AGÊNCIA NACIONAL DE AVIAÇÃO CIVIL - BRASIL

TYPE CERTIFICATE DATA SHEET Nº EM-2001T05

Type Certificate Holder:

GENERAL ELECTRIC COMPANY
GE AIRCRAFT ENGINES
1 Neumann Way
Cincinnati, OH 45215-6310
USA

EM-2001T05-03

Sheet 01

GENERAL ELECTRIC

GE90-76B; GE90-90B; GE90-94B; GE90-110B1; GE90-113B; GE90-115B

June 2008

Engines of models described herein conforming with this data sheet, which is part of Type Certificate No. 2001T05, meet the minimum standards for use in certificated aircraft in accordance with pertinent aircraft data sheets and applicable portions of the Brazilian Aeronautical Regulations provided they are installed, operated, and maintained as prescribed by the approved manufacturer's manuals and other instructions.

I - MODEL GE90-76B; GE90-90B; GE90-94B

TYPE Dual rotor, axial flow, high bypass turbofan. The 10-stage high pressure compressor is driven by a 2-stage high pressure turbine. The single stage fan and 3-stage low pressure compressor are driven by a 6-stage low pressure turbine.

RATINGS (See Note 5)

	GE90-76B	GE90-90B	GE90-94B
Maximum continuous at sea level, static thrust, kN (lb)	335.5 (75 430)	402.9 (90 580)	--
Takeoff (5 min. See Note 16) at sea level, static thrust, kN (lb)	636.4 (81 070)	418.1 (94 000)	432.8 (97 300)

		GE90-76B	GE90-90B	GE90-94B
RATINGS (CONT.)				
	Flat rating ambient temperature, °C (°F)			
	Takeoff	32.8 (91)	30 (86)	30 (86)
	Maximum continuous	25 (77)	--	--
COMPONENTS (GE P/N'S)				
	Hydro-mechanical Control Unit	1693M75 1851M65	1693M75 1851M65	1851M65
	Full Authority Digital Engine Control (FADEC)	1838M16	---	1959M87
	HW (See Note 21)	1959M87 1838M16	1959M87 1838M16	1838M16
	SW (See Note 21)	1853M99	1853M99	1853M99
	Configuration Type Box (See Note 10)	320-837-701-0 320-839-501-0 320-892-101-0 320-892-201-0 320-846-701-0 320-892-601-0 320-915-201-0 320-921-501-0	320-839-501-0 320-892-201-0 320-846-701-0 320-892-601-0 320-915-201-0 320-921-501-0	320-921-501-0
	FADEC Rating Plug	320-833-701-0	320-834-001-0	320-834-301-0
	Main Fuel Pump	689M10	1689M10	1689M10
	Ignition System			
	Two ignition units GE P/N	9238M66	9238M66	9238M66
	Two ignition plugs GE P/N	1754M84	1754M84	1754M84
FUEL TYPE		See Note 7		

Legend: "--" Same as preceding model "#" "Not Applicable"

OIL, LUBRICATION	Type 2 oils conforming to GE90 Specification D50TF1 or the latest revisions are authorized. For approved brand of oils refer to GE90 Service Bulletin 79-0001.			
		GE90-76B	GE90-90B	GE90-94B
PRINCIPAL DIMENSIONS	Length, cm (in) (fan spinner to nozzle centerbody)	728.7 (286.9)	--	--
	Width, cm (in) (maximum envelope)	387.1 (152.4)	--	--
	Height, cm (in) (maximum envelope)	395.2 (155.6)	--	--
WEIGHT	Dry, kg (lb) (1)	7 892 (17 400)	--	--
	(1) Includes basic engine, basic accessories, and optional equipment as listed in the manufacturer's engine specifications.			
CENTER OF GRAVITY LOCATIONS (ENGINE ONLY)	Station, mm (in) (axial)	5 778 ± 40 (227.5 ± 1.5)	--	--
	Waterline, mm (in)	2 538 ± 13 (99.9 ± 0.5)	--	--
	Buttline, mm (in)	2 550 ± 13 (100.4 ± 0.5)	--	--

II - MODEL GE90-110B1; GE90-113B; GE90-115B

TYPE Dual rotor, axial flow, high bypass turbofan. The 10-stage high pressure compressor is driven by a 2-stage high pressure turbine. The single stage fan and 3-stage low pressure compressor are driven by a 6-stage low pressure turbine.

RATINGS (See Note 5)	GE90-110B1	GE90-113B	GE90-115B
Maximum continuous at sea level, static thrust, kN (lb)	489.3 (110 000)	--	--
Takeoff (5 min. See Note 16) at sea level, static thrust, kN (lb)	492.7 (110 760)	505.0 (113 530)	513.9 (115 540)

			GE90-110B1	GE90-113B	GE90-115B
RATINGS (CONT.)					
	Flat rating ambient temperature, °C (°F)				
	Takeoff		33 (92)	30 (86)	--
	Maximum continuous		25 (77)	--	--
COMPONENTS (GE P/N'S)					
	Hydro-mechanical Control Unit		1962M80	--	--
	Full Authority Digital Engine Control (FADEC)				
	Hardware (HW) (See Note 21)		1962M80	--	--
	Software (SW) (See Note 21)		2041M27	--	--
	Configuration Type Box		390-850-001-0	--	--
	FADEC Rating Plug	G01	390-801-011-0	390-802-001-0	390-800-001-0
		G02	390-803-001-0	390-804-001-0	390-805-001-0
		G03	390-803-011-0	--	390-805-011-0
		G04	390-801-021-0	--	390-805-021-0
	Main Fuel Pump		2042M69	--	--
	Ignition System				
	Two ignition units GE P/N		9238M66	--	--
	Two ignition plugs GE P/N		1754M84	--	--
FUEL TYPE				See Note 7	
OIL, LUBRICATION	Type 2 oils conforming to GE90 Specification D50TF1 or the latest revisions are authorized. For approved brand of oils refer to GE90 Service Bulletin 79-0001.				
PRINCIPAL DIMENSIONS	Length, cm (in) (fan spinner to nozzle centerbody)		728.1 (286.67)	--	--
	Width, cm (in) (maximum envelope)		376.9 (148.38)	--	--
	Height, cm (in) (maximum envelope)		392.6 (154.56)	--	--

Legend: "--" Same as preceding model "#" "Not Applicable"

		GE90-110B1	GE90-113B	GE90-115B
WEIGHT	Dry, kg (lb) (1)	8 761.6 (19 316)	--	--
	(1) Includes basic engine, basic accessories, and optional equipment as listed in the manufacturer's engine specifications.			
CENTER OF GRAVITY LOCATIONS (ENGINE ONLY)	Station, mm (in) (axial)	5 570 ± 40 (219.2 ± 1.5)	--	--
	Waterline, mm (in)	2 544 ± 13 (100.14 ± 0.5)	--	--
	Buttline, mm (in)	2 547 ± 13 (100.28 ± 0.5)	--	--

IMPORT REQUIREMENTS

Each engine imported separately and/or spare parts must be accompanied by an export airworthiness approvals issued by FAA (or a third country authority, in case of used engine imported from such country) attesting that the particular engine and/or parts were submitted to the governmental quality control before delivery and are in conformity with the ANAC approved type design. The ANAC type design corresponds to the FAA approved type design, as stated in ANAC Report V33-0820-01, dated 11 June 2008 or further revisions.

CERTIFICATION BASIS

GE90-76B and GE90-90B

RBHA 33 corresponding to 14 CFR Part 33 - including Amendments 33-1 through 33-15, effective on 16 August 1993 and Special Condition Number SC-33-ANE-08-NE.

GE90-94B

RBHA 33 corresponding to 14 CFR Part 33 - including Amendments 33-1 through 33-15, effective on 16 August 1993, Special Condition Number SC-33-ANE-08-NE and Equivalent Level of Safety Finding for RBHA/14 CFR Part 33.68(b).

GE90-110B1, GE90-113B and GE90-115B

RBHA 33 corresponding to 14 CFR Part 33 - including Amendments 33-1 through 33-20, effective on 14 September 2000, Special Condition Number SC-33-ANE-08-NE and Exemption to § 33.73 (b), No. 7953 dated 15 January 2003.

CERTIFICATION BASIS (CONT.)	Model	Date of Application	Issued/Amended
	GE90-90B	18 July 2001	11 October 2001
	GE90-94B	18 July 2001	11 October 2001
	GE90-76B	17 November 2003	15 December 2003
	GE90-110B1	12 December 2007	11 June 2008
	GE90-113B	12 December 2007	11 June 2008
	GE90-115B	12 December 2007	11 June 2008

PRODUCTION BASIS FAA Production Certificate No. 108 for engines produced by General Electric Company in the United States of America.

NOTES:

NOTE 1

Maximum Permissible Engine Rotor Speeds	GE90-76B	GE90-90B	GE90-94B
Low pressure rotor (N1), rpm.	2 465 (109.0 percent)[1]	2 465 (109.0 percent)[1]	--
High pressure rotor (N2), rpm.	10 705 (114.7 percent)[2]	10 918 (117 percent)[2]	--

Maximum Permissible Engine Rotor Speeds	GE90-110B1	GE90-113B	GE90-115B
Low pressure rotor (N1), rpm.	2 602 (110.5 percent)[3]	--	--
High pressure rotor (N2), rpm.	11 292 (121 percent)[2]	--	--

([1]) 100 percent N1 is 2 261.5 rpm
([2]) 100 percent N2 is 9 332.0 rpm
([3]) 100 percent N1 is 2 355.0 rpm

NOTE 2	Maximum Permissible Temperatures	GE90-76B (see Note 10)	GE90-90B	GE90-94B
	Indicated turbine exhaust gas temperature (T49)			
	Takeoff (5 minutes see Note 16), °C (°F)	975 (1 787)*	1 030 (1 885)	--
	Maximum continuous, °C (°F)	925 (1 697)	1 015 (1 859)	--
	Ground starts, °C (°F) (manual or auto)	750 (1 382)	750 (1 382)	--**
	Inflight starts, °C (°F) (manual or auto)	825 (1 517)	825 (1 517)	--
	*60 seconds maximum transient °C (°F)	980 (1 796)	#	#
	**40 seconds start EGT exceedance limit °C (°F)	#	#	825 (1 517)
	Oil temperature limits			
	Continuous °C (°F)	--	124 (255)	--
	Transient °C (°F)	--	135 (275)	--

	Maximum Permissible Temperatures	GE90-110B1	GE90-110B1	GE90-110B1
	Indicated turbine exhaust gas temperature (T49)			
	Takeoff (5 minutes see Note 16), °C (°F)	1 090 (1 994)***	1 030 (1 885)	--
	Maximum continuous, °C (°F)	1 050 (1 922)	1 015 (1 859)	--
	Ground starts, °C (°F) (manual or auto)	750 (1 382)	750 (1 382)	--
	Inflight starts, °C (°F) (manual or auto)	825 (1 517)	825 (1 517)	--
	***30 seconds maximum transient °C (°F)	1 095 (2 003)	--	--
	Oil temperature limits			
	Continuous °C (°F)	132 (270)	--	--
	Transient °C (°F)	143 (290)	--	--

Legend: "--" Same as preceding model "#" "Not Applicable"

NOTE 3 Fuel and Oil Pressure Limits

Fuel Pressure Limits at the Engine Pump Inlet

The limit is from minimum fuel pressures of not less than greater of true vapor pressure plus 48.3 kPa (+7.0 psi) or ambient plus 48.3 kPa (7.0 psi) to a maximum of 482.6 kPa (70 psig).

Oil Pressure Limits

Low pressure

The limit is 69.0 kPa diff. (10.0 psid). (See Note 14)

NOTE 4 Accessory Drive Provisions. GE90-76B; GE90-90B; GE90-94B

Drive Pad	Rotation Facing Gearbox Pad	Gear Ratio to Core Speed	Horsepower Continuous Pad Rating, kW (hp)	Shear [2] Torque N.m (lb.in)	Maximum Overhung Moment N.m (lb.in)
IDG (120 kVA)	CCW [1]	0.7947	181.3 (243)	1130 –1 187 (10 000 – 10 500)	226.0 (2 000)
Hydraulic Pump	CCW	0.3783	63.5 (85)	480 – 548 (4 250 – 4 850)	26.0 (230)
VSCF/PMG Generator (20/30 kVA)	CCW	2.4126	43.3 (58)	395 – 508 (3 500 – 4 500) Maximum Values (see Note 20)	45.2 (400)
IDG Overload Limits	226.8 kVA (304 hp) for 5 minutes per 1 000 hours of operation. 302.9 kVA (406 hp) for 5 seconds per 1 000 hours of operation. 373.0 kVA (500 hp) electrical fault.				
VSCF/PMG Overload limits	64.9 kVA (87 hp) for 5 minutes per 1 000 hours of operation 86.5 kVA (116 hp) for 5 seconds per 1 000 hours of operation 95.5 kVA (128 hp) electrical fault				

100 percent core speed is 9 332 rpm

(1) Counter Clockwise

(2) Shear torque capability is a function of operator requirements. Consult GE Aircraft Engines for installed capability.

NOTE 4 (CONT.) Accessory Drive Provisions - GE90-110B1; GE90-113B; GE90-115B

Drive Pad	Rotation Facing Gearbox Pad	Gear Ratio to Core Speed	Horsepower Continuous Pad Rating, kW (hp)	Shear Torque N.m (lb.in)	Maximum Overhung Moment N.m (lb.in)
IDG (120 kVA)	CCW [1]	0.7947	181.3 (243)	1 187 (10 500) max.	226.0 (2 000)
Hydraulic Pump	CCW	0.3783	63.5 (85)	480 – 548 (4 250 – 4 850)	26.0 (230)
VSCF/PMG Generator (20/30 kVA)	CCW	2.4126	43.3 (58)	141.2 (1 250) max.	45.2 (400)
IDG Overload Limits	226.8 kVA (304 hp) for 5 minutes per 1 000 hours of operation. 302.9 kVA (406 hp) for 5 seconds per 1 000 hours of operation. 373.0 kVA (500 hp) electrical fault.				
VSCF/PMG Overload limits	64.9 kVA (87 hp) for 5 minutes per 1 000 hours of operation 86.5 kVA (116 hp) for 5 seconds per 1 000 hours of operation 95.5 kVA (128 hp) electrical fault				
	100 percent core speed is 9 332 rpm (1) Counter Clockwise				

NOTE 5 Engines ratings are based calibrated test stand performance under the following conditions:

1. Sea level static, standart pressure [101.33 kPa (14.696 psia), 15°C (59°F)]
2. No customer bleed or customer horsepower extraction
3. Ideal inlet, 100% ram recovery
4. Production aircraft flight cowling
5. Production instrumentation

Fuel lower heating value of 18 400 BTU#

NOTE 6 Maximum Permissible Air Bleed Extraction

Allowable Bleed Limits (Percent) - GE90-76B; GE90-90B; GE90-94B

	Stage 4	Stage 7	Stage 10	Maximum Allowable
Below 23 Percent N1K	7.8	1.8	13.6	15.4
23 to 31 Percent N1K	7.6	1.6	12.8	14.4
31 to 57.4 Percent N1K	7.4	1.3	12.6	13.9
57.4 to 80 Percent N1K	7.2	1.3	12.6	13.9
80 to 96.8 Percent N1K	7.0	1.3	6.5	8.3
Above 96.8 Percent N1K	6.5	1.3	6.5	7.8

Allowable Bleed Limits (Percent) - GE90-110B1; GE90-113B; GE90-115B

	Stage 4	Stage 7	Stage 9	Maximum Allowable
Below 27 Percent N1K	7.6	1.5	11.2	12.7
At 51 Percent N1K	7.6	1.5	11.5	13.0
At 80 Percent N1K	7.6	1.5	12.0	13.5
At 88 Percent N1K	7.6	1.5	11.0	12.5
At 93 Percent N1K **today**	7.6	1.5	8.0	9.1
Above 93 Percent N1K	7.6	1.5	7.3	9.1

NOTE 7 Fuel

Approved fuels must conform to GE Specification D50TF2. Certain fuels such as those produced to PRC Specification RP3 meet the requirements of D50TF2 by means of the Specification. The engine will operate with a mixture of fuels or additives conforming to GE Specification D50TF2.

NOTE 8 Life limits established for critical rotating components for:
GE90-76B, GE90-90B, GE90-94B are published in Chapter 5 of the GE90 Engine Manual, GEK 100700.
GE90-110B1, GE90-113B, GE90-115B are published in Chapter 5 of the GE90-100 Engine Manual, GEK 109993

NOTE 9 Power setting, power checks, and control of engine thrust output in all operations are based on Fan Speed (N1). Speed sensors are included in the engine assembly for this purpose.

NOTE 10 GE90-76B engines with configuration type box number 320-839-501-0 must incorporate the HP/LP turbine hardware and changes per General Electric GE90 Service Bulletin 72-169. The FADEC incorporates a 30°C shunt.
The corresponding indicated EGT limits are 975°C (takeoff), 980°C (take-off with 60 second max. transient), and 965°C (max. continuous).

NOTE 11 For ground operation in icing conditions the following procedures must be observed:

GE90-76B, GE90-90B, GE90-94B: During ground operations (including taxi-in and taxi-out) in icing conditions, the engine must be run up momentarily to a minimum of 50 percent N1 at intervals not to exceed 15 minutes. See GE90 Operating Instructions Manual GEK 100703.
GE90-110B1, GE90-113B, GE90-115B: During ground operations (including taxi-in and taxi-out) in icing conditions, the engine must be run up momentarily to a minimum of 50 percent N1 at intervals not to exceed 60 minutes. See GE90-100 Operating Instructions Manual GEK 109994. Note: For possible variations in engine acceleration times in icing conditions see the GE90-100 Inatallation Manual GEK 109995.

NOTE 12 All GE90 engines with configuration type box part numbers 320-892-101-0 or 320-892-201-0 must incorporate the PT25 extended wedge ice shield per GE90 Service Bulletin 77-008 and must incorporate FADEC software P/N 1853M99P06 (version 9.1.9.7) or later, per GE90 Service Bulletin 73-040.

All GE90 engines with configuration type box numbers 320-837-701-0, 320-839-501-0, 320-892-101-0, 320-892-201-0, 320-846-701-0, 320-892-601-0 and 320-915-201-0, have a minimum permissible N2 rpm of 6 066 rpm for in-flight during icing conditions.

All GE90 engines with configuration type box numbers 320-921-501-0 have a minimum permissible N2 rpm of 6 310 rpm for in-flight during icing conditions.

All GE90 engines with configuration type box part numbers 390-850-001-0 have a minimum permissible N1 rpm of 730 rpm for in-flight operation during icing conditions.

NOTE 13 Demonstration of compliance to RBHA/14 CFR Part 33.68, Induction System Icing is installation specific to the B777-200LR/300ER airplane for the GE90-110B1/-113B/-115B model engines. Installation of these model engines on different airplane models or type will require a separated evaluation and finding of compliance to RBHA/14 CFR Part 33.68.

NOTE 14 During "negative-G" operation only, it is permissible to operate below minimum oil pressure of 69.0 kPa diff (10 psid) for a maximum of 15 seconds.
See GE90 Operation Instructions, GEK 100703, for GE90-76B, GE90-90B, GE90-94B;
See GE90-100 Operation Instructions, GEK 109993, for GE90-110B1, GE90-113B, GE90-115B.

NOTE 15

Engine Model	Characteristics
GE90-76B	Basic Model
GE90-77B	Same as GE90-76B except improved HPT/LPT flowpath and higher thrust rating. Corresponding Rating Plug changes.
GE90-90B	Same as GE90-77B except higher thrust rating. Corresponding Rating Plug changes.
GE90-94B	Same as GE90-90B except 3D aero HPC and higher thrust rating. Corresponding Rating Plug changes.
GE90-110B1	Differs from the basic model in Fan, LPC, HPC, HPT and LPT hardware, higher takeoff thrust rating with increased speed and temperatures limitations. Corresponding rating plug changes. See Note 22.
GE90-113B	Same as GE90-110B1 except higher thrust rating. Corresponding Rating Plug changes.
GE90-115B	Same as GE90-113B except higher thrust rating. Corresponding Rating Plug changes.

NOTE 16 The normal 5 minutes takeoff time limit may be extended to 10 minutes for engine out contingency.

NOTE 17 Time Limited Dispatch Criteria

Criteria pertaining to the dispatch and maintenance requirements for the engine control systems are specified in the General Electric Document GEK 103084 and the airworthiness limitation section of the GE90 Engine Manual, GEK 100700, which defines the various configurations and maximum operating intervals.

For the GE90-110B1, GE90-113B; GE90-115B the requirements are defined in the Airworthiness Limitations Section of the GE90-100 Engine Manual GEK 109993.

NOTE 18 Repair of fan blade composite material in the root section of the fan blade up to the inner annulus flow path line is not permitted. Fan Blades with non-serviceable conditions existing on metallic components, erosion coating, or wear pads of the fan blade should be referred to General Electric for disposition.

NOTE 19 The engines meet the smoke and gaseous emission requirements of RBHA/14 CFR Part 34 . The GE90-76B, GE90-90B and GE90-94B engine models manufactured after 31 December 1999 comply with RBHA/14 CFR Part 34, effective 10 September 1990, including amendments 34-1 through 34-3.

NOTE 20 Reserved.

NOTE 21 The FADEC unit P/N originally defined both hardware and software. The hardware and software are now defined by separate P/N, the engine should be equipped with a FADEC defined either by the combined P/N or by the hardware and the software P/N's.

NOTE 22 An exemption to 14 CFR Part 21.19(a) was granted and issued by 26 August 2002 for the GE90-110B1, GE90-113B and GE90-115B engine models. This exemption allowed GEAE to amend the American Type Certificate N° E00049EN to add these models rather than apply for a new type certificate for those engines, subject to the following conditions and limitations:

1. GEAE must comply with 14 CFR Part 21.17 as if it was a new type certificate.
2. GEAE must conduct a large flocking bird test as part of compliance with RBHA/14 CFR Part 33.76, Bird Ingestion.
3. GEAE must include an engine test to demonstrate compliance with RBHA/14 CFR Part 33.90, Initial Maintenance Inspection.
4. An applicant installing the GE90-110B1, GE90-113B and GE90-115B engine models into an aircraft must comply with all of the applicable airworthiness standards for a new type certificated engine, including applicable aircraft special conditions.

NOTE 23 Demonstration of compliance with § 33.73(b), Power or Thrust Response is installation specific to B777-200LR/300ER airplane for the GE90-110B1, GE90-113B and GE90-115B engine models. Installation of these model engines on different airplane models or type will require a separate evaluation and finding of compliance to § 33.73(b).

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