European Aviation Safety Agency

EASA

TYPE-CERTIFICATE DATA SHEET

Number : E.042
Issue : 01
Date : 06 March 2006
Type : Rolls-Royce plc
RB211 Trent 700 series engines

Variants
RB211 Trent 768-60
RB211 Trent 772-60
RB211 Trent 772B-60
RB211 Trent 772C-60

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I. General

1. Type/Variants: RB211 Trent 768-60, 772-60, 772B-60, 772C-60. 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:

30 June 1991	30 June 1991	26 August 1997	06 May 2005
RB211 Trent 768-60	RB211 Trent 772-60	RB211 Trent 772B-60	RB211 Trent 772C-60

5. Certification Reference Date: 30 June 1991

6. EASA Certification Date:

24 January 1994	for RB211 Trent 768-60	(refer to note 11)
18 March 1994	for RB211 Trent 772-60	(refer to note 11)
11 September 1997	for RB211 Trent 772B-60	(refer to note 11)
06 March 2006 2006	for RB211 Trent 772C-60	

II. Certification Basis

1. Airworthiness Standards:

- JAR-E, change 8, dated 4 May 1990.
- Orange Paper E/91/1
- Emissions and Fuel Venting: ICAO Annex 16 Volume II (first edition 1981)

2. Special Conditions:

- JAR-E 790 Ingestion of Rain
- JAR-E 790 Ingestion of Hail

3. Deviations:

- JAR-E890(a) Engine Calibration in Reverse Thrust – Exemption
- JAR-E 570(a)(3) Scavenge pump inlet strainers - Exemption

4. Equivalent Safety Findings:

- JAR-E740(f) Speed Limitation at Maximum Continuous Rating
- JAR-E800(c) Number of medium birds (NPA-E-12 ref Orange Paper E/93/1)

III. Technical Characteristics

1. Type Design Definition:

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

DIS 2150 Issue 3 for Trent 768-60
DIS 2141 Issue 2 for Trent 772-60
DIS 2179 Issue 1 for Trent 772B-60
DIS 2276 Issue 2 for Trent 772C-60

2. Description:

The Trent 700 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 consists of 26-off Wide Chord Fan Blades. The combustion system consist of a single annular combustor, with 24-off Fuel Spray Nozzles. The LP, IP and HP assemblies rotate independently, and in an anti-clockwise direction when viewed from the rear of the engine. The Compressor and Turbine have the following features-

Compressor	Turbine
LP – Single stage	LP – 4 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 communications (ARINC).

3. Equipment:

For details of equipment included in the type design definition: refer to the appropriate engine DIS
For details of equipment supplied by the Airframe TC holder : refer to the appropriate engine DIS

The engine DIS includes the starter motor and Thrust Reverser Unit, and all engines are approved for reverse thrust operation.

4. Dimensions:

Overall Length (mm)	5639
Maximum Radius (mm)	1372

Length- tip of spinner minus rubber tip to rear of CNA
Diameter- from centre line, not including drains mast.

5. Dry Weight:

Dry engine weight (kg)	6160

(Not including fluids and Nacelle EBU)

6. Ratings:

The ISA sea-level static thrust ratings are:-

Rating		768-60	772-60	772B-60	772C-60
Thrust, kN (lbf)	Take-off (net) (5 minutes)	300.3 (67,500)	316.3 (71,100)	316.3 (71,100)	316.3 (71,100)
	Equivalent Bare Engine Take-off	304.3 (68400)	320.3 (72,000)	320.3 (72,000)	320.3 (72,000)
	Maximum Continuous (net)	268.7 (60410)	282.7 (63,560)	282.7 (63,560)	282.7 (63,560)

Refer to Note 1, 2, 12 & 13.

7. Control System:

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

Electronic Engine Control System , part number- EEC2000-04AS1 or later approved standard.

Software Standard – EEC A6.2 or later approved standard for RB211 Trent 768-60 and 772-60
EEC A9.0 or later approved standard for RB211 Trent 772B-60
EEC A12.5 or later approved standard for RB211 Trent 772C-60

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

Refer to notes 3 & 4.

8. Fluids

8.1 Fuel
Refer to the Operating Instructions for information on approved fuel and additive specifications for the Trent 700.

8.2 Oil
Refer to the Operating Instructions for information on approved oil specifications for the Trent 700

9. Aircraft Accessory Drives:

The engine's accessory gearbox may be fitted with up to two hydraulic pumps and one Integrated Drive Generator to provide electrical and hydraulic power to the aircraft. These units are formally part of the airframe, and certified under JAR-25 regulations.

10. Maximum Permissible Air Bleed Extraction:

Environmental Control System Bleed ('Customer Bleed') is bled from IP8 off take at take-off, cruise and climb, and from HP6 at descent and idle ground conditions. Switch-over from IP8 to HP6 off take takes place automatically, dependant upon engine and atmospheric conditions . Powerplant Anti-Icing Flow is bled from HP3 offtke at all conditions

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

Condition	CUSTOMER BLEED (HP6) %W26	CUSTOMER BLEED (IP8) %W24
Low Idle	11.6%	n/a
Switchover point (nominal 1.26 EPR)	5.2%	4.5%
Maximum Continuous	n/a	3.1%
Above Max Continuous	n/a	2.4%

Customer Bleed Off takes for abnormal operation

Condition	CUSTOMER BLEED (HP6) %W26	CUSTOMER BLEED (IP8) %W24
Low Idle	12.7%	n/a
Switchover point (nominal 1.26 EPR)	5.8%	5.3%
Maximum Continuous	n/a	4.0%
Above Max Continuous	n/a	2.9%

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

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

Nacelle Thermal Anti-Icing Bleed Off takes for normal and abnormal operation

TET (T41) K	NACELLE THERMAL ANTI-ICE BLEED (HP3) %W26
Low Idle to 1450	0.75%
Maximum Continuous	0.69%
Above Maximum Continuous	0.44%

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

Condition	PRE-COOLER BLEED (LPC) %W120
Low Idle	1.23%
Maximum Continuous	1.23%
Above Maximum Continuous	0.96%

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.

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 5):	920

Refer to note 6.

1.3 Fuel temperature (°C)

Minimum fuel temperature in flight:	– 54 (or the fuel freeze point, whichever is higher.)
Minimum fuel temperature for ground starting:	– 54
Maximum fuel temperature:	55

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:	-40
Minimum for acceleration to power:	20
Maximum for unrestricted use:	190

2. Pressure Limits

2.1 Fuel pressure kPa

Minimum absolute inlet pressure (measured at engine inlet): 34.5 + Vapour Pressure

Maximum pressure at inlet (measured at the pylon interface):

(i)	Continuous:	414
(ii)	Transiently:	483
(iii)	Static:	1276

2.2 Oil pressure (kPa)

Minimum oil pressure:

(i)	Ground idle to 70% HP rpm	165
(ii)	Above 95% HP rpm	345

2.2.1 Maximum allowable Oil Consumption l/hr: 0.67

3. Maximum / Minimum Permissible Rotor Speeds

	HP	IP	LP
Reference speeds, 100% rpm	10611	7000	3900
Maximum for Take-off (5 minute limit, refer note 2, 8, 9)	100.0%	103.3%	99.0%
Maximum Overspeed (20-second limit, refer note 8, 9)	100.0%	103.3%	99.0%
Maximum Continuous See note 10, 9	99.1%	100.8%	98.2%

Stabilised operation in the speed range 51% to 74% NL is not permitted during static operations. Passing through this speed range while increasing or decreasing thrust is permitted.

4. Installation Assumptions:

Refer to Installation Manual for details.

5. Dispatch Limitations:

The dispatch criteria for the control system are specified in Rolls-Royce plc report DNS21680.

V. Operating and Service Instructions:

Document	Trent 700 all variants
Installation Manual	EL2837
Operating Instructions	F-Trent-A330
Engine Manual	E-Trent-A330
Maintenance Manual	M-Trent-A330
Time Limits Manual	T-Trent-IRR
Service Bulletins	RB211—as required

VI. Notes

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

2. 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

3. The software of the Engine Electronic Control is designated Level "1" according to DO-178A/ED-12A

4. EMI / Lightning (Refer to Installation Manual for details.)

5. The Trent 700 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.

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

7. The fuel temperature limits are quoted for conditions at the engine inlet.

8. Post Modification 73-C780, the Maximum Take-Off speeds for LP and HP shafts are increased to 99.5% and 100.7%. The speed signals transmitted to the aircraft, however, are trimmed in order to maintain the same cockpit indicated Maximum Take-Off speeds as the pre-modification standard (i.e. 99.0% and 100.0% respectively.)

9. Post Modification 73-E502, the Maximum Take-Off speeds for the HP shaft is increased to 101.7%. The speed signals transmitted to the aircraft, however, are trimmed in order to maintain the same cockpit indicated Maximum Take-Off speeds as the pre-modification standard (i.e 100.0%.) The Maximum Continuous HP Shaft speed is also raised from 99.1% to 100.1%.

10. The Maximum Continuous Speed limitations defined in this Data Sheet are not displayed as limitations on the A330 flight deck. Non display of these limitations was agreed during the Certification programme.

11. Variants RB211 Trent 668-60, 772-60 and 772B-60 were previously covered under CAA-UK Engine Type Certificate 092/2 and Type Certificate Data Sheet 1050 prior to being superceded by the EASA Type Certificate and Type Certificate Data Sheet.

12. The Trent 772B-60 has the same ratings as the 772-60 except between 610 m (2,000 ft) and 2440 m (8,000 ft) altitude or when the ambient temperature is greater than ISA + 15ºC, where the 772B-60 produces increased thrust at take-off rating. The magnitude of this increase varies with altitude and ambient temperature and is limited to a maximum of 5.4%.

13. The Trent 772C-60 has the same ratings as the 772B-60 except at altitudes above 2440 m (8,000 ft) where the 772C can provide more thrust in both Take-Off and Continuous conditions. The extent of this thrust increase is dependent upon altitude, temperature and Mach number, but is limited to a maximum of 8.5%. From 3048 m (10,000 ft) to 4877 m (16,000 ft) there is a Take-Off thrust increase of 3% for day temperatures of ISA +28ºC and above, this reduces to 0% at ISA +18ºC and below. At altitudes greater than 3962 m (13,000 ft) and Mach numbers greater than 0.4 a further thrust increase results from maximum continuous thrust exceeding maximum Take-Off thrust, this increases the maximum Take-Off thrust below ISA +15ºC by a maximum of 5.0% relative to the Trent 772B-60 at 4877 m (16,000 ft), 0.5 Mn. Max Continuous thrust is increased by up to 8.5% relative to the Trent 772B-60 rating for altitudes between 4572 m (15,000 ft) and 7620 m (25,000 ft) for Mach numbers between 0.3 and 0.6 and day temperatures from ISA to ISA +30ºC.
