
Type Acceptance Report

TAR 12/21B/2 – Revision 1

TURBOMÉCA ARRIEL 2

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Executive Summary

New Zealand Type Acceptance has been granted to the Turboméca Arriel 2 Series turboshaft engines based on validation of EASA Type Certificate number E.001. There are no special requirements for import.

Applicability is limited to the Models and/or serial numbers detailed in Appendix 1, which are now eligible for installation on a NZ-registered aircraft. Additional variants or serial numbers approved under the foreign type certificate can become type accepted after supply of the applicable documentation, in accordance with the provisions of NZCAR §21.43(c).

1. Introduction

This report details the basis on which Type Acceptance Certificate No.12/21B/2 was granted in the Standard Category in accordance with NZCAR Part 21 Subpart B.

Specifically the report aims to:

- (a) Specify the foreign type certificate and associated airworthiness design standard used for type acceptance of the product in New Zealand; and
- (b) Identify any special conditions for import applicable to any model(s) covered by the Type Acceptance Certificate.

The report also notes the status of all models included under the foreign type certificate which have been granted type acceptance in New Zealand. Models covered by the type acceptance certificate issued under Part 21B at Amendment 6 or later are listed in Section 2 below. Models which were accepted prior to that are listed in Appendix 1 of this report.

2. ICAO Type Certificate Details

Manufacturer: Turboméca

Type Certificate: E.001

Issued by: European Aviation Safety Agency

Model(s): Arriel 2S1, 2S2, 2B, 2B1, 2C, 2C1, 2C2, 2D, 2E

Rating (kw)	Arriel 2S1	Arriel 2S2	Arriel 2B	Arriel 2B1	Arriel 2C	Arriel 2C1	Arriel 2C2	Arriel 2D	Arriel 2E
OEI-30	735	771	n/a	n/a	704	718	750	n/a	753
OEI-2 min	663	699	n/a	n/a	635	646	713	n/a	630
OEI-Cont.	639	659	n/a	n/a	610	616	640	n/a	490
30-min T/O	601	601	n/a	n/a	n/a	n/a	612	598	445
Take-off	601	601	557	557	531	581	612	598	445
Max. Cont.	592	601	543	543	531	531	612	598	360

3. Type Acceptance Details

The application for type acceptance of the Arriel 2D was from the manufacturer dated 29 July 2011. The Arriel 2D is fitted to the new Eurocopter “AS 350 B3e” model helicopter. (The Arriel 2B and 2B1 models have been previously type accepted in New Zealand, but were included as part of the type acceptance of the Eurocopter AS350B3 helicopter.) The Arriel 2 Series is a modular turboshaft engine with axial 1st stage compressor and centrifugal 2nd stage compressor driven by a single-stage turbine, a direct-flow annular combustion chamber, and a single-stage free turbine driving a reduction gear assembly located at the aft end. The accessory gearbox, located at the forward end, is driven by the gas generator. The engine is controlled by an Electronic Engine Control Unit (EECU).

Type Acceptance Certificate No. 12/21B/2 was granted on 16 July 2012 to the Arriel 2D based on validation of EASA Type Certificate E.001. Specific applicability is limited to the coverage provided by the operating documentation supplied. There are no special requirements for import into New Zealand.

The Arriel 2 is the second generation version of this gas turbine engine family intended for helicopter applications with thermal Take-off Power ratings in the range 500-750 kW. The principle change from the earlier Arriel 1 series is the use of FADEC electronic control, initially single channel with manual back-up. It also features a gas generator turbine made in one stage with single crystal blades.

The first certificated version was the Arriel 2S1 fitted to the Sikorsky S76C+. The engine is available in two basic family ranges, the Arriel 2B intended for single-engine helicopters (Eurocopter AS350B3/EC130), and the Arriel 2C for twin-engine installations (Eurocopter AS365/EC155). The subsequent Arriel 2B1 and 2C1 versions switched to dual channel DECU with provision for electrical or automatic back-up. The next development was the Arriel 2C2 and 2S2, which use an upgraded gas generator (increased TOT and improved compressor efficiency).

The latest evolution is the Arriel 2+ family (Arriel 2D single-engine application initially, followed by the Arriel 2E twin-engine) which incorporate a number of detailed changes, including: new 3D power turbine blade profile and rear bearing support; new dual-channel EECU; an HP blade creep damage counter; and an Engine Data Recorder. The internal improvements have resulted in an increased TOT, and a small increase in power thermal capability. The 2D engine has been approved with a 30-minute Take-off Power rating.

This report was raised to Revision 1 to include the Arriel 2E, which is intended to replace the Arriel 1E2 on upgraded versions of Airbus Helicopters Deutschland EC145/BK117-D2 twin-engine helicopters. The application was from the manufacturer dated 13 February 2014. The opportunity was also taken to include all the previous engine versions which were not covered by the Type Acceptance Certificate. (Except for two versions on the TCDS, the Arriel 2B1A and Arriel 2B1B, which were type certificated for specific projects. The 2B1A is fitted to the Chinese AC311 helicopter, while the 2B1B did not enter production.) As part of the Type Acceptance process a team from the CAA Aircraft Certification Unit visited Turboméca for a validation visit. (See Report of Meeting Technical Note A114042) Type Acceptance of the Arriel 2E and the other versions of the Arriel 2 family was granted on 23 September 2014.

4. NZCAR §21.43 Data Requirements

The type data requirements of NZCAR Part 21B Para §21.43 have been satisfied by supply of the following documents, or were already held by the CAA:

(1) ICAO Type certificate:

EASA Type Certificate Number EASA.E.001

EASA Type Certificate Data Sheet number E.001 at Issue 07 dated 17 Dec 2012

- Model Arriel 2S1 approved 26 April 1996
- Model Arriel 2C approved 29 August 1997
- Model Arriel 2B approved 1 December 1997
- Model Arriel 2C1 approved 8 December 1998
- Model Arriel 2B1 approved 15 November 2000
- Model Arriel 2C2 approved 5 July 2002
- Model Arriel 2S2 approved 6 December 2005
- Model Arriel 2D approved 16 May 2011
- Model Arriel 2E approved 17 December 2012

Supersedes:

Certificat de Type Moteur Numero M19

Fiche de Caracteristiques Moteur No. M19 – Edition 6, January 98

JAR-E Engine Data Sheet No. JAA/E/96-013 – Issue 8, 3 April 98

(2) Airworthiness design requirements:

(i) *Airworthiness Design Standards:*

The certification basis of the first Arriel 2 versions 2B/2B1/2C/2C1/2S1 is JAR-E Change 9 dated 21 October 1994, plus Orange Paper E/96/1 dated 08 August 1996. There was one JAA exemption and two equivalent safety findings, which have been reviewed and accepted by the CAA. Special Conditions were applied for the approval of the OEI and HIP/SARM ratings. For the Arriel 2 versions 2C2 and 2S2 this was updated by the addition of Orange Paper E/97/1.

For the Arriel 2D the same certification basis was used plus two paragraphs of JAR-E at Change 10, two paragraphs of CS-E at Amendment 1 and one paragraph of CS-E at Amendment 2. One Special Condition was applied for approval of the 30-minute take-off rating. This was also applied to the Arriel 2E, plus some “Elect to Comply” requirements. These included JAR-E 820 at Amendment 11, some paragraphs of JAR-E Amendment 12, plus CS-E 1030 at Amendment 1.

This is an acceptable certification basis in accordance with NZCAR Part 21B Para §21.41 and Advisory Circular 21-1A, because JAR-E is the European equivalent of FAR 33, the basic standard for aircraft engines called up under Part 21 Appendix C.

(ii) *Special Conditions:*

Arriel 2C/2C1/2S1:

SC1 to SC12: For approval of the 30-Second, 2-Min. and Continuous OEI ratings:

JAA CRI-T2 – Special Conditions for OEI Ratings (Specified eleven SC, which covered: Ratings; Controls; Provisions for Instruments; Conditions Applicable to Endurance Tests; Endurance Test Inspection and Calibration; Functioning; Vibration Surveys; Endurance Tests; Cyclic Endurance and Power Availability Tests; Safe Life; and Overtemperature Test.)

JAA CRI-T4 – SC12 (Special interpretation of paragraphs JAR-E 820 and JAR-E 830.)

Arriel 2S1:

SC13 to SC15: Special conditions for approval of the HIP/SARM rating

JAA CRI-T7 – This new rating for Hovering at Increased Power [for Search and Rescue operations] is for up to 30 minutes and is equivalent to the takeoff rating. SC13 established the rating. SC14 specifies Provisions for Instruments. SC15 requires the engine TBO be unaffected. (Achieved by requiring the operator to apply a lump sum increment each time this rating is used.)

Arriel 2C2/2S2:

SC1-C2 – SC for certification of “30 second and 2 minutes OEI ratings”

JAA CRI-T11 – This replaces the previous CRI-T2 with requirements based on various NPA-E-x proposed rules and the use of some sections of JAR-E at Change 10.

SC2-C2: Special Condition for certification of HIP/SARM rating – CRI-T7 applied.

Arriel 2D/2E:

SC-1 – Approval of Turboshaft 30-minute Take-off Power Rating.

EASA CRI-T1 – (See also Propulsion Certification Memo PCM03 – Approval of Turboshaft Rating for Hovering at Increased Power) This defined requirements for HIP equivalent to take-off rating, including: Endurance Tests (a further 25 hours of continuous periods over 30 mins); Pilot Alert (to warn the HIP rating time has expired [This is not actually imposed at the engine level, but is called up in the Operating Instructions Manual]); and Engine Deterioration.

(iii) *Equivalent Level of Safety Findings:*

Arriel 2B/2B1:

JAA CRI-T5 – Equivalent Safety Finding JAR E-740 Endurance Test – The Arriel 2S1 test was accepted on the basis of similarity and complementary analysis for the differences.

Arriel 2C1:

JAA CRI-T10 – Equivalent Safety Finding JAR E-740 Dual Channel Control System Endurance Test – Similar to the above the single channel with manual back-up Arriel 2S1 test was accepted on the basis of similarity and complementary analysis for the differences.

(iv) *Exemptions:*

Arriel 2B/2B1/2C/2C1/2S1/2C2/2S2:

JAA CRI-T1 – Arriel 2S1 JAR-E 570 Oil System – Non-compliance with E570(a)(4)(ii) which requires flight indication of impending blockage of the most critical main oil filter. Ground indication of by-pass operation was accepted on the basis of harmonization with FAR 27/29.

(v) *Airworthiness Limitations:*

See Arriel 2() MM Section 05-10-00 – Airworthiness Limitations – Approval

(3) Environmental Certification:

The Arriel 2 engine series has been shown to meet the fuel venting provisions of ICAO Annex 16, Vol II, Part 2, Chapter 2, Edition 1993 for the Arriel 2B/2C/2S Series and Amendment 6 effective 20 November 2008 for the Arriel 2D/2E.

(4) Certification Compliance Listing:

Arriel 2B – Compliance Check List – Issue 1 dated 15/10/1997

Arriel 2B1 – Certification Document Monitor Issued 16/10/2000 (Reports listing)

Arriel 2B1 – Civil Certification – Compliance Check List Document No. 433-2000

JAA Certification Review Item CRI-A1B1 – Arriel 2B1 JAA Type Certification

Basis: The Arriel 2B1 was accepted as a variant of the Arriel 2S1. The type certification basis was therefore specified as JAR-E at Change 9 dated 21 October 1994 and Orange paper E/96/1 dated 8 August 1996 (which incorporated NPA E-17). There was one exemption and one ESF. Compliance was shown with the fuel venting requirements of ICAO Annex 16, Volume II Issue 2, July 1993.

JAA CRI-A2 – Arriel 2C Additional National Requirement – ANR-1 Emissions

JAA CRI-T6 – Arriel 2B Means of Compliance for Approval of TBO – A set of criteria was provided to enable Turboméca to declare a TBO at entry into service, based on accelerated cyclic endurance test, validation of the maintenance program, complementary analysis and past experience.

JAA CRI-T9 – Arriel 2B EECU Automatic Cycles Counter – Turboméca wanted to use the built-in counter as the primary method for cycle recording of life-limited parts, under JAR E-20(d). This was accepted as the software is certified to DO-178A and periodic checks were introduced into the MM.

Arriel 2S1 – Compliance Check List – Issue 9 dated 29/4/1996

Arriel 2C – Compliance Check List – Issue 3 dated 1/9/1997

Arriel 2C1 – Compliance Check List – Issue dated 4/1/1999

Arriel 2C2 – Compliance Check List – Technical Memo 2002-407 rev.1

Note Technique AA003650 Version A – Arriel 2S2 Engine Compliance Check List

Note Technique AA062527 Version A – Arriel 2D Compliance Check List

EASA CRI-A1 – Arriel 2D Type Certification Basis – The Arriel 2D is a variant of the Arriel 2C2. However Turboméca established that the differences between the Arriel 2S1 were “non-significant” and proposed the same certification basis, plus some later “elect-to-comply” requirements.

Note Technique AA069937 Version A – Arriel 2E Compliance Check List

Plan de certification ou Maintenabilité AA050888 Version B – Arriel 2E CCS (Certification Compliance Sheets) Collection

EASA CRI-A1 – Arriel 2E EASA Type Certification Basis – The Arriel 2E is a variant of the Arriel 2C2, and was developed with a high degree of commonality with the Arriel 2D which was the last variant certified. Similar to the Arriel 2D Turboméca established that the differences between the Arriel 2E and the first certificated Arriel version, the 2S1, were “non-significant” and proposed the same certification basis, plus some later “elect-to-comply” requirements.

(5) Flight Manual: N/A

(6) Operating Data for Engine:

(i) *Maintenance Manual:*

Arriel 2X Maintenance Manual – P/N X 292 XX 450 2

Note: X 292 = Arriel; XX = Arriel version; 450 = manual type; 2 = language

M5 = Arriel 2B; N5 = Arriel 2B1; R1 = Arriel 2D;

M1 = Arriel 2C; N4 = Arriel 2C1; N6 = Arriel 2C2;

L0 = Arriel 2S1; P5 = Arriel 2S2; R2 = Arriel 2E

(ii) *Current service Information:*

Arriel 2 All Variants Service Letters Index – P/N X 292 20 953 2

Arriel 2X Service Bulletins (with Index) – P/N X 292 XX 952 2

Arriel 2X Modifications Index – P/N X 292 XX 950 1

(iii) *Illustrated Parts Catalogue:*

Arriel 2X – Maintenance Spare Parts Catalogue – No. X 292 XX 700 2

Arriel 2X – Maintenance Tools Catalog – No. X 292 XX 800 2

(7) Agreement from manufacturer to supply updates of data in (5), and (6):

CAA 2171 – Turboméca Head of Airworthiness dated 28.05.98 (Arriel 2B)

CAA 2171 – Turboméca Head of Airworthiness dated 05.06.02 (Arriel 2B1)

Access to publications is provided at the www.turbomeca-support.com website

(8) Other information:

Turboméca Arriel 2X Performance Brochure – Ref. X 292 XX 001 9

Turboméca Arriel 2X Installation and Operating Manual – P/N X 292 XX 001 2

Attachments

The following documents form attachments to this report:

Copy of EASA Type Certificate Data Sheet Number E.001

Sign off

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David Gill
Team Leader Airworthiness

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Checked – Owen Olls
Airworthiness Specialist

Appendix 1

List of Type Accepted Variants:

<i>Model:</i>	<i>Applicant:</i>	<i>CAA Work Request:</i>	<i>Date Granted:</i>
Arriel 2B	Eurocopter	98/21B/19	17 July 1998
Arriel 2B1	Eurocopter International Pacific Ltd	6/21B/23	12 January 2006
Arriel 2D	Turboméca	12/21B/2	16 July 2012
Arriel 2S1, 2S2	Turboméca	14/21E/14	23 September 2014
Arriel 2C, 2C1, 2C2	Turboméca	14/21E/14	23 September 2014
Arriel 2E	Turboméca	14/21E/14	23 September 2014