



**TYPE CERTIFICATE DATA SHEET Nº EM-2018T04**

Type Certificate Holder:

**CFM INTERNATIONAL S.A.**  
2 Boulevard du Général Martial Valin  
75724 Paris Cedex 15  
**France**

EM-2018T04-01

SHEET 01  
CFM INTERNATIONAL S.A.

LEAP-1B28, LEAP-1B28B1, LEAP-  
1B28B2, LEAP-1B28B3, LEAP-1B27,  
LEAP-1B25, LEAP-1B21, LEAP-1B23,  
LEAP-1B28B2C, LEAP-1B28BBJ1  
AND LEAP-1B28BBJ2

13 SEPTEMBER 2018

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Engines of models described herein conforming with this data sheet, which is part of Type Certificate No. 2018T04, 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.

**TYPE** High bypass turbofan engine, with: coaxial front fan/booster driven by a multi-stage low pressure turbine; a multi-stage compressor; two-stage high pressure turbine; twin annular pre swirl combustor, and a full authority digital engine control (FADEC).

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**RATINGS** (See Note 1)

**MODELS** LEAP-1B28, LEAP-1B28B1, LEAP-1B28B2, LEAP-1B28B3, LEAP-1B27, LEAP-1B25, LEAP-1B21, LEAP-1B23, LEAP-1B28B2C, LEAP-1B28BBJ1, LEAP-1B28BBJ2

<b>Static Thrust, at sea level, kN (lbf)</b>	LEAP-1B28 LEAP-1B28B1 LEAP-1B28B2 LEAP-1B28B3	LEAP-1B27	LEAP-1B25	LEAP-1B21	LEAP-1B23	LEAP-1B28B2C LEAP-1B28BBJ2	LEAP-1B28BBJ1
- Takeoff - 5 min	130,410 (29,317)	124,710 (28,037)	119,150 (26,786)	111,270 (25,014)	115,240 (25,907)	124,710 (28,037)	130,410 (29,317)
- Maximum Continuous	127,620 (28,690)	121,310 (27,272)	115,470 (25,958)	107,000 (24,054)	111,260 (25,012)	121,310 (27,272)	127,620 (28,690)

**Flat Rating Ambient Temp °C (°F)**

- Takeoff - 5 min	30 (86)	--	--	--	--	--	--
- Maximum Continuous – static	25 (77)	--	--	--	--	--	--

**ENGINE CONTROL**

**SYSTEM CONFIGURATION PART NUMBERS – P/N**

	LEAP-1B28, LEAP-1B28B1 LEAP-1B28B2, LEAP-1B28B3	LEAP-1B25 LEAP-1B27	LEAP-1B21, LEAP-1B23, LEAP-1B28B2C, LEAP-1B28BBJ1, LEAP-1B28BBJ2
- FADEC Electronic Control Unit (ECU) P/N	2474M64	--	--
- FADEC Pressure Sub System (PSS) P/N	2474M65	--	--
- FADEC Software P/N	2628M86, 2628M87 2628M88, 2697M83	--	--
- FADEC Identification Plug P/N	2531M61P26 (for -1B28), 2531M61P27 (for -B28B1), 2531M61P28 (for -B28B2), 2531M61P29 (for -B28B3),	2531M61P10 (for -1B25) 2531M61P18 (for -1B27)	2531M61P02 (for -1B21), 2531M61P06 (for -B23), 2531M61P24 (for -B28B2C), 2531M61P14 (for -B28BBJ1), 2531M61P30 (for -B28BBJ2)

<b>COMPONENTS AND CONFIGURATION</b>	For details of components included in the Type Design Definition, refer to the Installation Manual.	
<b>FUEL TYPE</b>	Approved fuel conforming to GE Specification D50TF2, Classes A, C, D, and E. Primary fuel is D50TF2 Class-A (Jet A) with other fuels listed being acceptable alternates. No fuel control adjustment is required when changing from primary to alternate fuels. Use of aviation gasoline and D50TF2 Class-B, Wide-Cut Distillate (Jet B or JP-4) is not authorized. Refer to the latest revision of CFM Service Bulletin LEAP-1B S/B 73-0001 for a list of fuels specifically approved for LEAP-1B engine.	
<b>OIL TYPE</b>	Synthetic type conforming to GE Specification D50TF1, Type I and Type II. Refer to the latest revision of CFM Service Bulletin LEAP-1B S/B 79-0001 for a list of oil specifically approved for the LEAP-1B engine.	
<b>REFERENCE PRESSURE RATIO</b>	The ratio of the mean total pressure at the last compressor discharge plane of the compressor to the mean total pressure at the compressor entry plane when the engine is developing take-off thrust rating in ISA sea level static conditions.	From 38 up to 42 depending on the model
<b>TEMPERATURE LIMITS</b>	For engine indicated turbine gas temperature limits, see Note 2.	
<b>PRESSURE LIMITS</b>	For fuel and oil pressure limits, see Note 3.	
<b>ROTOR SPEEDS</b>	For engine rotational speed limits, see Note 12.	
<b>AIR BLEED</b>	For maximum permissible air bleed extraction, see Note 13	
<b>DIMENSIONS AND WEIGHT</b>	Applicable to all models	
	LENGTH, mm (in.)	3147 (123.9)
	Fwd. fan case flange to TRF aft flange	
	WIDTH, mm (in.)	2421 (95.31)
	Maximum Envelope	

<b>DIMENSIONS AND WEIGHT CONT...</b>	HEIGHT, mm (in.)	2256 (88.82)
	Maximum Envelope	
	WEIGHT, kg (lb.)	The engine weight is defined as the weight of the basic engine, including basic engine accessories and fluids weight (oil and fuel).
	Not to exceed	2780 (6128)
<b>CENTER OF GRAVITY</b>	Engine only, nominal weight, mm. (in.)	
	Station (Axial)	5380 (211.8)
	<i>- HPC case fwd flange = 5080mm (200 in)</i>	
	Waterline	2494 (98.2)
	Buttline	2494 (98.2)
<b>IMPORT REQUIREMENTS</b>	<p>Each engine imported separately and/or spare parts must be accompanied by an Export Airworthiness Approval through the FAA Form 8130-3 or EASA Form 1, Authorized Release Certificate, certifying that the engine is in compliance with the ANAC approved Type Design, defined by the Brazilian Type Certificate Data Sheet No. 2018T04-00, is in condition for safe operation and has undergone a final operational check. The original Authorized Released Certificate should be sent with the engine and a copy remains with the issuing organization. The ANAC type design corresponds to the FAA and EASA approved type designs, as stated in ANAC report number V.33-1081-00, dated 03 April 2018, or further revisions. (See Note 10).</p>	

- CERTIFICATION BASIS** Brazilian Type Certificate No. 2018T04 issued on 03 April 2018 is based on RBAC 21.29 including the following requirements:
- RBAC 33 (Requisitos de aeronavegabilidade: motores aeronáuticos), Amendement 28; corresponding to 14 CFR Part 33, effective 01 February 1965, as amended by 33-1 through 33-28, inclusive; Additionally, based on RBAC 21.29(1)(a)(ii) the following requirements are applicable: 14 CFR Part 33, effective 01 February 1965, as amended by amendment 33-29 through amendment 33-33.
  - Equivalent Level of Safety (ELOS) findings, raised by FAA:
    - LEAP1B-2014-TC-01-P-1 to 14 CFR 33.27(c): High Pressure Shaft Loss-of-Load;
    - LEAP1B-2014-TC-01-P-2 to 14 CFR 33.77: Foreign object Ingestion – Ice and
    - LEAP1B-2014-TC-01-P-3 to 14 CFR 33.83: Vibration Test.
  - Special Condition, raised by FAA:
    - Fan Blade Special Condition No. 33-017-SC.
  - RBAC 34 (Requisitos para drenagem de combustível e emissões de escapamento de aviões com motores a turbina, Amendement 05; corresponding to 14 CFR Part 34, effective 23 October 2013, amendment 5A, inclusive (see Note 14 for further information about certification basis for fuel venting and exhaust emissions);
  - ICAO Annex 16, Vol. II, third edition, July 2008, including Amendment 8, effective 01JAN2015, as applicable to turbofan engines. NOx standards in accordance with Part III, Chapter 2, Section 2.3.2.e (CAEP/8), for emissions.

<u>Model</u>	<u>Application</u>	<u>Issued TC/Emended</u>
LEAP-1B28	04 April 2017	06 April 2018
LEAP-1B28B1	04 April 2017	06 April 2018
LEAP-1B28B2	04 April 2017	06 April 2018
LEAP-1B28B3	04 April 2017	06 April 2018
LEAP-1B27	04 April 2017	06 April 2018
LEAP-1B25	04 April 2017	06 April 2018
LEAP-1B21	01 August 2018	13 September 2018
LEAP-1B23	01 August 2018	13 September 2018
LEAP-1B28B2C	01 August 2018	13 September 2018
LEAP-1B28BBJ1	01 August 2018	13 September 2018
LEAP-1B28BBJ2	01 August 2018	13 September 2018

**PRODUCTION BASIS**

Production Certificate No. 108 for engines produced in the United States by General Electric under license from CFM International, S.A. (See NOTE 10).

Production Certification No. FR.21G.0007 dated December 17th, 2009 for engines produced in France by Safran under license from CFM International, S.A (See NOTE 10).

**NOTES****NOTE 1****ENGINE RATING**

Engine ratings are based on calibrated stand performance under the following conditions:

Takeoff thrust is nominally independent of ambient temperature (flat rated) up to ambient temperature of: Std + 15°C (30°C, 86°F) for all models, except as noted above.

Maximum continuous thrust is nominally independent of ambient temperature (flat rated) up to ambient temperature of Std. + 10°C (25°C, 77°F) for all models

- Sea level static, standard day: 101.325 kPA Pressure (14.696 psia); 15°C temperature (59°F)
- Zero customer bleed or customer horsepower extraction
- Ideal inlet, 100% ram recovery
- Production aircraft flight cowling
- Production instrumentation
- Fuel lower heating value of 18,400 BTU/lb

**THRUST SETTING PARAMETER**

Power setting, power checks and control of engine thrust output in all operations is to be based on CFM International engine charts referring to fan speed. Fan speed sensors are included in the engine assembly for this purpose.

**NOTE 2****TEMPERATURE LIMITS:****- Indicated Turbine Exhaust Gas Temperature <sup>♦</sup>, °C (°F):**

Takeoff - 5 minutes:	1038 (1900)
Maximum continuous:	1013 (1855)
Max Transient (30 sec.):	1048 (1918)
Ground Starts:	753 (1387)

**NOTE 2  
CONT...****Inflight Starts**

• Starter Assist or Steady State Windmill	883 (1621)
• Quick Windmill Relight	920 (1688)
• High Power Fuel Cut	981 (1798)

**- Fuel Pump Inlet Temperature, °C (°F):**

Maximum	54.5 (130)
Maximum (Cold Start)*	- 43 (- 45) *Or the relevant fuel freezing point, whichever is higher

**- Oil Temperature, °C (°F):**

Maximum	
Continuous Operation	140 (284)
Transient (15 minutes)	155 (311)
Minimum (Cold Start)	
Engines Not Compliant with LEAP-1B S/B 72-0011	- 19 (- 2)
Engines Compliant with LEAP-1B S/B 72-0011	- 40 (- 40)

**♦ EXHAUST GAS TEMPERATURE INDICATION °C (°F):**

The Exhaust Gas Temperature (EGT = T48) is measured at low pressure turbine inlet

**Model Ratings****Indicated Turbine Exhaust Gas Maximum Exhaust Gas Temperature Limit**

		Temperature	Pre-Service Bulletin LEAP-1B 72-0169	Post-SB LEAP-1B 72-0169
LEAP-1B28, LEAP-1B28B2, LEAP-1B25, LEAP-1B27,	Takeoff, 5 min	1038 (1900)	1038 (1900)	1060 (1940)
LEAP-1B28B1, LEAP-1B28B3	Maximum Continuous	1013 (1855)	1013 (1855)	1040 (1904)
LEAP-1B21, LEAP-1B23, LEAP-1B28B2C, LEAP-	Takeoff, 5 min	1038 (1900)	#	1060 (1940)
1B28BBJ1, LEAP-1B28BBJ2	Maximum Continuous	1013 (1855)	#	1040 (1904)

All models are certified for a max transient exhaust gas temperature (EGT) exceedance at take-off of 10°C for 30 seconds maximum.

**NOTE 3** FUEL AND OIL PRESSURE LIMITS:

## - Fuel Pressure Limits (measured at engine pump inlet):

## Aircraft Boost Pump Operative

The minimum pressure at the engine fuel pump inlet with aircraft boost pumps operative is true vapor pressure plus 5 psia (32.4 kPa). The maximum vapor to liquid ratio at the engine fuel pump inlet with aircraft boost pumps operative is zero.

## Aircraft Boost Pump Inoperative

The engine fuel system operation is restricted with the aircraft boost pumps inoperative as outlined in the LEAP-1B Installation Manual.

- Oil Pressure Limits:

The minimum pressure limit at idle is 17.4 psid (120.0 kPa) and varies up to 29 psid (200.0 kPa) at redline.

The maximum pressure is limited during cold starts by a 420.5 psid (2900 kPa differential) pressure-relief valve.

**NOTE 4** ACCESSORY DRIVE CHARACTERISTICS

## - ELECTRICAL (IDG)\*

Rotation Direction <sup>+</sup>	CCW
Speed ratio to core**	0.418
Pad Rating kW (HP)	125 (168)
Shear Torque N.m (in.lbf)	1063 (9408)
Maximum overhung moment (wet) N.m (in.lbf)	108 (956)

## - HYDRAULIC PUMP\*

Rotation Direction	CCW
Speed ratio to core**	0.191
Pad Rating N.m (in.lbf)	159 (1407)
Shear Torque N.m (in.lbf)	407 (3602)
Maximum overhung moment (wet) N.m (in.lbf)	18.8 (166)

\* - *Airframer Supplied Hardware*

+ - *CW = CLOCKWISE (looking at the Pad)*

\*\* - *100% core speed = 17,167 RPM*



**NOTE 5** ENGINE MODEL CHARACTERISTICS:

The models shown on this TCDS have the following general characteristics:

LEAP-1B28	737MAX 8 Configuration
LEAP-1B28B2	Same as LEAP-1B28 with additional takeoff thrust at high altitude conditions.
LEAP-1B28B1	Same as LEAP-1B28B2 with revised takeoff thrust schedule at high altitude conditions.
LEAP-1B28B3	Same as LEAP-1B28B2 with revised takeoff thrust schedule at low altitude conditions.
LEAP-1B27	Same as LEAP-1B28 except for lower thrust rating.
LEAP-1B25	Same as LEAP-1B28 except for lower thrust rating.
LEAP-1B21	Same as LEAP-1B28 except for lower thrust rating.
LEAP-1B23	Same as LEAP-1B28 except for lower thrust rating.
LEAP-1B28B2C	Same as LEAP-1B28B2 except thrust is capped by LEAP-1B27 below 1,000 ft and fairs to equivalent of LEAP-1B28B2 thrust by 7,000 ft
LEAP-1B28BBJ1	Same as LEAP-1B28, but customized for Boeing Business Jet application
LEAP-1B28BBJ2	Same as LEAP-1B28C, but customized for Boeing Business Jet application

LEAP-1B engine series includes: LEAP-1B28, LEAP-1B28B2, LEAP-1B28B1, LEAP-1B28B3, LEAP-1B27, LEAP-1B25, LEAP-1B21, LEAP-1B23, LEAP-1B28B2C, LEAP-1B28BBJ1, LEAP-1B28BBJ2.

The parts list for each engine model contains a configuration group number to identify the engine configurations. The engine model configuration is identified as LEAP-1BxxG0y where xx is the model and y is the applicable configuration as described in [LEAP-1B Service Bulletin 72-0187](#).

**NOTE 6** COMPATIBLE SYSTEM ASSEMBLIES  
THRUST REVERSER

The LEAP-1B engine is approved for use with the Boeing thrust reverser system: P/N 315A6295.

**NOTE 7** SPECIAL REQUIREMENTS

## ETOPS

LEAP-1B series engines have complied with the requirements of §§ 33.4 (A33.3(c)), 33.71(c) (4) and 33.201, and are therefore eligible for installation on Extended Operations (ETOPS) and Early ETOPS approved airplanes. The demonstrated diversion time is 180 minutes at maximum continuous thrust plus 15 minutes at hold power. Note that ETOPS eligibility does not constitute airplane or operational level approvals necessary to conduct ETOPS flights.

LEAP-1B S/B 71-0002 defines the requirements for conducting ETOPS operation.

## TIME LIMITED DISPATCH CRITERIA

Criteria pertaining to the dispatch and maintenance requirements for the engine control systems are specified in the airworthiness limitation section of the LEAP-1B Engine Shop Manual (LEAP-1B-05-17-00), which defines the various configurations and maximum operating intervals.

A control system reliability monitoring program has been established with LEAP, as a contingency of the dispatch criteria approval, to ensure that overall engine control system and specific component failure rates do not exceed the maximum values permitted by the reliability analysis.

## INDUCTION SYSTEM ICING

Demonstration of compliance to RBAC 33.68, which corresponds to 14 CFR Part 33.68, Induction System Icing, is installation specific to the Boeing B737 MAX model aircraft for the LEAP-1B28, -1B28B2, -1B28B1, - 1B28B3, -1B27 and -1B25 engines models. Installation of these engine models on different airplane models or types will require a separate evaluation and finding of compliance to RBAC 33.68.

**NOTE 8** SPECIAL OPERATING PROCEDURES

## Negative G Operation

During negative g operation only, it is permissible to operate below minimum oil pressure (17.4 psid) for a maximum of 10 seconds. See LEAP-1B Specific Operating Instruction Manual, GEK 113769.

## Minimum Flight Idle

The minimum permissible idle in flight is a non-adjustable limit, preset into the EEC Control schedule. Flight idle is engaged based on thrust lever position and operating conditions as specified in the LEAP-1B Specific Operating Instructions Manual, GEK 113769.

- NOTE 8** Takeoff Time Limit  
**CONT...** The normal 5 minutes takeoff rating may be extended to 10 minutes for engine out contingency, as specified in the LEAP-1B Specific Operating Instructions Manual, GEK 113769.
- Icing Operation  
For operation in icing conditions; requirements, limitations, and notes are specified in the LEAP-1B Specific Operating Instructions Manual, GEK 113769.
- NOTE 9** The applicable installation and operating manuals are:
- 1) Turbofan Engine Installation Manual (EIM): CRL-2106b, CRL-2106b\_1;
  - 2) Specific Operating Instructions (SOI): CRL-2105b (GEK 113769) and
  - 3) Installation Drawing; CRL-2107b.
- Or later approved Issues or Revisions. Refer to manual for applicability.

Instructions for Continued Airworthiness (ICA): Installation Manuals, Specific Operating Instructions, Engine Shop Manuals, Service Bulletins, Overhaul and Maintenance Manuals, Repair Manuals, Vendor Manuals, and Design Changes which contain a statement that the document is EASA approved or approved under authority of DOA No. EASA.21J.086 or FAA approved are accepted by the ANAC and considered ANAC approved. Repair data and related instructions are considered ANAC approved or accepted as applicable. These approvals pertain to the type design only. The LEAP-1B ICA includes:

- 1) Engine Shop Manual (ESM): SM.21
- 2) Standard Practices Manual (SPM): SPM.25
- 3) Consumable Product Manual (CPM): CPM.25
- 4) Non Destructive Test Manual (NDTM): NDTM.25
- 5) Components Maintenance Manuals (CMM): as published by CFM
- 6) Service Bulletins (SB): as published by CFM
- 7) Maintenance Manual: see Aircraft Maintenance Manual (AMM)
- 8) Fault Isolation Manual: see Fault Isolation Manual (FIM)

**NOTE 10** IMPORT REQUIREMENTS

The type certificate holder, CFM International, S.A., is a company jointly owned by Safran Aircraft Engines (France) and the General Electric Company (USA). CFM is responsible for the certification, sale, and customer support activities. The LEAP-1B engine series is a product line designed to power the Boeing 737MAX 7, 8 and 9 aircraft. With respect to the benefits of type certification for production, General Electric and Safran function as licensees of CFM International, S.A.

All LEAP-1B engines will be assigned serial numbers sequentially, with the three-digit prefix “602-“, regardless of engine final assembly location. The location of final assembly can be inferred from the engine manufacturer, which will be identified on the engine identification plate, along with the date of production. Engines produced in the United States by GE are identical to and fully interchangeable with engines produced in France by Safran.

Modules, assemblies, or parts produced in France or USA are eligible for use in engines produced to this type certificate provided an export airworthiness approval through an Authorized Release Certificate (EASA Form 1 or JAA Form 1 or FAA Form 8130-3, depending on the manufacturing origin) issued by Safran under authority of European Aviation Safety Agency (EASA) Production Certificate No. FR.21G.0007 or by General Electric under authority of Federal Aviation Administration (FAA) Production Certificate No. 108 is attached to the item or invoice covering shipment of items (Ref. RBAC 21.502, which corresponds to 14 CFR § 21.502).

**NOTE 11** CRITICAL ENGINE PARTS

Life limits established for critical engine parts are published in the ALS section of Chapter 05 of the LEAP-1B Engine Shop Manual, ESM.21.

**NOTE 12** MAXIMUM PERMISSIBLE ENGINE ROTOR SPEEDS

SPOOL	RPM	%
Low pressure rotor (N1)	4,586	104.3
		100 % N1 is defined as 4397 rpm
High pressure rotor (N2)		
Pre-SB LEAP-1B 72-0169:	20,171	117.5 - 100 % N2 is defined as 17167 rpm
Post-SB LEAP-1B 72-0169:	19,828	indicated 117.5

**NOTE 13** MAXIMUM PERMISSIBLE BLEED AIR EXTRACTION

LOCATION	TEMPERATURE CORRECTED FAN SPEED	FLOW LIMIT
HPC Stage 4	All speeds above minimum idle.	10% of primary airflow*
HPC Stage10	All speeds above minimum idle.	15.0% of primary airflow*
Bypass Duct	All speeds above minimum idle.	1% of primary airflow

\*Absolute maximum. Refer to the LEAP-1B Installation Manual, for detailed bleed schedule.

**NOTE 14** EXHAUST EMISSIONS AND FUEL VENTING

The following emissions standards promulgated in RBAC 34, amendment 05, which corresponds to 14 CFR Part 34, Amendment 5A, effective October 23, 2013, have been complied with for the all LEAP-1B.

- Fuel Venting Emission Standards: RBAC 34.10(a) and 34.11, which correspond to 14 CFR 34.10(a) and 34.11 ;
- Smoke Number (SN) Emission Standards: RBAC 34.21(e)(2), which corresponds to 14 CFR 34.21 (e)(2);
- Carbon Monoxide (CO) Emission Standards: RBAC 34.21(d)(1)(ii), which corresponds to 14 CFR 34.21(d)(1)(ii);
- Hydrocarbons (HC) Emission Standards: RBAC 34.21(d)(1)(i), which corresponds to 14 CFR 34.21(d)(1)(i);
- Oxides of Nitrogen (NOx) Emission Standards: RBAC 34.23(b)(1), which corresponds to 14 CFR 34.23(b)(1);

The engine manufacturer has declared that the ICAO emissions standards identified in Annex 16, Volume II, Third Edition, Part III, Chapter 2, Section 2.2.2 for SN, Section 2.3.2 for CO and HC, Section 2.3.2.e.2(i) for NOx (also known as CAEP/8), and Part II Chapter 2 for fuel venting have also been demonstrated.



MARIO IGAWA

**Gerente Geral de Certificação de Produto Aeronáutico  
(General Manager, Aeronautical Product Certification Branch)**