

U.S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION TYPE CERTIFICATE DATA SHEET E00076EN	TCDS NUMBER E00076EN DATE: November 18, 2011 Revision 3 ROLLS-ROYCE plc MODELS: Trent 1000-A Trent 1000-G Trent 1000-C Trent 1000-H Trent 1000-D Trent 1000-E
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Engines of models described herein conforming with this data sheet (which is part of Type Certificate Number E00076EN) and other approved data on file with the Federal Aviation Administration, meet the minimum standards for use in certificated aircraft in accordance with pertinent aircraft data sheets and applicable portions of the Federal Aviation Regulations, provided they are installed, operated, and maintained as prescribed by the approved manufacturer's manuals and other approved instructions.

TYPE CERTIFICATE (TC) HOLDER: Rolls-Royce plc
 PO Box 31
 Derby, DE24 8BJ
 United Kingdom

I. MODELS	Trent 1000-A	Trent 1000-C	Trent 1000-D	Trent 1000-E	Trent 1000-G	Trent 1000-H									
TYPE	<p>The 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 112 inches with a swept fan blade and outlet guide vanes. The combustion system consists of a single annular combustor with 18 fuel spray nozzles. The LP and IP assemblies rotate independently in a counter clockwise direction; the HP assembly rotates clockwise, when viewed from back of the engine looking forward. The compressor and turbine have the following features:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;"><u>Compressor</u></td> <td style="text-align: center;"><u>Turbine</u></td> </tr> <tr> <td style="text-align: center;">LP - single stage</td> <td style="text-align: center;">LP - 6 stage</td> </tr> <tr> <td style="text-align: center;">IP - 8 stage</td> <td style="text-align: center;">IP - single stage</td> </tr> <tr> <td style="text-align: center;">HP - 6 stage</td> <td style="text-align: center;">HP - single stage</td> </tr> </table> <p>The engine control system utilizes an electronic engine controller (EEC) which has an airframe interface for digital bus communications. An engine monitoring unit (EMU) is fitted to provide vibration signals to the aircraft.</p>							<u>Compressor</u>	<u>Turbine</u>	LP - single stage	LP - 6 stage	IP - 8 stage	IP - single stage	HP - 6 stage	HP - single stage
<u>Compressor</u>	<u>Turbine</u>														
LP - single stage	LP - 6 stage														
IP - 8 stage	IP - single stage														
HP - 6 stage	HP - single stage														
RATINGS (See NOTE 1)															
Takeoff (5 min) Thrust, (net) - lbf (See NOTE 5)	69,194	74,511	--	59,631	72,066	63,897									
Maximum continuous Thrust, (net) - lbf	64,722	69,523	--	60,253	64,722	61,758									
Equivalent bare engine Takeoff thrust - lbf	69,885	75,239	--	58,866	72,777	64,551									
Equivalent bare engine Maximum continuous- lbf	65,382	70,217	--	59,481	65,382	62,397									

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LEGEND: "--" INDICATES "SAME AS PRECEDING MODEL"
 "----" INDICATES "NOT APPLICABLE"

I. MODELS	Trent 1000-A		Trent 1000-C	Trent 1000-D	Trent 1000-E	Trent 1000-G	Trent 1000-H
PRINCIPAL DIMENSIONS, inches Length - tip of spinner to rear of cold nozzle Radius – from centerline not including drain mast	187.8		--	--	--	--	--
CENTER OF GRAVITY, inches From center of front engine mount. (power plant station 3000mm) From Horizontal Centerline From Vertical Centerline	Without Service Bulletin 72-G319 Incorporated 31.0 0.7 -3.3	With Service Bulletin 72-G319 Incorporated 31.7 0.6 -3.4	--	--	--	--	--
WEIGHT Dry with nacelle engine build-up items (lbs)	Without Service Bulletin 72-G319 Incorporated 13059	With Service Bulletin 72-G319 Incorporated 13240	--	--	--	--	--
ENGINE PARTICULARS BUILD STANDARD RR Drawing Introduction Sheet (DIS)	2286 Issue3		2287 Issue3	2288 Issue3	2289 Issue3	2291 Issue3	2292 Issue3

APPROVED FUELS	See Engine Operating Instructions for approved fuels and additives.
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APPROVED OILS	See Engine Operating Instructions for approved oils.
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OIL CONSUMPTION	Maximum 0.53 U.S. Quarts per hour.
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EQUIPMENT	For details of equipment included in the type design definition refer to the Installation manual. For details of equipment supplied by the Airframe TC holder, refer to the installation manual. A thrust reverser unit is not part of the engine type design and is certified as part of the aircraft type design. The engine is approved for operation with a thrust reverser unit.
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<p>CERTIFICATION BASIS</p>	<p><u>Airworthiness Standards:</u> FAR 33 effective February 1, 1965, as amended by FAR 33-1 through 33-21.</p> <p><u>Emissions Standards:</u> 14 CFR part 34, effective September 10, 1990, as amended by 34-1 through 34-3 and 40 CFR part 87, effective December 19, 2005. In addition the engine meets ICAO environmental standards defined in Annex 16, amendment 6, dated November 20, 2008.</p> <p>Pursuant to FAR 21.29(a)(1)(ii), the Type Certificate was issued in validation of the European Aviation Safety Agency (EASA) Certification Standards CS-E, issue 24 October 2003 which were found to provide a level of safety equivalent to that provided by FAR 33, Amendment 33-21.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>MODEL</u></th> <th style="text-align: left;"><u>APPLICATION DATE</u></th> <th style="text-align: left;"><u>ISSUED/REVISED</u></th> <th style="text-align: left;"><u>DELETED</u></th> </tr> </thead> <tbody> <tr> <td>Trent 1000-A</td> <td>December 10, 2004</td> <td>August 7, 2007</td> <td></td> </tr> <tr> <td>Trent 1000-C</td> <td>December 10, 2004</td> <td>August 7, 2007</td> <td></td> </tr> <tr> <td>Trent 1000-D</td> <td>December 10, 2004</td> <td>August 7, 2007</td> <td></td> </tr> <tr> <td>Trent 1000-E</td> <td>December 10, 2004</td> <td>August 7, 2007</td> <td></td> </tr> <tr> <td>Trent 1000-G</td> <td>December 10, 2004</td> <td>August 7, 2007</td> <td></td> </tr> <tr> <td>Trent 1000-H</td> <td>December 10, 2004</td> <td>August 7, 2007</td> <td></td> </tr> </tbody> </table>	<u>MODEL</u>	<u>APPLICATION DATE</u>	<u>ISSUED/REVISED</u>	<u>DELETED</u>	Trent 1000-A	December 10, 2004	August 7, 2007		Trent 1000-C	December 10, 2004	August 7, 2007		Trent 1000-D	December 10, 2004	August 7, 2007		Trent 1000-E	December 10, 2004	August 7, 2007		Trent 1000-G	December 10, 2004	August 7, 2007		Trent 1000-H	December 10, 2004	August 7, 2007	
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<p>IMPORT REQUIREMENTS</p>	<p>To be considered eligible for installation on U.S. registered aircraft, each new engine to be exported to the United States with UK CAA or EASA airworthiness approval shall have a Joint Aviation Authorities (JAA) or EASA Form 1, Authorized Release Certificate. The JAA or EASA Form 1 should state that the engine conforms to the type design approved under the U.S. Type Certificate E00076EN, is in a condition for safe operation and has undergone a final operational check.</p> <p>Additional guidance is contained in FAA Advisory Circular 21-23, "Airworthiness Certification of Civil Aircraft, Engines, Propellers, and Related Products Imported into the United States."</p>
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NOTES

NOTE 1. The engine ratings are based on sea-level static, International Standard Atmosphere (ISA) conditions. The Equivalent Bare Engine Take-off Thrust quoted is derived from the approved Net Take-off Thrust by excluding the losses attributable to the inlet, cold nozzle, hot nozzle, by-pass duct flow leakage and the afterbody. No power take-offs are assumed. All models are flat rated to ISA + 15 °C except the Trent 1000D which is flat rated to ISA +20 °C.

NOTE 2. MAXIMUM PERMISSIBLE ENGINE ROTOR SPEEDS (%)

100% HP = 13,391 rpm; 100% IP = 8937 rpm; 100% LP = 2683 rpm

Without Service Bulletin 72-G319 Incorporated Takeoff (5 minutes, see NOTE 5)	With Service Bulletin 72-G319 Incorporated Takeoff (5 minutes, see NOTE 5)
HP 98.6%	HP 100.2%
IP 100.8%	IP 103.5%
LP 101.4%	LP 101.5%
Maximum Continuous	
HP 97.8%	HP 99.2%
IP 99.5%	IP 100.8%
LP 101.4%	LP 101.5%

When maintenance running is performed above idle thrust with the aircraft static, the control system automatically applies a temperature dependent LP speed Keep Out Zone. Refer to the Maintenance Manual for details.

For engines without SB 72-G319, LP speed must not exceed 96.5% during any aircraft operation with an apparent tailwind, ie tailwind greater than aircraft forward speed. This limitation does not apply to an engine with SB 72-G319.

The Maximum Continuous speeds noted above are not displayed as limitations on the Aircraft flight deck.

NOTE 3.**TEMPERATURE LIMITS****TURBINE GAS TEMPERATURE - trimmed (TGT) °C**Measured by thermocouples positioned at the 1st stage Nozzle Guide Vane of the LP Turbine.

Maximum Ground Starting and Shutdown	700
Maximum Inflight Relights	900
Maximum Takeoff (5 min., see NOTE 5.)	900
Maximum Continuous (unrestricted)	850
Maximum Over-temperature (see NOTE 11)	920

FUEL °C

Measured at the inlet to the engine.

Minimum Fuel Temperature	-45
Maximum Fuel Temperature	65

OIL °C

Combined scavenge temperature.

Without Service Bulletin 72-G319 Incorporated

Minimum for starting:	-40
Minimum for acceleration to power, for fuel inlet temperature -23°C and higher:	40
Minimum for acceleration to power, for fuel inlet temperature from -45°C to -23°C:	
Varies linearly from 40 to 77	
Maximum for unrestricted use:	196
Transient limit (15 minutes):	205

With Service Bulletin 72-G319 Incorporated

Minimum for starting:	-40
Minimum for acceleration to power, for fuel inlet temperature -23°C and higher:	40
Minimum for acceleration to power, for fuel inlet temperature from -45°C to -23°C:	
Varies linearly from 40 to 77	
Maximum for unrestricted use:	193
Transient limit (15 minutes):	201

NOTE 4.**PRESSURE LIMITS****FUEL**

Minimum absolute pressure at engine inlet:	5 psi + Vapor Pressure
Transient conditions with engine running (2 seconds):	2 psi + Vapor Pressure
Maximum absolute pressure at the pylon interface:	

Transient	140 psi
Static	170 psi

OILWithout Service Bulletin 72-G319 Incorporated

Minimum Ground idle to 74% IP rpm	30 psi	
Minimum between 74% and 100% IP rpm, Varies linearly from 30 to 75 psi		Varies linearly from 30 to 90 psi
Minimum Above 100% IP rpm	75 psi	90 psi

With Service Bulletin 72-G319 Incorporated**NOTE 5.**

The take-off rating and its associated operating limitations may be used for up to 10 minutes in the event of engine out contingency, but their use is otherwise limited to not more than 5 minutes.

NOTE 6. **MAXIMUM PERMISSIBLE COMPRESSOR AIR BLEEDS**
 The Trent 1000 engines do 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)).

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

Engine Power Setting	Maximum Cowl Thermal Anti Ice Flow
TET (K)	% Core Mass Flow (W26)
Idle to 1430	2.67
1430 to 1785	2.67 to 1.25 varying linearly
1785 to 1820	1.25 to 0.54 varying linearly
1820 and above	0.54

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

NOTE 7. Life-limited parts are identified in Time Limits Manual (See NOTE 8).
 The Trent 1000 cyclic life limits are based on a commercial mission cycle, which consists of a start, takeoff, climb, cruise, descent, and landing. Use (or non-use) of a fan reverser for braking during landing does not affect cycle counts. Each of the following constitutes one cycle:
 (1) a flight consisting of a takeoff and landing,
 (2) a touch-and-go landing or simulated touch-and-go landing (no weight on wheels) for pilot training,

NOTE 8. Trent 1000 manuals submitted under EASA requirements and accepted as equivalent to FAR 33.4 and FAR 33.5 requirements are:

OPERATING INSTRUCTIONS	MAINTENANCE MANUAL	INSTALLATION MANUAL	ENGINE MANUAL	TIME LIMITS MANUAL
OI-Trent 1000-B787	B787-81205-A220100*	DNS 130613	E-Trent-10RR	T-Trent-10RR

NOTE 9. Service bulletins, structural repair manuals, vendor manuals, and engine maintenance manuals, which contain a statement that the document is approved by the European Aviation Safety Agency, are accepted by the FAA and are considered FAA approved. (These approvals pertain to the design data only).

NOTE 10. These engines are fitted with a Digital Electronic Engine Fuel Control system in which the software is designated as follows according to EUROCAE ED-12B/RTCA DO178B:
 • EEC: Level “A”.:
 • EMU: Level “E”, except that the flight deck vibration display is Level “C”.

NOTE 11. The engine is approved of a maximum exhaust gas over-temperature of 920 °C for inadvertent use for periods up to 20 seconds without requiring maintenance action. The cause of the over-temperature must be investigated and corrected.

NOTE 12.

VARIANTS

Trent 1000-A	Basic model.
Trent 1000-C	Same as basic model except for increased thrust ratings.
Trent 1000-D	Same as Trent 1000-C except flat rated to ISA +20°C.
Trent 1000-E	Same as basic model except for decreased thrust ratings.
Trent 1000-G	Same as basic model except for increased Take-off thrust ratings.
Trent 1000-H	Same as Trent 1000-E except for increased Take-off thrust ratings.

NOTE 13.

The engine has demonstrated eligibility for ETOPS under 14 CFR §33.201 for a maximum diversion time of 330 minutes. Models Trent 1000-A, Trent 1000-C, Trent 1000-D, Trent 1000-E, Trent 1000-G, and Trent 1000-H have complied with the requirements of §§ 33.4 (A33.3(c)), 33.71(c)(4) and 33.201, and is therefore eligible for installation on Extended Operations (ETOPS) and Early ETOPS approved airplanes. The demonstrated diversion time is 330 minutes at MCT plus 15 minutes at hold power. Note that ETOPS eligibility does not constitute airplane or operational level approvals necessary to conduct ETOPS flights.

NOTE 14.

The engine has been approved for Time Limited Dispatch. The maximum rectification period for each dispatchable state is specified in the Installation Manual.

NOTE 15.

These engines are approved for use in thrust reverse operation.

NOTE 16.

COMMERCIAL ENGINES IN MILITARY SERVICE: FAA-certified commercial engines in military service are not necessarily operated or maintained in accordance with the type design certification basis or Federal Aviation Regulations contained in CFR Title 14. Commercial-service use of Trent 1000 series engines or engine parts thereof that have operated in military applications is prohibited unless specific prior FAA (Engine Certification Office, ANE-140) approval is granted.

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