UK CIVIL AVIATION AUTHORITY
ENGINE TYPE CERTIFICATE DATA SHEET NO. 3022

I. GENERAL

II. **CAA ETCDS No. 3022** Issue: 5 Date 5th March 2001

2. **Type/Variants:**
ARRIEL 2Sl
ARRIEL 2C
ARRIEL 2B
ARRIEL 2C1
ARRIEL 2B1

3. **Type Certificate Holder:**
TURBOMECA
64511 BORDES CEDEX
FRANCE

4. **Manufacturer:** TURBOMECA

5. **JAA Certification Application Date**
2S1: 14 May 1993
2C: 09 Dec 1996
2B: 09 Dec 1996
2C: 10 Sept 1997
2B1: 03 June 1998

6. **JAA Certification Recommendation Date:**
2S1: 26 April 1996
2C: 28 Sept 1997
2B: 27 Nov 1997
2C1: 08 Dec 1998
2B1: 30 Oct 2000

7. In this case, the CAA Type Certification has been granted on the basis of a recommendation from the Joint Aviation Authorities (JAA) following an investigation carried out in accordance with the JAA Joint Certification Procedures. Accordingly, the JAA Data Sheet No. JAA/E/96-013 issue 11 dated 27 September 2000 has been used as the basis of this CAA Engine Type Certificate Data Sheet.

II. CERTIFICATION BASIS

1. The above mentioned engines are approved for use on multi engined (2S1, 2C and 2C1) and singled engined (2B and 2B1) helicopters classified in the Transport Category (passenger) subject to compliance with the appropriate United Kingdom Installation Airworthiness Requirements. The Type Certificate is 097/4 latest issue dated 5 March 2001.

2. **Reference Application Date for CAA Certification:** 14 May 1993

3. **CAA Certification Date:**

2S1	13 May 1996
2C	18 December 1997
2B	27 October 1998
2C1	28 January 1999
2B1	2 March 2001

4. **CAA Certification Basis:** Same as the JAA Certification Basis specified in paragraphs 4 to 8 below

5. **JAA Airworthiness Requirements:**
   - JAR-E Change 9 dated 21 October 1994
   - Orange Paper E/96/1

6. **JAA Special Conditions:** SC1 to SC12 : Special Conditions for approval of the 30-Second, 2-Minute and Continuous OEI ratings (for 2S1 and 2C only).

7. **JAA Exemptions :** JAR-E570 (a)(4)(ii) and (5)(ii) - Indication to the flight crew of impending blockage of main oil filter.

8. **JAA Equivalent Safety Finding :** JAR-E 740 Endurance Test (2B, 2B1 and 2C1 only).
   JAR-E 80, Equipment (2C1 only).

9. **JAA Environmental Standards :** Fuel venting provisions of ICAO Annex 16, vol. II, Part 2, Chapter 2 (Edition 1993)

III. TECHNICAL CHARACTERISTICS

1. **Type Design Definition :**

2S1:	P/N 0 292 00 531 0
2C:	P/N 0 292 536 0
2B:	P/N 0 292 00 534 0
2C1:	P/N 0 292 00 539 0
2B1:	P/N 0 292 00 541 0

2. **Description:** The Arriel 2 type is a 640 kw class turboshaft engine. The engine consists of an axial air intake, an axial compressor and a centrifugal compressor driven by a single stage turbine, a combustion chamber, and a single stage power turbine driving a reduction gearbox located at the rear. An accessory drive gearbox, driven by the gas generator, is located at the front. Arriel 2S1, 2C and 2C1 are physically identical except for the mounts (dedicated to the installation) and the fitment of an helicopter fan cooler drive on the 2S1. The 2B mounts are also different adapted to the AS350 application and casing from the

   Arriel 1B. The 2B also has provision for the tail rotor drive (similar to the Arriel 1B). The 2B rating structure is simplified for the single engine application including Take-off

and Maximum Continuous Power only. Mounts are part of the engine type definition. For all models the starter-generator is not part of the engine type definition.

The Arriel 2B1 is designed for single engine application on the Eurocopter EC130 helicopter. The Arriel 2B1 is similar to the Arriel 2B engine, with the exception of the control system featuring a dual channel FADEC with optional manual backup (Single channel with manual backup on the 2B version).

3. **Equipment:** Included in Type Design Definition

4. **Dimensions:**

Dimension (m)	2S1	2C and 2B	2C1	2B1
Overall Length	1,539 m	1.181	1.015	1.140
Overall Height	0,715 m	0.616	0.576	0.616
Overall width	0,504 m	0.498	0.498	0.491

5. **DryWeight:**
2S1: 131,2kg
2C: 131.0kg
2B: 134.0kg
2B1: 132.2kg

6. **Ratings:**

		2S1	2C	2B	2C1	2B1
30-Second OEI	30 Sec	735	704	N/A	718	N/A
2-Minute OEI	2 min	663	635	N/A	653	N/A
Continuous OEI	unlimited	639	610	N/A	622	N/A
Take-off	5 min	621	581	557	581	557
Maximum Continuous	unlimited	592	581	543	581	543

Note : The performance values specified above (see Performance Brochure for details) correspond to minimum values defined under the following conditions:

- mean swirl angle in the compressor air intake plane less than or equal to 0.5°
- ISA conditions at sea level, on test bed,
- engine equipped with a test bed air intake and primary exhaust pipe,
- no air bleed,
- no power drawn by any accessories other than those required for engine operation,
- output shaft rotation speed : 2S1: 6409 rpm; 2C, 2C1 and 2B 6000 rpm.
- fuel Low Heat Value = 43 136 kJ/kg

7. **Control System:** Single channel electronic engine control system with manual backup (2S1, 2C, 2B)

Dual channel electronic engine control system with manual backup (2C1,2B1)

8. **Fluids (Fuel/Oil/Additives) :** see Installation Manual.

9. **Aircraft Accessory Drives:**

DESIGNATION	ROTATION DIRECTION	ROTATION SPEED rpm	MAXIMUM TORQUE OVERLOAD daN.m	MAXIMUM STATIC OPERATING daN.m	FUSE SHAFT BREAKAWAY TORQUE daN.m	MAXIMUM PERMANENT SHAFT POWER KW		
						TWIN ENGINE	OEI SITUATION	2B, 2B1
Starter - generator	CW	11330	5	2.5	9.5	2S1: 7.5 2C: 3.5 2C1 3.5	2S1: 7.5 2C: 5.0 2C1 5.0	6
Fan out put (2S1 only)	CCW	12253	1	1.5	10	1.5	1.5	N/A

Note : CW : clockwise. CCW: counter clockwise. The rotation direction of the power drives for the accessories is indicated considering the power drive seen from the outside. The rotation direction of the engine rotors is indicated with respect to viewing the engine from its rear end. For further details see Installation Manual.

10. **Bleed Extraction.**

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

- 100 g/sec at Take-off rating
- 98 g/sec at Maximum Continuous rating

For details. see Installation Manual.

IV <u>OPERATIONAL LIMITATIONS</u>

1. **Temperature Limits:**

1.1. Gas generator exhaust temperature (T45) limits on start-up:

On start up

- for an unlimited duration : 750°C
- maximum overtemperature (< 10 sec) : 865°C

In flight in stabilised conditions

- 30-Second OEI rating : 1000°C N/A
- 2-Minute OEI rating : 941°C N/A

- Continuous OEI rating	:	912°C	N/A
- Take-off rating	:	912°C	915°C
- Max Continuous	:	877°C	849°C
- Max Transient		N/A	941°C

1.2. **Fuel temperature**

- Maximum temperature:	normal fuels	:	+ 50°C
	JP4	:	+ 43°C
	restricted use fuels	:	+ 25°C

For definition of normal and restricted use fuels, see Installation Manual.

- Use of anti-icing additive for fuel temperature $\leq$ - 20°C
- The fuel temperature conditions for engine starting are described in the Installation Manual.

1.3 **Oil Temperature**

- Minimum oil temperature for engine starting:	-30°C for oil with a kinematic viscosity of 5cst -50°C for oil with a kinematic viscosity of 3 to3.9cst
- Minimum oil temperature for power up:	O°C for oil with a kinematic viscosity of 5cst -10°C for oil with a kinematic viscosity of 3 to 3.9 cst
- Maximum oil temperature:	115°C

2. **Maximum/Minimum Speeds**

2.1. **Gas generator speed (Nl)**

2.1.1 2S1, 2C and 2C1:

100%Nl =52 110 rpm

Minimum stabilised speed:

- IDLE mode speed range	2S1:	48 % to 52 % (25 013 to 27 097 rpm)
	2C, 2C1:	67% to 68% (34 914 to 35 435 rpm)
FLIGHT mode:		62 % (32 308 rpm)

Maximum stabilised speed:

Rating	2S1	2C	2C1
30-Second OEI rating	105.8 % (55 156 rpm)	105.6% (55 051 rpm)	105.52% (54986)
2-Min OEI rating	102.4 % (53 386 rpm)	102.1% (53 192 rpm)	101.95% (53126)
Continuous OEI rating	101,2 % (52 756 rpm)	100.9% (52 571 rpm)	100.76% (52506)
Take-off rating	101.2 % (52 756 rpm)	101.1% (52 660 rpm)	101.25% (52776)
Max Continuous	99.1 % (51 616 rpm)	98.9% (51 520 rpm)	98.9% (51520)

Transient speed:

FLIGHT mode (2S1 only) 52% to 62% (27 097 to 32 308 rpm) avoid continuous operation in this range.

Maximum overspeed 102,3 % (53 312 rpm) all engines operating

2.1.2 2B and 2B1

100%Nl =52 110 rpm

Minimum stabilised speed: 62 % (32 308 rpm)
- IDLE mode speed range 67% to 68% (34914 to 35435 rpm)

Take-off: 101% (52 756 rpm)
Maximum Continuous 97.2% (50 672 rpm)
Maximum Overspeed (<20s) 102.3% (53 312 rpm)

2.2. **Power turbine speed (N2)**

100 % N2 = 39 095 rpm

During ground run, avoid continuous operation in the range :87 % to 90,5 % (34 012 to 35 381 rpm)

Limit values authorised other than during starting and idle (FLIGHT mode):

2.2.2 2S1, 2B, 2B1,2C, 2C1

Minimum stabilised	- power off	:	85% (33230 rpm)
	- power on	:	90.5% (35381 rpm)
Maximum stabilised		:	108.5% (42418 rpm)
Minimum transient (<20sec)		:	68% (26584 rpm)
Maximum transient (<20sec)	- power off	:	121% (47305 rpm)
	- power on	:	109% (42613 rpm)

During ground run avoid continuous operation in the range of 87% to 90.5% (34012 to 35381 rpm)

3. **Torque Limits:**

Maximum torque on shaft during operation

	Torque (da Nm)				
Rating	2S1	2B	2B1	2C	2C1
30-Second OEI	120,0	N/A	N/A	116.8	118.7
2-Minute OEl	113,0	N/A	N/A	107.3	107.9
Continuous OEI	104,0	N/A	N/A	103.0	102.9
Take-off rating	92,5	88.7	92.5	92.5	92.5
Maximum Continuous	92,5	88.7	92.5	92.5	92.5
Max. over-torque (transient ≤ 20 sec) 2S1	143,0	132.2	132.2*	132.2	132.2

* Max overtorque for training on 2B1 is 91.3 da Nm.

4. Pressure Limits:

4.1. Oil pressure

Minimum oil pressure	:	110 kPa
Maximum oil pressure	:	600 kPa
Normal operating	:	200 to 600 kPa

4.2. Fuel pressure

Minimum fuel pressure:

- Normal operation, i.e. excluding starting phase:
The minimum (absolute) pressure is defined by the highest of the following conditions: 20 kPa, 35% of atmospheric pressure, 7 kPa above the vapour pressure of the fuel used, fuel pressure corresponding to a Vapour volume over Liquid volume ratio of 0,30.

- During the starting phase or at relight: - 25 kPa

Maximum fuel pressure:

- Less than or equal to 150 kPa (relative pressure), whether during starting phase or in normal operation.

5. Installation Assumptions:

See Installation Manual

6. Dispatch Limitations:

All engine systems and equipment must be functional prior to aircraft take-off. Any engine system or equipment the failure of which would occur in flight shall be replaced or repaired prior to commencement of next flight.

V - OPERATIONAL AND SERVICE INSTRUCTIONS

	2S1	2C and 2B	2C1
Installation drawing and Manual	X 292 L0 001 1	X 292 M1 001 2	x 292 N4 0012
Operating Instructions are provided in Installation Manual Chapter 5	X 292 L0 001 1	X 292 M1 001 2	x292 N4 0012
Performance Brochure	X 292 LO 001 9	X 292 M1 001 9*	x292 N4 0019
Maintenance Manual (Life limitations are given in chapter 5 of the Maintenance Manual)	X 292 LO 300 2	X 292 M1 450 2	x294 N4 4502
Repair Manual	X 292 LO 500 2	not available	
Service Letters and Service Bulletins	refer to SB and SL directory		

* Performance Brochure for 2B1 is x292N50029

VI - NOTES

1. The operation of the Arriel 2S1, 2C and 2C1 engines is restricted to multi-engine helicopter applications.

2. The operation of the Arriel 2B and 2B1engine is restricted to single engine helicopter applications.

3. The engine capability against ingestion of foreign matter has not been fully assessed [JAR-E 790(a) and JAR-E 800 (a) (3)]. The protection of the engine against strike/ingestion of foreign matter other than rain must be ensured by the powerplant installation on the aircraft.

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

5. The electronic control system provides "TRAINING" function for training crews in an engine failure situation. Refer to the installation Manual for the characteristics of this function. (2S1, 2C and 2C1 only).

6. The software of the electronic control system has been validated according to DO178A level 1. For Arriel 2C variants certificated configuration includes software version 5.01 or latter approved version.

7. The operating/starting envelope is provided in the Installation Manual.

8. EMI/Lightning (Refer to Installation Manual for details).

Validation levels have been tested according to the following standards:

- Induced signal susceptibility : DO-160C Section 19, Category Z
- Radio Frequency susceptibility (BCI) : DO-160C Section 20.4, Category Y; MIL STD 461C-CSOl, CSO2, RSO2, RS03

- Emission of Radio Frequency energy : DO-160C Section 21, Category Z; MIL STD 461C-CEOl, CEO3, CEO7, REO2

- Lightning induced transient susceptibility : DO-160 Section 22

9. Repair/overhaul

Until the repair and overhaul manual is published, engine overhaul may only be performed by an organisation approved by TURBOMECA.

10. Power turbine overspeed shut-down device, previously available as an option, is now part of the basic Type Design and has been fitted to all production engines. (2S1 and 2C only).

11. The 2B and 2B1 variant of this engine is not approved for operation in icing conditions with Eurocopter AS 350 B3 sand filter P/N 709A 41 650 010.

12. Where in this datasheet data is provided without reference to an engine variant the data is applicable to all variants covered by the datasheet.