TYPE-CERTIFICATE DATA SHEET

No. E.006

for
MAKILA 2 SERIES ENGINES

Type Certificate Holder
Safran Helicopter Engines

64510 Bordes
France

For Models:

MAKILA 2A
MAKILA 2A1

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I. General

1. Type/ Model

MAKILA 2A, MAKILA 2A1. These models are approved for use on multi-engined civil rotorcraft at the ratings and within the operating limitations specified below, subject to compliance with the powerplant installation requirements appropriate to approved installations.

Except where otherwise noted, data applies to all models.

2. Type Certificate Holder

Safran Helicopter Engines
64510 Bordes
France

to 18 July 2016 : Turbomeca
After 18 July 2016 : Safran Helicopter Engines

3. Manufacturer

to 18 July 2016 : Turbomeca
After 18 July 2016 : Safran Helicopter Engines

4. DGAC/EASA Certification Application Date:

MAKILA 2A	Initial : 17 November 1999 Last request for extension: 10 October 2002
MAKILA 2A1	14 August 2007

5. DGAC/EASA Certification Reference Date:

MAKILA 2A	30 November 2001
MAKILA 2A1	30 November 2001

6. EASA Certification Date:

MAKILA 2A	12 July 2004
MAKILA 2A1	05 May 2008

II. Certification Basis

1. Certification Specifications:

MAKILA 2A	JAR-E Amendment 11 dated 1st November 2001
MAKILA 2A1	JAR-E Amendment 11 dated 1st November 2001 CS-E, initial issue dated 24 October 2003, paragraphs CS-E 50(f), CS-E 570(b)(2) and CS-E 570(c)(2)

2. Special Conditions:

MAKILA 2A	SC1: Special Conditions for approval of 30-second and 2-minute OEI Ratings SC2: Special Conditions for approval of a 30-minute AEO Rating SC3: Special Conditions for approval of Software and Programmable Logic Devices
MAKILA 2A1	SC1: Special Conditions for approval of 30-second and 2-minute OEI Ratings SC2: Special Conditions for approval of a 30-minute AEO Rating

3. Deviations

None

4. Equivalent Safety Findings:

MAKILA 2A	JAR-E 570(a)(4)(ii) and (a)(5)(ii) – Indication to the flight crew of oil filter impending blockage for a filter with a bypass SC1 – Availability of the 30 second OEI rating during transition from the OEI training mode
MAKILA 2A1	SC1 – Availability of the 30 second OEI rating during transition from the OEI training mode

5. Environmental Protection Requirements:

Compliance with the fuel venting provisions of ICAO Annex 16 (Amendment 5, November 2005), Volume II, Part 2, Chapter 2, has been demonstrated on 01 June 2007

III. Technical Characteristics

1. Type Design Definition

MAKILA 2A	P/N 0 298 00 519 0
MAKILA 2A1	P/N 0 298 00 521 0

2. Description

The MAKILA 2 engines consist of an annular air intake, a gas generator, a two stage axial power turbine, an exhaust pipe and rear power transmission off-take. The gas generator has a three stage axial compressor and a single stage centrifugal compressor, driven by a two stage axial turbine, and

an annular combustion chamber with centrifugal fuel injection. An accessory drive located at the front and driven by the gas generator powers the engine accessories.

3. Equipment

All equipment required for engine operation is included in the engine Type Design Definition. For additional details, refer to the relevant Installation and Operating Manual.

4. Dimensions

Overall Length (mm)	Overall Height (mm)	Width (mm – including exhaust pipe)
2115	668	785

5. Dry Weight

278.9 kg -0/+1 % (including FADEC)

6. Ratings

6.1 All Engines Operative kW

	Maximum Continuous (unlimited duration)	Take-off (5 minutes)	30-minute AEO
MAKILA 2A(1)(2)	1303	1303	1303
MAKILA 2A1(1)(2)	1303	1303	1303

6.2 One Engine Inoperative kW

	Continuous OEI (unlimited duration)	2-minute OEI	30-second OEI
MAKILA 2A(1)(2)	1573	1660	1758
MAKILA 2A1(1)(2)	1608	1668	1776

(1) Minimum values defined under the following conditions:
- ISA conditions at sea level, on test bed
- engine equipped with a test bed air intake and primary exhaust pipe,
- mean swirl angle in the compressor air intake plane less than or equal to 0.5°
- no customer air bleed
- OEI mode selected
- no power drawn by any accessories other than those required for engine operation.
- output shaft rotation speed : 22962 rpm
- fuel Low Heat Value : 43 136 kJ/kg

(2) Declared power is limited by the first reached limit - either the engine thermal limit, or the engine mechanical limit, or a DECU torque limit implemented to protect the main gearbox of the helicopter.

7. Control System

Full Authority Digital Electronic Control (FADEC) without manual backup

8. Fluids (Fuel, Oil, Coolant, Additives)

8.1 Fuel

For a list of fuels and fuel additives approved for use in each model consult the relevant Installation and Operating Manual.

8.2 Oil

For a list of oils approved for use in each model consult the relevant Installation and Operating Manual.

9. Aircraft Accessory Drives

None

10. Maximum Permissible Air Bleed Extraction

P3 air bleed for aircraft use – maximum flow rate at standard sea level conditions:

220 g/s at OEI Continuous rating
210 g/s at Maximum Continuous rating

P24 air bleed for aircraft use (only in case of failure of the helicopter main gear-box lubricating system) – maximum flow rate at standard sea level conditions:

20 g/s at Maximum Continuous rating

For further details, see the relevant Installation and Operating Manual.

IV. Operating Limitations

1. Temperature Limits

1.1 Gas generator exhaust temperature (T45) limits

On start-up:

	For an unlimited duration	Maximum overtemperature (< 5 s)	Maximum overtemperature (< 2 s)
MAKILA 2A	780°C	830°C	840°C
MAKILA 2A1	780°C	830°C	840°C

In flight:

	Continuous OEI	30-minute AEO	Take-off	Max Continuous
MAKILA 2A	799°C	796°C	796°C	749°C
MAKILA 2A1	814°C	801°C	801°C	754°C

1.2 Fuel temperature

Maximum temperature – normal fuels (as specified in the Installation and Operating Manual): +50°C

Minimum temperature for engine starting: -45°C depending on the fuel used (refer to Installation and Operating Manual)

Use of anti-icing additive is mandatory for fuel temperature below 0°C

1.3 Oil temperature

Minimum oil temperature for engine starting:
-30°C for 5 cSt oils (having a $5x10^{-6}$ m^2/s kinematic viscosity)
-45°C for 3 cSt or 4 cSt oils (having a $3x10^{-6}$ or $4x10^{-6}$ m^2/s kinematic viscosity)

Minimum oil temperature for power-up:
10°C for 5 cSt oils (having a $5x10^{-6}$ m^2/s kinematic viscosity)
-30°C for 3 cSt or 4 cSt oils (having a $3x10^{-6}$ or $4x10^{-6}$ m^2/s kinematic viscosity)

Maximum oil temperature: 120°C

2. Speed Limits

2.1 Gas generator speed (N1)

100% N1 = 33200 rpm

Maximum stabilised speed – All Engines Operative:

	Maximum Continuous	Take-off	30-minute AEO
MAKILA 2A	96.85% (32155 rpm)	99.18% (32927 rpm)	99.18% (32927 rpm)
MAKILA 2A1	96.45% (32022 rpm)	98.75% (32786 rpm)	98.75% (32786 rpm)

Maximum stabilised speed – One Engine Inoperative:

	Continuous OEI	2-minute OEI	30-second OEI
MAKILA 2A	99.33% (32977 rpm)	100.68% (33425 rpm)	102.24% (33943 rpm)
MAKILA 2A1	99.42% (33008 rpm)	100.30% (33302 rpm)	102.09% (33895 rpm)

Maximum transient (≤20s) overspeed All Engines Operative:

MAKILA 2A	100.68% (33425 rpm)
MAKILA 2A1	100.30% (33302 rpm)

2.2 Power turbine speed (N2)

100% N2 = 22962 rpm

Limit values authorised in IDLE mode for an unlimited duration:

minimum stabilised – 45% (10333 rpm)
maximum stabilised – 106% (24340 rpm)

Limit values authorised in FLIGHT mode for an unlimited duration:

minimum stabilised – 93% (21355 rpm)
maximum stabilised, 30-second OEI – 104.5% (23995 rpm)
maximum stabilised, all other ratings – 106% (24340 rpm)

Transient limits:

minimum transient (20 s) – 80% (18370 rpm)
maximum transient (20 s) – 111% (25488 rpm)

3.Thrust / Torque Limits:

Maximum torque on engine output shaft during operation – All Engines Operative(1):

Maximum Continuous	Take-off	30-minute AEO
551 Nm	551 Nm	551 Nm

Maximum torque on engine output shaft during operation – One Engine Inoperative(1):

Continuous OEI	2-minute OEI	30-second OEI
933 Nm	933 Nm	933 Nm

Maximum over-torque (< 20 s), all engines operative(1): 933 N.m

(1) Torques shown above correspond to the engine torque limit. A DECU limit may be implemented to protect the main gearbox of the helicopter.

4. Pressure Limits:

4.1 Oil pressure

Minimum oil pressure: 160 kPa gauge
Maximum oil pressure: 600 kPa gauge

4.2 Fuel pressure

Minimum fuel pressure:

Refer to Installation and Operating Manual

Maximum fuel pressure:

Less than or equal to 150 kPa gauge, in all operating phases.

5. Installation Assumptions:

See the relevant Installation and Operating Manual

6. Time Limited Dispatch:

All engine systems and equipment must be functional prior to aircraft take-off. MAKILA 2A and MAKILA 2A1 engines are not herein approved for Time Limited Dispatch with any systems or equipment inoperative.

V. Operating and Service Instructions

	Installation and Operating Manual	Performance Brochure	Maintenance Manual	Overhaul Manual
MAKILA 2A	X 298 N7 001 2	X 298 N7 002 9	X 298 N7 460 1	X 298 N7 500 2
MAKILA 2A1	X 298 N7 001 2	X 298 U3 001 9	X 298 U3 460 1	X 298 N7 500 2

For Service Letters and Service Bulletins, refer to the SB and SL directory.
Operating Instructions are provided in Chapter 15 of the Installation and Operating Manual.

VI. Notes

1. The MAKILA 2 series engines on their own have not been submitted to the foreign object ingestion tests defined by the airworthiness regulation, except for rain, water and snow/slush. Consequently, protection against foreign objects must be assessed by the aircraft manufacturer prior to approval of the powerplant installation of the helicopter concerned (JAR-E 800(e)(3)).

2. The electronic control unit must not be installed in a designated fire zone. The installation conditions are defined in the relevant Installation and Operating Manual.

3. The electronic control system provides a "TRAINING" function for training crews in an engine failure situation. Refer to the relevant Installation and Operating Manual for the characteristics of this function.

4. The engine control system software has been validated in accordance with the requirements of RTCA/DO-178B, Level A.

5. The starting and operating envelopes are provided in the relevant Installation and Operating Manual.

6. The following capabilities and characteristics with regard to EMI and Lightning have been demonstrated by test (refer to the relevant Installation and Operating Manual for details):

Induced signal susceptibility	– RTCA/DO-160D Section 19, Category Z
Radio Frequency susceptibility	– RTCA/DO-160D Section 20, Category Y + additional requirements
Emission of Radio Frequency energy	– RTCA/DO-160D Section 21, Category H + additional requirements
Lightning induced transient susceptibility	– RTCA/DO-160D Section 22

7. A power turbine overspeed shut-down device, is available as an option.

8. Conversion from non-civil use.

MAKILA 2 series engines originally assembled by Safran Helicopter Engines ca may have been in service with military, customs, police or other operators not under the jurisdiction of a civil Authority. Before such engines can be converted to civil operation, their compliance with the European rules enabling issuance of an aircraft standard certificate of airworthiness must be checked. Their configuration, including design changes and repairs, does not necessarily conform to the type definition approved by EASA, and it is possible that in operation they have exceeded the limits approved by EASA. Before a standard certificate of airworthiness is issued to an aircraft in which such an engine is installed, an EASA Form 1 must be issued for the engine. This requires incorporation of Safran Helicopter Engines Mandatory Service Bulletin A298 72 2804, Version C (or any subsequent approved issue).

SECTION: ADMINISTRATIVE

I. Acronyms and Abbreviations

n/a

II. Type Certificate Holder Record

to 18 July 2016 : Turbomeca
After 18 July 2016 : Safran Helicopter Engines

III. Change Record

Issue	Date	Changes	TC issue
Issue 01	12 July 2004	Initial Issue	12 July 2004 initial issue
Issue 02	01 June 2007	Major Change EASA.E.C.01546	
Issue 03	05 May 2008	Add Model Makila 2A1	05 May 2008
Issue 04	21 August 2009	Editorial Revisions	
Issue 05	24 July 2012	EASA Approval 10040715 Separation of Makila 2A and Makila 2A1 Maintenance Manual	
Issue 06	15 Oct 2012	EASA Approval 10041771 Introduction of fire detectors and EASA Approval 10041772 introduction of fire detector harness	
Issue 07	27 Oct 2014	Include latest version of service bulletin A298 72 2804, Version C	
Issue 08	01 August 2016	Name change from Turbomeca to Safran Helicopter Engines	01 Ausgust 2016

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