European Aviation Safety Agency

EASA

TYPE-CERTIFICATE DATA SHEET

Number: E.073
Issue: 02
Date: 18 September 2008
Type: TURBOMECA
Arriel 1 series engines

Variants
Arriel 1A
Arriel 1A1
Arriel 1A2
Arriel 1B
Arriel 1C
Arriel 1C1
Arriel 1C2
Arriel 1D
Arriel 1D1
Arriel 1E2
Arriel 1K
Arriel 1K1
Arriel 1S
Arriel 1S1

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I. General

1. Type : Arriel 1 Variants: Arriel 1,1A,1A1,1A2,1C,1C1,1C2,1S,1S1, 1K, 1K1,1E,1E2 for twin-engines helicopters.
Arriel 1B, 1B2, 1D, 1D1 for single-engine helicopters.

2. Type Certificate Holder:

TURBOMECA
64511 BORDES CEDEX
RANCE
DOA-ref: EASA.21J.070

3. Manufacturer:

- TURBOMECA, Bordes, France
- TURBOMECA USA (formerly Turbomeca Engine Corporation), Grand Prairie, Texas, USA

4. Certification Application Date/EASA Certification Date:

Model	Application Date	EASA Certification Date	Type certificate canceled
Arriel 1			19 November 1999
Arriel 1A	05 June 1974	01 June 1977	
Arriel 1A1	20 March 1979	26 March 1979	
Arriel 1A2	01 September 1978	07 December 1979	
Arriel 1B	05 June 1974	01 June 1977	
Arriel 1B2			19 November 1999
Arriel 1C	01 September 1978	23 December 1980	
Arriel 1C1	18 June 1981	27 January 1982	
Arriel 1C2	21 October 1988	24 February 1989	
Arriel 1D	07 December 1984	04 October 1985	
Arriel 1D1	10 May 1988	19 July 1988	
Arriel 1E			19 November 1999
Arriel 1E2	02 April 1993	08 October 1993	
Arriel 1K	24 October 1984	04 October 1985	
Arriel 1K1	09 February 1990	29 August 1990	
Arriel 1S	09 September 1985	06 May 1987	
Arriel 1S1	21 October 1989	19 December 1990	

Note: EASA type certification for all these models is granted in accordance with Article 2a paragraph 1(a) of EU Commission Regulation EC 375/2007 amending EU Commission Regulation 1702/2003 based on the DGAC France certification of these products (French Type Certificate N° M5).

II. Certification Basis

1. Airworthiness requirements: JAR-E issue 1 and amendments applicable on June 5th 1974, including ratings as per FAR 33 for helicopter engines.

2. Special condition: Special requirement applicable to the single-engine helicopters versions to take the free wheel into account. See letter from SGAC, former French Airworthiness Authority, reference 7525/DTA/SDT/MC dated 12/12/1974.

III. Technical Characteristics

1. Type Design Definition:

Arriel 1A	P/N 0 292 00 505 0
Arriel 1A1	P/N 0 292 00 505 0
Arriel 1A2	P/N 0 292 00 507 0
Arriel 1B	P/N 0 292 00 506 0
Arriel 1C	P/N 0 292 00 514 0
Arriel 1C1	P/N 0 292 00 515 0
Arriel 1C2	P/N 0 292 00 524 0
Arriel 1D	P/N 0 292 00 518 0
Arriel 1D1	P/N 0 292 00 522 0
Arriel 1E2	P/N 0 292 00 532 0 P/N 0 292 00 546 0*
Arriel 1K	P/N 0 292 00 517 0
Arriel 1K1	P/N 0 292 00 527 0
Arriel 1S	P/N 0 292 00 519 0
Arriel 1S1	P/N 0 292 00 525 0

* when modified by TU 324

2. Description:

The Arriel 1 engine is a turboshaft engine consisting of an axial air intake, an axial compressor and a centrifugal compressor driven by a two-stage turbine, a combustion chamber, and a single stage power turbine (free turbine) driving a reduction gearbox located at the rear. An accessory drive gearbox, driven by the gas generator, is located at the front. Mounts and starter-generator are not part of the engine type definition.

3. Equipment: Engine equipment is specified by the applicable Type Design Definition

4. Dimensions:

Model	Length (m)	Height (m)	Width (m)
Arriel 1A/1A1	1.12	0.6	0.41
Arriel 1A2	1.12	0.61	0.41
Arriel 1B	1.21	0.6	0.44
Arriel 1C	1.17	0.61	0.41
Arriel 1C1/1C2	1.17	0.61	0.47
Arriel 1D	1.26	0.61	0.49
Arriel 1D1	1.20	0.61	0.47
Arriel 1E2	1.19	0.7	0.49
Arriel 1K/1K1	1.17	0.61	0.5
Arriel 1S/1S1	1.54	0.79	0.49

5. Dry Weight:

Model	Weight dry (Kg)
Arriel 1A/1A1	111
Arriel 1A2	116.5
Arriel 1B	114.5
Arriel 1C	116.5
Arriel 1C1	118.6
Arriel 1C2	119
Arriel 1D	122.5
Arriel 1D1	122
Arriel 1E2	125
Arriel 1K	121
Arriel 1K1	123
Arriel 1S	126.75
Arriel 1S1	130

6. Ratings:

Ratings kW	Arriel 1A	Arriel 1A1	Arriel 1A2	Arriel 1B
2 – ½ minute OEI	486	498	500	NA
Continuous OEI**	466	480	490	NA
Takeoff	466	470	470	478
Maximum continuous	430	432	432	440

Ratings kW	Arriel 1C	Arriel 1C1	Arriel 1C2	Arriel 1D	Arriel 1D1
2 – ½ minute OEI	522	538*	569*	NA	NA
Continuous OEI**	512	526	550	NA	NA
Takeoff	492	526	550	510	531*
Maximum continuous	437	437	471	450	466

Ratings kW	Arriel1E2	Arriel 1K	Arriel 1K1	Arriel 1S	Arriel 1S1
2 – ½ minute OEI	528*	476*	494*	560*	598
Continuous OEI**	528*	476*	494*	544	588
Takeoff	528*	476*	494*	523	541
Maximum continuous	516	437	471	523	541

* The mechanical power is restricted to the values indicated above, taking into account the fuel flow limit corresponding to the engine installation, although the engine is capable of greater values which have also been validated.
** The intermediate contingency rating, with unlimited display time, according to BCAR-C (JAR-E) has also been validated.

Note 1: Engine ratings correspond to minimum values defined under the following conditions:

- Static, sea level standard conditions (15ºC, 1013 hPa)
- engines equipped with calibrated test bed air intake Nº6.202.81.719.0
- Use of following exhaust pipe:
  - Arriel 1A/1A/1A2/1C: 0.292.80.869.0
  - Arriel 1B/1D: 0.292.80.870.0
  - Arriel 1C1/1C2/1D1/1E2/1K/1K1/1S/1S1: 0.292.80.871.0
- no air bleed,
- no power drawn by any accessories other than those required for engine operation.
- fuel Low Heat Value : 43 136 kJ/kg
- output shaft rotation speed : 5976 rpm, Arriel 1A, 1A1, 1A2, 1B, 1C, 1C1, 1C2, 1D, 1D1, 1K, 1K1
  6000 rpm, Arriel 1E2
  6057 rpm, Arriel 1S
  6409 rpm, Arriel 1S1

Note 2: Ratings declared for Arriel 1A/1A1/1A2/1B/1C/1C1/1D/1K correspond to the minimum power ratings for new engines. For overhauled engines in operation, a performance decrement function to the operation time since overhaul have to be done, up to 2 % for 3000 operating hours.

Ratings declared for Arriel 1C2/1D1/1K1/1S/1S1/1E2 correspond to the minimum power ratings for aged engines.

Note 3: Detailed performance curves are provided in the relevant Installation / Operating Manuals.

7. Control System:

Arriel 1 engines are uipped with Hydromechanical Fuel Control Units, including a proportional free turbine speed control and a proportional integral gas generator speed control.

Refer to the Installation / Operating Manuals for further information.

8. Fluids (Fuel, Oil, additives)

Refer to applicable Installation / Operating Manuals.

9. Aircraft Accessory Drives:

Designation	**Rotation direction Facing pad**	**Rotation speed**	**Maximum Steady state**	**Maximum torque at overload**	**Maximum static overhung moment**
		(rpm)	**(kW)**	**(daN.m)**	**(daN.m)**
Arriel 1A, 1A1, 1A2, 1B not modified TU 77	CCW	NTL x 0.306122 12182	13.5	3.99	1.5
Arriel 1A, 1A1, 1A2, 1B modified TU 77 Arriel 1C, 1C1, 1C2, 1K, 1K1, 1D, 1D1, 1E2,	CCW	NTL x 0.29293 12182	13.5	3.99	1.5
Arriel 1S, 1S1	CCW	NTL x 0.29293 12297	5	1	1.5

Notes:

- CCW: counter clockwise
- The rotation direction of the power drives for the accessories is indicated considering the power drive seen from the outside.

10. Maximum Permissible Air Bleed Extraction:

P2 air bleed for helicopter use, maximum flow rate at standard sea level conditions: 100 g/s at Take-off rating
For further details, see Installation / Operating Manuals

IV. Operating Limitations:

1. Temperature Limits

1.1 Turbine Gas Temperature (°C)

	Arriel variants						
	1A/1A1/1A2	**1B**	**1C**	**1C1**	**1C2**	**1D**	**1D1**
Take off	810	810	835	845	845	845	845
Maximum continuous	775	775	785	775	775	795	795
30 minute OEI rating	810	NA	835	845	845	NA	NA
2-1/2 minute OEI rating	840	NA	860	865	885	NA	NA
Maximum overtemperature at starting	840	840	860	865	865	865	865
Transient (<20s)					920 **		870 *

	Arriel variants				
	1E2	**1K**	**1K1**	**1S**	**1S1**
Take off	845	845	845	845	845
Maximum continuous	845	775	775	845	845
30 minute OEI rating	845	845	845	845	868
2-1/2 minute OEI rating	885	865	885	885	885
Maximum overtemperature at starting	865	865	865	865	865
Transient (<20s)	920 **		920 **	920 **	920 **

* Allowed on helicopters equipped with digital avionics VEMD (Vehicule and Engine Monitoring Display)
** Only when reaching the 2 ½ min.OEI rating (maximum contingency power), see Installation / Operating Manuals

1.2 Fuel temperature

Refer to relevant Installation / Operating Manuals

1.3 Oil temperature (°C)

- Minimum for starting: between -55ºC and -40ºC, according to oil specification. Refer to Installation / Operating Manuals.
- Minimum for power application: -10ºC with 3 and 3.9 cst oils
  0ºC with 5 cst oil.
- Maximum operating temperature:
  - Arriel 1A/1A1/1A2/1B: 110ºC
  - Arriel 1C/1C1/1C2/1D/1D1/1E2/1K/1K1/1S/1S1: 115ºC

2. Pressure Limits

2.1 Fuel pressure

See installation / Operating Manuals

2.2 Oil pressure (hPa)

	Arriel variants		
	1A/1A1/1A2/1B	**1C/1C1/1C2/1E2/1K/1K1/1S/1S1**	**1D/1D1**
Minimal **70% < N1 <85%** **N1 ≥ 85%**	 1900 2800	 1300 1800	 1300 1800
Maximal	> 9000	> 5000	> 5000

3. Maximum / Minimum Permissible Rotor Speeds

3-1. Gas generator speed (N1)

Variants Arriel	2-1/2 minute OEI rating	30 minute OEI rating	Takeoff rating	Maximum continuous rating	Transient (5 second limit)	Transient (20 second limit)
1A	101.7	100.4*	100.4*	98*	105.5	NA
1A1	102.2	100.9	100.4*	98*	105.5	NA
1A2	102.2	101.4	100.4	98	105.5	NA
1B	NA	NA	100.4*	98*	105.5	NA
1C	102.7	101*	100	97.5	105.5	NA
1C1	102.7	100.8	100.8	97	105.5	NA
1C2	103.4*	102*	102*	98.2*	NA	107.5
1D	NA	NA	100.8	98	105.5	NA
1D1	NA	NA	101.9*	98	107.5	103.1 **
1E2	103.3*	102*	102*	100.3*	NA	107.5
1K	102.7	100.6	100.6	97	105.5	NA
1K1	103.4*	102*	102*	98.2*	NA	105.5
1S	102.7*	101*	100	100	NA	105.35
1S1	102.7*	102.2*	100	100	NA	105.35

* With NG de-rating law as function of outside temperature (and altitude for: 1S, 1S1, 1D1, 1C2, 1K1, 1E2)
** Allowed on helicopters equipped with digital avionics VEMD (Vehicule and Engine Monitoring Display)

With 100%= 51800 rpm for all variants except 1S/1S1
With 100%= 52110 rpm for Arriel 1S and 1S1

Notes:

- For the NG limit variation as function of ambient temperature and altitude if applicable, confer relevant Installation / Operating Manuals
- Minimum speed: 67% for all variants except for the Arriel 1E2 (63%).

3-1. Power turbine speed (N2) (%):

	Arriel Variants				
	1A1/1A1/1A2 1B	**1C/1C1/1C2/ 1D/1D1/ 1K/1K1**	**1E2**	**1S**	**1S1**
Maximum stabilized	113.5	108.5	108	108	102.07
Maximum transient 5 sec.	120.5	120.5	120	118.9	112.34
Minimum transient 5 sec.	86	86	85.6	84.8	80.2

Notes: 100% means:

- 39635 rpm for free turbine shafts of Arriel 1A/1A1/1A2/1B non -modified TU77
- 41420 rpm for free turbine shafts of Arriel 1A/1A1/1A2/1B modified TU77 and Arriel 1C/1C1/1C2/1D/1D1/1K/1K1
- 41981 rpm for free turbine shafts of Arriel 1S
- 44421 rpm for free turbine shafts of Arriel 1S1
- 41586 rpm for free turbine shafts of Arriel 1E2

4. Torque Limits (m.daN)

	Arriel Variants				
	1A/1A1/1A2	**1C/1C1/1E2/1K/1K1**	**1C2**	**1S**	**1S1**
Max at OEI 2 ½ min	83	87.7	87.5	87.9	113
20 seconds	87.7	98.6	105	118.4	132.2

	Arriel Variants	
	1B	**1D/1D1**
Max	83	83
20 seconds	87.7	91.5

5. Installation Assumptions:

Refer to Installation / Operating Manuals for details.

6. Dispatch Limitations:

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

V. Operating and Service Instructions:

Note: For all tables in this section, when 2 references separated by "/" are provided, the first one refers to the document in French language and the second one to the document in English language. In case of conflict of translation the French version shall take precedence.

	1A	1A1	1A2	1B
Installation Drawing and Manual	292 00930 / 292 00931			
Operation Manual	292 00 932			
Performance Boocklet	Included in the Installation Manual			
Maintenance Manual	292 01 931	X 292 B3 452 1 / X 292 B3 452 2	X 292 A9 452 1 / X 292 A9 452 2	X 292 65 452 1 / X 292 65 452 2
Repair Manual	X 292 87 500 1 / X 292 87 500 2			
Service Letters and Service Bulletins	refer to SB and SL directory			

	1C	1C1	1C2	1D	1D1
Installation Drawing and Manual	X 292 B0 002 1 / X 292 B0 002 2				
Operation Manual	Included in the installation Manual chapter 5				
Performance bBoocklet	X 292 B0 001 9				
Maintenance Manual	X 292 B0 452 1 / X 292 B0 452 2	X 292 C3 452 1 / X 292 C3 452 2	X 292 G1 452 1 / X 292 G1 452 2	X 292 E5 452 1 / X 292 E5 452 2	X 292 G2 452 1 / X 292 G2 452 2
Repair Manual	X 292 87 500 1 / X 292 87 500 2				
Service Letters and Service Bulletins	refer to SB and SL directory				

	1K	1K1
Installation Drawing and Manual	X 292 D8 001 1 / X 292 D8 001 2	
Operation Manual	Included in the Installation Manual chapter 5	
Performance boockletBooklet	X 292 D8 002 1 / X 292 D8 001 9	
Maintenance Manual	X 292 D8 452 1 / X 292 D8 452 2	X 292 H3 452 1 / X 292 H3 452 2
Repair Manual	X 292 87 500 1 / X 292 87 500 2	
Service Letters and Service Bulletins	refer to SB and SL directory	

	1S	1S1
Installation Drawing and Manual	X 292 F9 001 1 / X 292 F9 001 2	
Operation manual	Included in the Installation Manual chapter 5	
Performance boockletBooklet	X 292 F9 900 9	
Maintenance Manual	X 292 F9 452 1 / X 292 F9 452 2	X292 H4 452 1 / X 292 H4 452 2
Repair Manual	X 292 87 500 1 / X 292 87 500 2	
Service Letters and Service Bulletins	refer to SB and SL directory	

	1E2
Installation Drawing and Manual	X 292 G9 001 1 / X 292 G9 001 2
Operation manual	Included in the Installation Manual chapter 5
Performance boockletBooklet	X 292 G9 900 9
Maintenance Manual	X 292 M3 452 1 / X 292 M3 452 2
Repair Manual	X 292 87 500 1 / X 292 87 500 2
Service Letters and Service Bulletins	refer to SB and SL directory

VI. Notes

1. Ingestion of foreign matter:

The engine capability against ingestion of foreign matter has not been fully assessed (C4-4 18 and 19, C 4-6 19 and 20). The protection of the engine against strike / ingestion of foreign matter other than rain is to be ensured by the powerplant installation on the aircraft.

Anti icing protection: the operating characteristics in icing conditions shall be evaluated before approval is given for the installation of the power plant on the helicopter concerned, refer to the relevant installation manual.

2. Vibrations:

Measure tooks by probe located on gas generator rear bearing

3. Conversion from non civil use:

This note is applicable to the following variants:

Case 1: Arriel 1A, 1A1, 1A2, 1B, 1C, 1C1, 1C2, 1D, 1D1, 1E2, 1K, 1K1, 1S, 1S1 engines originally assembled by Turbomeca and having previously been used by an operator engaged in military, customs, police or similar services, and not under the control of a civil Authority.

Case 2: The Arriel 1M and Arriel 1MN are military variants of the Arriel 1C1, known to be installed on, but not limited to, a military helicopter. Arriel 1C1 engines can be created by converting Arriel 1M or Arriel 1MN engines.

Case 3: The Arriel 1M1 and Arriel 1MN1 are military variants of the Arriel 1C2, known to be installed on, but not limited to, a military helicopter. Arriel 1C2 engines can be created by converting Arriel 1M1 or Arriel 1MN1 engines.

The compliance of such engines 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 engines are installed, an EASA Form 1 must be issued for these engines. This requires incorporation of the following Turbomeca Mandatory Service Bulletins:

Case 1: A292 72 0806 Update 1 (or any subsequent approved issue).

Case 2: A292 72 0813 Original Issue (or any subsequent approved issue).

Case 2: A292 72 0814 Original Issue (or any subsequent approved issue).
