European Aviation Safety Agency

EASA

TYPE-CERTIFICATE DATA SHEET

Number : E.036
Issue : 01
Date : 07 August 2007
Type : Rolls-Royce plc
Trent 1000 series engines

Variants
Trent 1000 – A
Trent 1000 – C
Trent 1000 – D
Trent 1000 – E
Trent 1000 – G
Trent 1000 – H
Trent 1000 – Z

List of effective Pages:

Page	1	2	3	4	5	6	7	8										
Issue	1	1	1	1	1	1	1	1										

Intentionally left blank

I. General

1. Type/Variants:

Trent 1000-A, Trent 1000-C, Trent 1000-D, Trent 1000-E, Trent 1000-G, Trent 1000-H, Trent 1000-Z. 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

DOA ref.: EASA.21J.035

3. Manufacturer:

Rolls-Royce plc

4. Certification Application Date:

30 April 2004

5. Certification Reference Date:

30 September 2004

6. EASA Certification Date:

07 August 2007

II. Certification Basis

1. Airworthiness Standards and Environmental Requirements:

- CS-E, issue 24 October 2003
- Emissions and Fuel Venting: ICAO Annex 16, Volume II, Parts II & III (2nd Edition, July 1993), Amendment 5 dated 24th November 2005.

2. Special Conditions:

None

3. Deviations:

None

4. Equivalent Safety Findings:

- CS-E 740 150 Hour Endurance Test
- CS-E 740(f) Non declaration or display of Maximum Continuous Speed Limitation
- CS-E 790 Ingestion of Rain and Hail

III. Technical Characteristics

1. Type Design Definition:

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

DIS 2286 Issue 2 for Trent 1000-A
DIS 2287 Issue 2 for Trent 1000-C
DIS 2288 Issue 2 for Trent 1000-D
DIS 2289 Issue 2 for Trent 1000-E
DIS 2291 Issue 2 for Trent 1000-G
DIS 2292 Issue 2 for Trent 1000-H
DIS 2295 Issue 2 for Trent 1000-Z

2. Description:

The Trent 1000 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 2.85m with a swept fan blade and OGV's. The combustion system consists of a single annular combustor with 18-off fuel spray nozzles.

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 – 6 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. An EMU (Engine Monitor Unit) is fitted (to provide vibration signals to the aircraft).

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

The Thrust Reverser Unit does not form part of the engine type design and is certified as part of the aircraft type design. The engine is not certified for use with an operable Thrust Reverser Unit.

4. Dimensions:

Overall Length (mm)	4738
Maximum Radius (mm)	1899

Length - tip of spinner minus rubber tip to rear of Cold Nozzle
Radius - from centre line, not including drains mast

5. Dry Weight:

Dry engine weight (kg)	5765

Not including fluids and Nacelle Engine Build-Up (EBU)

6. Ratings:

The ISA sea-level static thrust ratings are:

Rating		**Trent 1000-A**	**Trent 1000-C**	**Trent 1000-D**	**Trent 1000-E**
Thrust, kN (lbf)	Take-off (net) (5 minutes)	307.8 (69,194)	331.4 (74,511)	331.4 (74,511)	277.0 (62,264)
	Equivalent Bare Engine Take-off	310.9 (69,885)	334.7 (75,239)	334.7 (75,239)	279.8 (62,906)
	Maximum Continuous (net)	287.9 (64,722)	309.3 (69,523)	309.3 (69,523)	274.7 (61,758)
	Equivalent Bare Engine Maximum Continuous	290.8 (65,382)	312.3 (70,217)	312.3 (70,217)	277.6 (62,397)

Rating		**Trent 1000-G**	**Trent 1000-H**	**Trent 1000-Z**
Thrust, kN (lbf)	Take-off (net) (5 minutes)	320.6 (72,066)	284.2 (63,897)	346.2 (77,826)
	Equivalent Bare Engine Take-off	323.7 (72,777)	287.1 (64,551)	349.5 (78,576)
	Maximum Continuous (net)	287.9 (64,722)	274.7 (61,758)	309.3 (69,523)
	Equivalent Bare Engine Maximum Continuous	290.8 (65,382)	277.6 (62,397)	312.3 (70,217)

Refer to Notes 1 & 2.

7. Control System:

The engine is equipped with a Full Authority Digital Engine Control (FADEC) system and an Engine Monitoring Unit (EMU).

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

Refer to Notes 3 and 4.

8. Fluids:

8.1 Fuel and Additives

Refer to the Operating Instructions for information on approved fuel and additive specifications for the Trent 1000.

8.2 Oil

Refer to the Operating Instructions for information on approved oil specifications for the Trent 1000.

9. Aircraft Accessory Drives:

The engine's accessory gearbox may be fitted with two Variable Frequency Starter Generators (VFSG) and one Hydraulic Pump to provide electrical and hydraulic power to the aircraft. These units are part of the airframe, and certified under Aircraft Airworthiness Standards. The Engine Installation Manual details installation and operational requirements.

10. Maximum Permissible Air Bleed Extraction:

The Trent 1000 does not supply compressor air for airframe ventilation (Cabin Bleed), but does supply compressor air for the purpose of preventing ice build-up on the engine nacelle (Cowl Thermal Anti-Ice (CTAI)).

The nacelle thermal anti-icing flow demand (HP3) is modulated via a regulating valve.

Cowl Thermal Anti-Icing Bleed Off takes for Normal and Abnormal operation

Condition	Flow (%W26)
Up to 1380K TET	1.0%
1905K TET and above	0.5%

NB "W26" represents the air mass-flow through the core of the engine. Bleed flows vary linearly between the points listed.

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)

Maximum during ground starts and shutdown:	700
Maximum during in-flight relights:	900
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: –25

Maximum fuel temperature: 45

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: –10

Minimum for acceleration to power: 80

Maximum for unrestricted use: 185

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 (conditions up to and including Idle):	483
	Continuous (conditions above Idle)	310
(ii)	Transiently:	966
(iii)	Static:	1172

2.2 Oil pressure (kPa)

Minimum oil pressure:

(i)	Ground idle to 74% IP rpm	206.8
(ii)	Above 100% IP rpm	517.1

2.2.1 Maximum allowable Oil Consumption (l/hr): 0.57

3. Maximum Permissible Rotor Speeds:

	HP	IP	LP
Reference speeds, 100% rpm	13391	8937	2683
Maximum for Take-off (5 minute limit) See Note 2	95.0%	99.0%	98.0%
Maximum Continuous See Note 8	95.0%	98.5%	98.0%

(Data makes allowance for instrumentation accuracies)

For static (below 20kts) ground operation, temperature-dependent LP speed Keep Out Zones apply. The engine should be accelerated through this restriction in 5 seconds. Refer to the Engine Operating Instructions for details of the procedure.

The maximum NL speed during all aircraft operations with forward airspeed less than 60 knots must not exceed 96.5%.

4. Installation Assumptions:

Refer to Installation Manual for details.

5. Dispatch Limitations:

The engine has not been approved to operate with faults present in the control system.

V. Operating and Service Instructions

Document	Trent 1000 all variants
Installation Manual	DNS 130613
Operating Instructions	OI-Trent 1000-B787
Engine Manual	E-Trent-10RR
Maintenance Manual	D633Z101-RRY
Time Limits Manual	T-Trent-10RR
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 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 “A” according to EUROCAE ED-12B/RTCA DO178B.

4. Electro-Magnetic Interference (EMI), High Intensity Radiated Fields (HIRF) and Lightning (Refer to Installation Manual for details).

5. The Trent 1000 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. The Maximum Continuous Speed limitations defined in this Data Sheet are not displayed as limitations on the Aircraft flight deck. Non display of these limitations was agreed during the Certification programme.
