# TYPE-CERTIFICATE DATA SHEET

No. E.031

**for**
ARRIUS 2F Engines

**Type Certificate Holder**

Safran Helicopter Engines

64510 Bordes
France

For Models:

ARRIUS 2F
ARRIUS 2R

Intentionally left blank

**TABLE OF CONTENTS**

# I. General

## 1. Type / Model

| Model | Installation |
|---|---|
| ARRIUS 2F | Single-engine helicopters |
| ARRIUS 2R | |

## 2. Type Certificate Holder

Safran Helicopter Engines
64510 Bordes
France
DOA ref: EASA.21J.070

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

## 3. Manufacturer

Safran Helicopter Engines
64510 Bordes
France

## 4. Date of Application

| Model | Application Date |
|---|---|
| ARRIUS 2F | 29 November 1994 |
| ARRIUS 2R | 04 April 2013 |

## 5. EASA Type Certification Date

| Model | EASA Certification Date | Note |
|---|---|---|
| ARRIUS 2F | 22 January 1997 | (1) |
| ARRIUS 2R | 15 December 2015 | |

Note (1): EASA type certification for this model is granted in accordance with article 3 paragraph 1(a) of EU Commission Regulation (EU) 748/2012 based on the DGAC France certification of this product (French Type certificate N° M22) which is hereby replaced.

## II. Certification Basis

### 1. Reference Date for Determining the Applicable Airworthiness Requirements

| Model | Reference Date |
|---|---|
| ARRIUS 2F | 29 November 1994 |
| ARRIUS 2R | 04 April 2013 |

### 2. State of Design Authority (EASA) Certification Basis

2.1. Airworthiness Standards

| Model | Airworthiness Standards |
|---|---|
| ARRIUS 2F | JAR-E Change 9 dated 21st October 1994, except Section 4 which is deleted by NPA-E-17 (Orange Paper E/96/1 dated 08 August 1996) |
| ARRIUS 2R | CS-E Amendment 3, dated 23rd December 2010, except:<br>- CS-E 515, for the Centrifugal Compressor Impeller, the Power Turbine Disc, the Power Turbine Shaft where JAR-E515 Change 9, amended by Orange Paper E/96/1 is applied;<br>- CS-E 650 where JAR-E Change 9, dated 21st October 1994 for the whole engine is applied;<br>- CS-E 850 where JAR-E Change 9, dated 21st October 1994 for the whole engine is applied. |

2.2. Special Conditions (SC)

| Model | Special Conditions |
|---|---|
| ARRIUS 2F | None |
| ARRIUS 2R | None |

2.3. Equivalent Safety Findings

| Model | Equivalent Safety Findings |
|---|---|
| ARRIUS 2F | JAR-E840 – Compressor and Turbine Rotor Integrity Tests |
| ARRIUS 2R | None |

2.4. Deviations

| Model | Deviations |
|---|---|
| ARRIUS 2F | JAR-E570 (a)(4)(ii) and (a)(5)(ii) – Oil system |
| ARRIUS 2R | None |

2.5. Environmental Protection

| Model | Environmental Protection |
|---|---|
| ARRIUS 2F | Emissions requirement of ICAO Annex 16, Volume II, Part II, issue 2 (Edition 1993) |
| ARRIUS 2R | CS-34 Amendment 1, dated 29th January 2013 in accordance with CS-E1010 Fuel Venting<br>Environmental protection requirements of ICAO Annex 16, Volume II, Part II, Chapter 2 Amendment 7 effective 17th November 2011 |

## III. Technical Characteristics

### 1. Type Design Definition

| Model | Part Number |
|---|---|
| ARRIUS 2F | P/N 0 319 00 800 0 |
| ARRIUS 2R | P/N R 319 00 900 0 |

### 2. Description

ARRIUS 2F

The ARRIUS 2F engine is a turboshaft engine intended for powering single-engine helicopters. The engine consists of an annular air intake, a centrifugal compressor driven by a single stage turbine, an annular reverse flow combustion chamber, and a single stage free power turbine with through shaft driving a reduction gearbox located at the front. The reduction gear unit also includes the accessory gearbox driven by the gas generator and an oil tank. The fuel control system is Hydro Mechanical.

ARRIUS 2R

The ARRIUS 2R is a turboshaft engine intended for powering single-engine helicopters. It consists of an annular air intake, a single stage centrifugal compressor driven by a single stage gas generator turbine, an annular reverse flow combustion chamber, a single stage free turbine with a through shaft driving a reduction gearbox located at the front. The reduction gear unit also includes the accessory gearbox driven by the gas generator. Primary Engine Control System consists of a dual-channel digital Engine Control Unit (ECU), a dual-channel electric actuator and a fuel metering valve. There is also a Back-up Engine Control System consisting of an auxiliary metering valve, an auxiliary electric actuator and the same ECU.

## 3. Equipment

ARRIUS 2F

Engine equipment is specified by the applicable Type Design Definition.
Starter-generator has to be supplied by the aircraft manufacturer.

ARRIUS 2R

Engine equipment is specified by the applicable Type Design Definition.
Starter-generator and aircraft free wheel unit have to be supplied by the aircraft manufacturer.

## 4. Dimensions

| Model | Overall Length (m) | Overall Height (m) | Overall Width (m) |
|---|---|---|---|
| ARRIUS 2F | 1.168 | 0.674 | 0.488 |
| ARRIUS 2R | 0.934 | 0.676 | 0.553 |

## 5. Dry Weight

| Model | Dry Weight (kg) |
|---|---|
| ARRIUS 2F | 104 |
| ARRIUS 2R | 119.9 |

## 6. Ratings

| Ratings – Power (kW) | Maximum duration | ARRIUS 2F | | | | ARRIUS 2R | |
|---|---|---|---|---|---|---|---|
| | | without Tf39 (*) | | with Tf39 (*) | | | |
| | | With torque and fuel flow limitations | Without torque and fuel flow limitations | With torque and fuel flow limitations | Without torque and fuel flow limitations | With torque and fuel flow limitations | Without torque and fuel flow limitations |
| Take-Off | 5 minutes | 322 | 376 | 376 | 376 | 352 | 389 |
| Maximum Continuous | unlimited | 322 | 335 | 335 | 335 | 323 | 355 |

ARRIUS 2F:

The performance values specified above correspond to minimum values defined under the following conditions:

- ISA conditions at sea level, on test bed
- Engine equipped with a test bed air flow measurement intake plenum and a test bed exhaust jet pipe
- No air bleed
- No power drawn by any accessories other than those required for engine operation
- Power off-take speed = 6 000 rpm constant
- Usual Fuel Heating Value = 43 136 kJ/kg
- Alternative Fuel Heating Value = 43 500 kJ/kg

* See note 4 paragraph VI.

ARRIUS 2R:

The performance values specified above correspond to minimum values defined under the following conditions:

- Neither pressure drop nor heating, nor swirl, at engine inlet plane 1 (see Installation / Operating Manual §2.2 for reference plane definition)
- Atmospheric humidity used for performance calculation: Humidity Mixing Ratio = 0.0069 (65% at sea level 15°C)
- Engine equipped with a test bed air flow measurement intake plenum and a test bed exhaust jet pipe
- No back pressure downstream of the test bed exhaust pipe plane 7
- No air bleed
- No electrical power off-take
- No power drawn by any accessories other than those required for engine operation
- Output shaft rotation speed 100% = 5 610 rpm constant
- Fuel Heating Value = 43 136 kJ/kg
- No fuel flow limit

## 7. Control System

| Model | Control System |
|---|---|
| ARRIUS 2F | Hydro Mechanic with manual backup mode |
| ARRIUS 2R | Dual-channel electronic engine control system with auxiliary fuel metering back-up control |

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

Refer to applicable Installation / Operating Manual.

## 9. Aircraft Accessory Drives

| | | Starter-generator Output | | | | |
|---|---|---|---|---|---|---|
| Model | Rotation direction | Rotation speed (rpm) | Maximum torque in overload (N.m) | Maximum static overhang (N.m) | Fuse shaft breakaway torque (N.m) | Maximum Continuous Mechanical Power (kW) |
| ARRIUS 2F | CW | 12 334 | 25 | 25 | 77 | 5.7 |
| ARRIUS 2R | CW | 12 334 | 25 | 25 | 95 | 6.9 |

At 100% N1

For further details, see Installation Manual

Additional note:
The rotation direction of the engine rotors is indicated with respect to viewing the engine from its rear end.

## 10. Maximum Permissible Air Bleed Extraction

At Take-off, at ISA conditions on ground:

| Model | Maximum Permissible Air Bleed Extraction | |
|---|---|---|
| ARRIUS 2F | Two ports used<br>On one port maximum air flow<br>On the other port maximum air flow<br>Maximum total bleed air flow | <br>70 g/s<br>40 g/s with Tf39 (*)<br>70 g/s without Tf39 (*)<br>110 g/s with Tf39 (*) |
| ARRIUS 2R | Two ports used<br>On one port maximum air flow<br>Maximum total bleed air flow | <br>70 g/s<br>80 g/s on the two ports |

(*): see note 4 paragraph VI

## IV. Operating Limitations

### 1. Temperature Limits

1.1. Gas Generator Exhaust Temperature (T45) Limits

| T45 on start-up (°C) | ARRIUS 2F | ARRIUS 2R |
|---|---|---|
| For an unlimited duration | 800 | 800 |
| Maximum overtemperature (< 10 sec) | 870 | 870 |

| T45 in-flight (°C) | ARRIUS 2F | ARRIUS 2R |
|---|---|---|
| Take-off | 870 | 865 |
| Maximum continuous | 830 | 829 |
| Maximum inadvertent overtemperature | 900 (< 5 sec) | 882 (< 20 sec) |

1.2. Fuel Temperature

Maximum temperature: see Installation Manual Chapter 6.1.1.1

Minimum temperature for engine starting: s see Installation Manual Chapter 6.1.1.1

For definition of normal and restricted use fuels, see Installation Manual Chapter 6.1.1.1

Use of anti-icing additive for fuel temperature:

< -15°C for ARRIUS 2F
< -20°C for ARRIUS 2R

1.3. Oil Temperature

Minimum oil temperature depending on kinematic viscosity for starting:

For ARRIUS 2F

For 5 $mm^2/s$ and 3,9 $mm^2/s$ oil:
-30°C
For 3 $mm^2/s$ oil:
-50°C

For ARRIUS 2R

For 5 $mm^2/s$ and 4 $mm^2/s$ oil:
-30°C
For 3 $mm^2/s$ oil:
-50°C

Minimum oil temperature depending on kinematic viscosity for power application:
For ARRIUS 2F
For 5 $mm^2/s$ and 3,9 $mm^2/s$ oil:
+10°C in transient condition
+50°C in continuous operation
For 3 $mm^2/s$ oil:
+0°C in transient condition
+50°C in continuous operation

For ARRIUS 2R
For 5 $mm^2/s$ and 4 $mm^2/s$ oil:
+10°C in transient condition
+50°C in continuous operation
For 3 $mm^2/s$ oil:
+0°C in transient condition
+50°C in continuous operation

Maximum oil temperature:

110°C

**2. Speed Limits**

2.1. Gas Generator Speed (N1)

100% N1 = 54 117 rpm

| Minimum stabilised N1 speed | ARRIUS 2F | ARRIUS 2R |
|---|---|---|
| Minimum stabilised N1 speed | 63% (34 094 rpm) | |

| Maximum stabilised N1 speed | ARRIUS 2F | ARRIUS 2R |
|---|---|---|
| Take-off | 101.2% (54 768 rpm) | 101.4% (54 872 rpm) |
| Maximum continuous | 99.7% (53 956 rpm) | 99.9% (54 066 rpm) |

| Transient speeds | ARRIUS 2F | ARRIUS 2R |
|---|---|---|
| Maximum inadvertent overspeed (< 20 sec) | 103.6% (56 065 rpm) | |

2.2. Power Turbine Speed (N2)

100% N2 = 44 009 rpm for ARRIUS 2F
100% N2 = 42 014 rpm for ARRIUS 2R

| Maximum N2 speed<br>Flight mode | ARRIUS 2F | ARRIUS 2R |
|---|---|---|
| Continuous | 104%<br>(45 770 rpm) | 105%<br>(44 114 rpm) |
| Maximum inadvertent transient overspeed (< 20 sec) | 110%<br>(48 410 rpm) | 112%<br>(47 055 rpm) |

| Minimum N2 speed<br>Flight mode | ARRIUS 2F | ARRIUS 2R |
|---|---|---|
| Continuous | 92%<br>(40 488 rpm) | 94%<br>(39 493 rpm) |
| Maximum inadvertent transient overspeed (< 20 sec) | 90%<br>(39 608 rpm) | 92%<br>(38 653 rpm) |

## 3. Thrust / Torque Limits

| Maximum torque<br>(N.m) | ARRIUS 2F | ARRIUS 2R |
|---|---|---|
| Take-off | 650 | 600 |
| Maximum continuous | 600 | 550 |
| Maximum inadvertent overtorque | 752<br>(< 20 s) | 660<br>(< 5 s) |

## 4. Pressure Limits

### 4.1. Fuel Pressure

Refer to applicable Installation / Operating Manual Chapter 6.1.1.1.

For ARRIUS 2R:

- Within starting or relight phase and above 2000m altitude, a prime pump is necessary. This shall maintain a relative pressure equal to or greater than 25 kPa.
- The maximum fuel system inlet pressure is 110 kPa relative to atmospheric pressure.

### 4.2. Oil Pressure

| Oil Pressure (differential) | ARRIUS 2F | ARRIUS 2R |
|---|---|---|
| Minimum: (kPa) | 170 | * See Installation Manual |
| Maximum (kPa) | 1500 | 1500 |

* The Minimum Oil Pressure for the ARRIUS 2R is a function of N1. Refer to the Installation Manual.

## 5. Oil Capacity, Consumption Limit

| | ARRIUS 2F | ARRIUS 2R |
|---|---|---|
| Maximum oil tank volume (l) | 4.9 | see note 5 paragraph VI |
| Minimum oil tank volume (l) | 3 | |
| Consumption limit (l/h) | 0.3 | 0.3 |

Refer to Installation / Operational Manual

## 6. Installation Assumptions

Refer to Installation / Operational Manual

## 7. Time Limited Dispatch

The engines have not been approved for Time Limited Dispatch (in accordance with CS-E1030 for ARRIUS 2R).

## V. Operating and Service Instructions

| Manuals | | |
|---|---|---|
| Document | ARRIUS 2F | ARRIUS 2R |
| Installation and Operating Manual (1) | X 319 L6 001 2 | X 319 R5 003 2 |
| Performance Brochure | Without Tf39 (2)<br>Usual fuels: X 319 L6 002 9<br>Alternative fuels: X 319 L6 004 2<br><br>With Tf39 (2)<br>Usual fuels: X 319 L6 005 9<br>Alternative fuels: X 319 L6 006 9 | X 319 R5 001 2 |

| Instructions for Continued Airworthiness (ICA) | | |
|---|---|---|
| Document | ARRIUS 2F | ARRIUS 2R |
| Maintenance Manual | X 319 L6 301 2 | X 319 R5 460 2 |
| Overhaul Manual | X 319 L6 501 2 | |
| Service Letters and Service Bulletins | As published by SAFRAN HELICOPTER ENGINES | |

Note (1) Operating Instructions are provided in Installation Manual.
Note (2) see note 4 paragraph VI.

## VI. Notes

1. The ARRIUS 2F is approved to be fitted to rotorcraft only where the installation precludes ingestion of foreign objects (as defined in JAR-E790 (c) and JAR-E800) from entering the engine inlet.

2. The ARRIUS 2F (without the aircraft air inlet) meet the JAR requirement for operation in icing conditions within the envelope defined in JAR29 Appendix C.

3. The EASA approved Airworthiness Limitations Section of the Instructions of Airworthiness is published in the applicable “Engine Maintenance Manual, Chapter 5, “Airworthiness Limitations”.

4. Tf39 is a major non-significant modification. The purpose of this modification is to adjust the Fuel Control Unit maximum flow in order to avoid torque limitations when operating with JP4 fuel. A consequence is that the maximum air flow extracted can be increased up to flow rate of 110 g/s (at Take-off power rating under standard ground conditions) when Tf39 is embodied.

5. For ARRIUS 2R, the oil tank is not part of the type design, it shall be supplied by aircraft manufacturer taking into account the conditions for installation of the oil tank as described in the Installation Manual (Chapter 11 and 12).

6. The ARRIUS 2R is approved to be fitted to rotorcraft only where the installation precludes ingestion of hailstone and birds (as defined in CS-E 790 (a)(d) and CS-E 800) from entering the engine inlet.

7. Conversion from a non-civil use:

This note is applicable to the Arrius 2F – 2R engines originally assembled by TURBOMECA or SAFRAN HELICOPTER ENGINES and previously operated by an operator not under the control of a Civil Authority (military, paramilitary, etc.).

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 SAFRAN HELICOPTER ENGINES Mandatory Service Bulletin 319 72 4838.

## VII. Section: Administrative

### 1. Acronyms and Abbreviations

| | |
|---|---|
| CCW | Counter clockwise |
| CRI | Certification Review Item |
| CS | Certification Specification |
| CS-E | Certification Specification for Engines |
| CW | Clockwise |
| DGAC | Direction Générale de L'Aviation Civile (French Civil Aviation Authority) |
| DOA | Design Organisation Approval |
| EASA | European Union Aviation Safety Agency |
| ECU | Engine Control Unit |
| EU | European Union |
| ICAO | International Civil Aviation Organisation |
| ISA | International Standard Atmosphere |
| JAR | Joint aviation Requirements |
| JAR-E | Joint Aviation Requirement for Engines |
| N1 | Gas Generator Speed |
| N2 | Power Turbine Speed |
| NPA | Notice of Proposed Amendment |
| P/N | Part Number |
| rpm | Rotation per minute |
| SB | Service Bulletin |
| SC | Special Conditions |
| SL | Service Letter |
| T45 | Gas Generator Exhaust Temperature |
| TC | Type Certificate |
| TCDS | Type Certificate Data Sheet |

### 2. Type Certificate Holder Record

Until July 18 2016 Turbomeca
After July 18 2016 Safran Helicopter Engines

## 3. Change Record

| Issue | Date | Changes | TC issue |
|---|---|---|---|
| Issue 01 | 15 December 2015 | Initial Issue | Initial Issue, 15 December 2015 |
| Issue 02 | 01 August 2016 | Name Change from Turbomeca to Safran Helicopter Engines | 01 August 2016 |
| Issue 03 | 24 October 2016 | Administrative Update | |
| Issue 04 | 15 March 2019 | Change of the reference of Manuals (EASA Major Change Approval 10068685) | |
| Issue 05 | 7 July 2020 | Change of the Arrius 2R Engine Ratings (EASA Major Change Approval 10073727) | |

-END-