European Aviation Safety Agency

EASA

TYPE-CERTIFICATE DATA SHEET

Number : E.012
Issue : 04
Date : 24 May 2007
Type : Rolls-Royce plc
RB211 Trent 900 series engines

Variants
RB211 Trent 970-84
RB211 Trent 970B-84
RB211 Trent 972-84
RB211 Trent 972B-84
RB211 Trent 977-84
RB211 Trent 977B-84
RB211 Trent 980-84

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I. General

1. Type/Variants:

RB211 Trent 970-84, 970B-84, 972-84, 972B-84, 977-84, 977B-84, 980-84. These variants are approved for use on multi-engined civil aircraft classified in the Transport Category (Passenger) at the ratings and within the operating limitations specified below, subject to compliance with the powerplant installation requirements appropriate to approved installations.

2. Type Certificate Holder:

Rolls-Royce plc
PO Box 31
Derby DE24 8BJ
United Kingdom

3. Manufacturer:

Rolls-Royce plc

4. Certification Application Date:

3 April 2002	3 April 2002	3 April 2002	3 April 2002	18 March 2003
RB211 Trent 970-84	RB211 Trent 970B-84	RB211 Trent 977-84	RB211 Trent 980-84	RB211 Trent 977B-84

11 April 2005	11 April 2005
RB211 Trent 972-84	RB211 Trent 972B-84

5. Certification Reference Date:

3 April 2002

6. EASA Certification Date:

29 October 2004 for RB211 Trent 970-84, 970B-84, 977-84, 977B-84, 980-84
11 August 2005 for RB211 Trent 972-84, 972B-84

II. Certification Basis

1. Airworthiness Standards:

- JAR-E, amendment 11, dated 1 November 2001.
- E800(c) of CS-E, issue 1 for Large Flocking Bird Ingestion.
- E580(b) of CS-E, issue 1 for Failure of External Air Ducts.
- Emissions and Fuel Venting: ICAO Annex 16, Volume II, Parts II & III (2nd Edition, 1993), Amendment 4 (November 1999).

2. Special Conditions:

- JAR-E50 Programmable Logic Devices

3. Deviations:

- JAR-E890(a) Engine Calibration in Reverse Thrust

4. Equivalent Safety Findings:

- JAR-E740 150 Hour Endurance Test
- JAR-E740(f) Non declaration or display of Maximum Continuous Speed Limitation
- JAR-E800(c) Medium Bird Ingestion – Fan rig test
- JAR-E800(c)(iii) Medium Bird Ingestion – Flock encounter

III. Technical Characteristics

1. Type Design Definition:

The build standards are defined in the following Drawing Introduction Sheet (DIS) or later approved issues:

DIS 2244 Issue 4 for Trent 970-84
DIS 2245 Issue 4 for Trent 970B-84
DIS 2247 Issue 4 for Trent 977-84
DIS 2275 Issue 4 for Trent 972B-84
DIS 2248 Issue 4 for Trent 977B-84
DIS 2249 Issue 4 for Trent 980-84
DIS 2274 Issue 4 for Trent 972-84

2. Description:

The Trent 900 engine is a three shaft high bypass ratio, axial flow, turbofan with Low Pressure, Intermediate Pressure and High Pressure Compressors driven by separate turbines through coaxial shafts. The LP Compressor fan diameter is 2.95m with a swept fan blade and OGV's to increase efficiency and reduce noise. The combustion system consists of a single annular combustor.
The LP and IP assemblies rotate independently in an anti-clockwise direction, the HP assembly rotates clockwise, when viewed from the rear of the engine. The Compressor and Turbine have the following features-

Compressor	Turbine
LP – Single stage	LP – 5 stage
IP – 8 stage	IP – single stage
HP – 6 stage	HP – single stage

The engine control system utilises an EEC (Electronic Engine Controller) which has an airframe interface for digital bus communications (AFDX).

3. Equipment:

For details of equipment included in the type design definition: refer to Installation Manual
For details of equipment supplied by the Airframe TC holder: refer to Installation Manual

At engine certification, the engine has been approved for use with Aircelle Thrust Reverser Unit (TRU) at the inboard engine positions (part numbers ASE 0010-XX-0 for the left hand installation and ASE 0050-XX-0 for the right hand installation) and for a Fixed Fan Duct (FFD) in the outboard engine positions (part numbers ASE 5010-XX-0 for the left hand installation and ASE 5050-XX-0 for the right hand installation).

The TRU and FFD do not form part of the engine type design and must be certified as part of the aircraft type design.

4. Dimensions:

Overall Length (mm)	5477.5
Maximum Diameter (mm)	3944

Length - tip of spinner minus rubber tip to Tail Bearing Housing Plug Mount Flange
Diameter - around centre line, inc. VFG Cooler, not including drains mast.

5. Dry Weight:

Dry engine weight (kg)	6246

Not including fluids and Nacelle EBU

6. Ratings:

The ISA sea-level static thrust ratings are:-

Rating		970-84	970B-84	977-84	977B-84	980-84
Thrust, kN	Take-off (net) (5 minutes)	334.29	348.31	359.33	372.92	374.09
	Equivalent Bare Engine Take-off	338.75	352.91	364.07	377.83	379.0
	Maximum Continuous (net)	319.60	319.60	319.60	319.60	319.60
	Equivalent Bare Engine Maximum Continuous	323.91	323.91	323.91	323.91	323.91

Rating		972-84	972B-84
Thrust, kN	Take-off (net) (5 minutes)	341.41	356.81
	Equivalent Bare Engine Take-off	345.95	361.51
	Maximum Continuous (net)	319.60	319.60
	Equivalent Bare Engine Maximum Continuous	323.91	323.91

Refer to Notes 4 & 5.

7. Control System:

The engine is equipped with a Full Authority Digital Engine Control (FADEC) system.

For the FADEC:
Electronic Engine Control System – part number 1002600-3 or later approved standard.
Software Standard – part number RRY28-0902-380A or later approved standard.

Refer to the Installation Manual and Operating Instructions for further information.

The engine is also equipped with an Engine Monitoring Unit (EMU):
EMU– 271-123-035-036 or later approved standard.
Software Standard – 271-123-800-411 or later approved standard.

Refer to the Installation Manual and Operating Instructions for further information.
Refer to Notes 2, 3 & 8.

8. Fluids:

8.1 Fuel

Refer to the Operating Instructions for information on approved fuel and additive specifications for the Trent 900.

8.2 Oil

Refer to the Operating Instructions for information on approved oil specifications for the Trent 900.

9. Aircraft Accessory Drives:

The loads, weights and power extraction of the accessory gearbox aircraft power off takes (two hydraulic pumps and one variable frequency generator) are described in the Installation Manual.

10. Maximum Permissible Air Bleed Extraction:

Environmental Control System Bleed and Wing Anti-Icing Flow ('Customer Bleed') is bled from IP8 off take at take-off, cruise and climb, and from HP6 at descent and idle ground conditions. At holding conditions (from 1524 m to 9144 m) (5000ft to 30000ft), switch-over from IP8 to HP6 off take takes place. The maximum allowable Customer Bleed and nacelle thermal anti-icing flow is given in the tables below. Bleed flows vary linearly between the points listed.

Customer Bleed Off takes for normal operation

TET (T41) K	CUSTOMER BLEED (HP6) %W26	CUSTOMER BLEED (IP8) %W24
Low Idle to 1251	12.5 to 12	n/a
1251 to 1545	12 to 5.5	n/a
1545 to 1672	n/a	5.11 to 4.1
1672 to 1787	n/a	4.1 to 1.95
1760 to Max Take-Off	n/a	1.95

At normal operating conditions (4 bleeds and 2 aircraft air-conditioning packs), air is bled from IP off take whenever IP port pressure is greater than 206.8 kPa. For IP off take pressures lower than this value, air is bled from HP.

Customer Bleed Off takes for abnormal operation

TET (T41) K	CUSTOMER BLEED (HP6) %W26	CUSTOMER BLEED (IP8) %W24
Low Idle to 1272	14.9 to 14.35	n/a
1272 to 1406	14.35 to 13.25	n/a
1406 to 1662	13.25 to 6.6	n/a
1662 to 1803	n/a	6.35 to 2.6
1803 to Max Take-Off	n/a	2.6

Note: W24 is IP compressor inlet flow and W26 is HP compressor inlet flow.

At abnormal operating conditions (2 bleeds and 1 aircraft air-conditioning pack), air is bled from the IP off take as long as the IP port pressure is greater than 231 kPa (237.9 kPa in icing conditions); otherwise, air is bled from the HP off take.

The nacelle thermal anti-icing flow demand (HP3) is modulated via a regulating valve to provide a constant flow function at the engine/nacelle.

Nacelle Thermal Anti-Icing Bleed Off takes for normal operation

TET (T41) K	NACELLE THERMAL ANTI-ICE BLEED (HP3) %W26
Low Idle to 1160	1.37 to 1.32
1160 to 1565	1.32 to 1.31
1565 to 1820	1.31 to 1.27
1820 to max take-off	1.27

Nacelle Thermal Anti-Icing Bleed Off takes for abnormal operation

TET (T41) K	NACELLE THERMAL ANTI-ICE BLEED (HP3) %W26
Low Idle to 1160	1.39 to 1.32
1160 to 1565	1.32 to 1.25
1565 to 1820	1.25 to 1.18
1820 to max take-off	1.18 to 1.16

Bleed is taken off the fan outlet to cool the air in the cabin bleed system pre-cooler. The maximum allowable pre-cooler flows are given in the table below. Bleed flows vary linearly between the points listed.

Pre-cooler flow for normal and abnormal operation

TET (T41) K	PRE-COOLER FLOW %W120
Idle to 1373	0.62
1373 to 1600	0.62 to 0.27
1600 to 1870	0.27

Note: W120 is fan inlet flow

IV. Operating Limitations

1. Temperature Limits:

1.1 Climatic Operating Envelope

The engine may be used in ambient temperatures up to ISA +40°C. Refer to the Installation Manual for details of the Operating Envelope, including the air inlet distortion at the engine inlet.

At take-off ratings, the Trent 970-84, 972-84, 977-84 and 980-84 are flat rated to ISA +15°C at all altitudes. The Trent 970B-84, 972B-84 and 977B-84 are flat rated to ISA +10°C at all altitudes.

1.2 Turbine Gas Temperature – Trimmed (°C)

Below 50% HP speed, maximum during starts on the ground:	700
Maximum during relights in flight:	850
Maximum for take-off (5 min. limit):	900
Maximum Continuous (unrestricted duration):	850
Maximum over-temperature (refer to Note 14):	920

Refer to Note 6.

1.3 Fuel temperature (°C)

Minimum fuel temperature in flight: –54 or the fuel freeze point (whichever is the higher).

Maximum fuel temperature:
(i) On ground to top of climb: 55
(ii) At the top of descent: 50

Refer to Note 7.

Refer to the Installation Manual for additional information.

1.4 Oil temperature (°C)

Combined oil scavenge temperature -

Minimum for engine starting with Special Starting procedure: –40
Minimum for engine starting with no Special Starting procedure: –30

Note: In temperatures less than –30°C but not less than –40°C, the Special Starting procedure as defined in the Operating Instructions must be followed.

Minimum for acceleration to take off power: 40
Maximum for unrestricted use: 196

2. Pressure Limits:

2.1 Fuel pressure (kPa)

Minimum absolute inlet pressure (measured at the pylon interface): 34

Maximum pressure at inlet (measured at the pylon interface):
(i) Continuous: 276
(ii) Transiently: 690
(iii) Static: 345

2.2 Oil pressure (kPa)

Minimum oil pressure:
(i) Ground idle to 70% HP rpm 172
(ii) Above 95% HP rpm 344

2.2.1 Maximum allowable Oil Consumption (l/hr): 0.46

3. Maximum / Minimum Permissible Rotor Speeds:

	HP	IP	LP
Reference speeds, 100% rpm	12200	8300	2900
Maximum for Take-off (5 minute limit) See Note 5	97.8%	98.7%	97.2%
Maximum Continuous See Note 11	97.7%	97.8%	97.2%

Stabilised operation in the speed range 64% to 72% NL is not permitted during all aircraft operations with forward airspeed less than 32.5 knots. The speed range restriction is in place until 45 knots with the minimum approved software and 60 knots with the software RRY28-0920-380A (modification 73-F328) or later approved standard installed. Passing through the speed range 64% to 72%NL while increasing or decreasing thrust is permitted.

The maximum NL speed during all aircraft operations with forward airspeed less than 32.5 knots must not exceed 78%. This speed restriction is in place until 45 knots in the minimum approved software and 35 knots with the software RRY28-0920-380A (modification 73-F328) or later approved standard installed.

4. Installation Assumptions:

Refer to Installation Manual for details.

5. Dispatch Limitations:

The engine has been approved for Time Limited Dispatch. The maximum justifiable rectification period for each dispatchable state is specified in the Installation Manual; no extension to such rectification period is allowed.

V. Operating and Service Instructions

Document	Trent 900 all variants
Installation Manual	DKC237292
Operating Instructions	OI-Trent-A380
Engine Manual	E-Trent-A380
Maintenance Manual	M-Trent-A380
Time Limits Manual	T-Trent-9RR
Service Bulletins	RB211—as required

Refer to Notes 9 & 10

VI. Notes

1. Not used.

2. The software of the Engine Electronic Control is designated Level “A” as defined by EUROCAE ED-12B/RTCA DO178B.

3. The software of the Engine Monitoring Unit is in part designated Level “C” and part level “E” as defined by EUROCAE ED-12B/RTCA DO178B.

4. The Equivalent Bare Engine Take-off and Maximum Continuous thrust quoted above is derived from the approved Net Take-off and Net Maximum Continuous thrust by excluding the losses attributable to the inlet, cold convergent nozzle, hot nozzle, by-pass duct flow leakage and the after body. No bleed or power off takes are assumed.

5. The take-off rating and the associated operating limitations may be used for up to 10 minutes in the event of an engine failure, but their use is otherwise limited to no more than 5 minutes.

6. Turbine Gas Temperature is measured by thermocouples positioned at the 1st stage Nozzle Guide Vane of the LP Turbine.

7. The fuel temperature is taken as that in the Wing Tank. The minimum and maximum fuel temperature and pressure are not measured on the engine and therefore, not provided to the flight deck. However, the wing tank temperature is available on the flight deck and it is assumed that there is negligible difference in temperature between the tank and the engine inlet.

8. HIRF, EMI / Lightning (Refer to Installation Manual for details.)

9. Engine repair and overhaul can only be carried out by Rolls-Royce until the relevant section of the Engine Manual has been approved and published.

10. The engine components subjected to a limited service life are specified in the Airworthiness Limitations Section of the Time Limits Manual.

11. The Maximum Continuous Speed limitations defined in this Data Sheet are not displayed as limitations on the A380 flight deck. In accordance with the Equivalent Safety Finding against JAR-E740(f), non display of these limitations is acceptable.

12. The acceleration from 15% to 95% rated take off power is 5,6 seconds.

13. Not used.

14. The Trent 900 is approved for a maximum exhaust gas over-temperature of 920 degrees C for inadvertent use for periods of up to 20 seconds without requiring maintenance action.
The cause of the over-temperature must be investigated and corrected.
