 3 BoM Plus Service Bulletin 72-G319) – Trent 1000-A, Trent 1000-C, Trent 1000-D, Trent 1000-E, Trent 1000-G, Trent 1000-H (Package B)

Rolls Royce Report DNS 189332 – Issue 2 dated 29 August 2013 – Certification Summary Report – Trent 1000-A2, Trent 1000-C2, Trent 1000-D2, Trent 1000-E2,

Trent 1000-G2, Trent 1000-H2, Trent 1000-J2, Trent 1000-K2, Trent 1000-L2 (Package C1)

Rolls-Royce Report EDNS01000300207 – Issue 2 dated 24 March 2015 – Compliance Summary – Trent 1000-AE, Trent 1000-CE (Package B Enhanced Ratings)

Rolls-Royce Report EDNS01000300208 – Issue 1 dated 1 April 2015 – Compliance Summary – Trent 1000-AE2, Trent 1000-CE2 (Package C1 Enhanced Ratings)

Rolls Royce Report EDNS01000566683 – Issue 2 dated 11 August 2017 – Compliance Summary – Trent 1000-AE3, Trent 1000-CE3, Trent 1000-D3, Trent 1000-G3, Trent 1000-H3, Trent 1000-J3, Trent 1000-K3, Trent 1000-L3, Trent 1000-M3, Trent 1000-N3, Trent 1000-P3, Trent 1000-Q3, Trent 1000-R3 (TEN)

(5) Flight Manual: Not Applicable

(6) Operating Data for Engine:

(i) Maintenance Manual:
Document B787-81205-Axxxx-00

(ii) Current Service Information:
Rolls Royce Trent 1000 Service Bulletins Index

(iii) Illustrated Parts Catalogue:
Engine Illustrated Parts Manual (Part of Engine Manual)

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

Access to publications is provided on the website www.aeromanager.com

(8) Other information:

Installation Manual: DNS 130613 (Package A/B)
DNS 193530 (Package C1)
EDNS01000566257 (TEN)

Operating Instructions: OI-Trent 1000-B787 (Package A/B)
OI-Trent 1000-B787C1 (Package C1)
OI-Trent 1000-TEN-B787 (TEN)

Engine Manual: E-Trent-10RR (Package A/B)
E-Trent-10RRC (Package C1)
E-Trent-10RRT (TEN)

EASA Certification Information No.: 2019-04 – Issued: 16/01/2019 – Subject: Intention to transfer all EASA civil Type Certificates held by Rolls Royce plc to Rolls Royce Deutschland

Attachments

The following documents form attachments to this report:

Copy of EASA Type Certificate Data Sheet Number E.036

Sign off

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David Gill	Checked – Greg Baum
Team Leader Airworthiness	Team Leader Product Certification

Appendix 1

List of Type Accepted Variants:

Models:	*Applicant:*	*CAA Work Request:*	*Date Granted:*
Trent 1000-A, -C, -D, -E, -G, -H	Rolls Royce plc	14/21B/6	26 March 2014
Trent 1000-A2, -C2, -D2, -E2 -G2, -H2, -J2, -K2, -L2	Rolls Royce plc	14/21B/6	9 June 2014
Trent 1000-AE, -AE2, -AE3, -CE -CE2, -CE3, -D3, -G3 -H3, -J3, -K3, -L3, -M3 -N3, -P3, -Q3, -R3	Rolls Royce plc	18/21B/9	20 November 2017