TYPE-CERTIFICATE DATA SHEET

No. E.037

for Engine
ARDIDEN 1 series engines

Type Certificate Holder

Safran Helicopter Engines

64510 Bordes
France

For Models:

ARDIDEN 1H
ARDIDEN 1H1
ARDIDEN 1U

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I. General

1. Type / Models

ARDIDEN 1H, ARDIDEN 1H1, ARDIDEN 1U. These models are approved for use on multi (ARDIDEN 1H and ARDIDEN 1H1) or single (ARDIDEN 1U) -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 variants.

2. Type Certificate Holder

Safran Helicopter Engines
64510 Bordes
France

Design Organisation Approval No.: 21.J2070

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

3. Manufacturer

Safran Helicopter Engines

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

4. EASA Certification Reference Date:

31 December 2005

5. EASA Certification Date:

ARDIDEN 1H	20 December 2007
ARDIDEN 1H1	11 March 2009
ARDIDEN 1U	31 October 2019

II. Certification Basis

1. Certification Specifications:

CS-E, initial issue, dated 24 October 2003

2. Special Conditions:

SC1 – 30-minute AEO rating
SC2 - CRI T10 – mountings (for Ardiden 1U)

3. Deviations:

None

4. Equivalent Safety Findings:

None

5. Environmental Protection Requirements:

Fuel venting per CS-34, Original Issue, dated 17 October 2003 (ICAO Annex 16, Volume II, Amendment 5, dated 24 November 2005, Part II, Chapter 2)

III. Technical Characteristics

1. Type Design Definition

ARDIDEN 1H	P/N 0 421 00 002 0
ARDIDEN 1H1	P/N 0 421 00 005 0
ARDIDEN 1U	P/N 0 421 00 101 0

2. Description

The Ardiden 1 series engines are turboshaft engines. They have a radial air intake and a two-stage centrifugal compressor driven by a single stage axial gas generator turbine. Airflow is directed through a reverse flow annular combustion chamber, through the gas generator turbine and then through and a two-stage axial free power turbine. Output power is transmitted to a front-mounted reduction gearbox by a shaft concentrically mounted within the gas generator rotor assembly. The accessory gearbox, also mounted at the front end, is driven by the gas generator. Control is by means of a dual-channel digital engine electronic control unit (DECU).

3. Equipment

All equipment required for engine operation, except the starter-generator, vibration sensors, fuel flow meter and air inlet plenum, is included in the engine Type Design Definition. For additional details, refer to the applicable Installation and Operating Manual.

4. Dimensions

	Overall Length (mm)	Overall Height (mm)	Overall Width (mm)
ARDIDEN 1H / 1H1	1250	716	525
ARDIDEN 1U	1295	709	550

5. Dry Weight

Maximum engine dry weight: 205 kg for ARDIDEN 1H and ARDIDEN 1H1, 210 kg for ARDIDEN 1U.
This weight includes the DECU (2m harness included) for ARDIDEN 1H and ARDIDEN 1H1, the DECU and EACB (2m harness included) for ARDIDEN 1U, but excludes the equipment listed in paragraph 3 of this section.

This weight excludes also the exhaust pipe for all ARDIDEN 1 engines.

Additional weight of residual oil and fuel: 1 kg for ARDIDEN 1H and ARDIDEN 1H1, 2 kg for ARDIDEN 1U.

6. Ratings

6.1 Thermal Power without torque limitation – All Engines Operative kW

	Maximum Continuous (unlimited duration)	Take-off (5 minutes)	30-minute AEO
ARDIDEN 1H	801	938	938
ARDIDEN 1H1	863	1032	1032
ARDIDEN 1U	912	1058	1058

6.2 Thermal Power without torque limitation – One Engine Inoperative kW

	Continuous OEI (unlimited duration)	2-minute OEI	30-second OEI
ARDIDEN 1H	931	975	1108
ARDIDEN 1H1	1004	1077	1180
ARDIDEN 1U	N/A	N/A	N/A

6.3 Shaft Power with torque limitation – All Engines Operative kW

	Maximum Continuous (unlimited duration)	Take-off (5 minutes)	30-minute AEO
ARDIDEN 1H	568	640	640
ARDIDEN 1H1	568	640	640
ARDIDEN 1U	620	750	750

6.4 Shaft Power with torque limitation – One Engine Inoperative kW

	Continuous OEI (unlimited duration)	2-minute OEI	30-second OEI
ARDIDEN 1H	640	700	800
ARDIDEN 1H1	640	700	800
ARDIDEN 1U	N/A	N/A	N/A

- Minimum values defined under the following conditions:
- ISA conditions at sea level (15 °C, 1013 mbar);
- at the engine test bed with hydraulic brake system ensuring a constant (100% = 6000 rpm) output shaft rotation speed;
- neither air intake nor exhaust gas pressure drop;
- no bleed air;
- no power drawn by any accessories other than those required for engine operation;
- fuel low heat value: 43 136 kJ/kg;
- engine equipped with test bed air intake P/N 6528095020 for ARDIDEN 1H or P/N 6528305000 for ARDIDEN 1H1 and ARDIDEN 1U, and test bed exhaust pipe P/N 6528307040.
- Performance curves are given in the applicable performance brochures.
- Power limited in accordance with a torque limit imposed by the DECU to protect the main gearbox of the helicopter.

7. Control System

The DECU (and the EACB for ARDIDEN 1U) shall be installed in the airframe in accordance with the installation conditions defined in the applicable Installation and Operating Manual.

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

8.1 Fuel

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

8.2 Oil

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

9. Aircraft Accessory Drives

Accessory	Direction of rotation(1)	Nominal speed rpm	Maximum steady state shaft power kW	Maximum torque in overload conditions daNm	Maximum unbalance according to ISO 1940	Fuse shaft breakaway torque daNm	Maximum static cantilever (3) daNm
Starter-generator	CW	11 693	9.0(2)	7.0	2.5	17.5	3.8

(1) As viewed from the rear of the engine (CW – clockwise, CCW – counter-clockwise)
(2) Reduced to 7.5 kW for 30-second and 2-minute OEI ratings (not applicable for ARDIDEN 1U)
(3) Moment exerted by the weight of the accessory at the drive pad

10. Maximum Permissible Air Bleed Extraction

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

100 g/s at take-off rating

Limitations on the use of air bleed are defined in the applicable 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 transient overtemperature (<10 s)
ARDIDEN 1H	1073 K	1123 K
ARDIDEN 1H1	1073 K	1133 K
ARDIDEN 1U	1073 K	1133 K

In Flight – All Engines Operative:

	Max Continuous	Take-off	30-minute AEO	Maximum transient overtemperature (1) (< 20 s)
ARDIDEN 1H	1129 K	1178 K	1178 K	1192 K
ARDIDEN 1H1	1152 K	1201 K	1201 K	1221 K
ARDIDEN 1U	1156 K	1206 K	1206 K	1221 K

(1) These maximum Inadvertent Overtemperatures have been certified for the ARDIDEN 1 engines. This means the maximum T45 temperature in AEO conditions for which inadvertent occurrence of up to 20 seconds has been agreed not to require rejection of the engine from service or maintenance action (other than to correct the cause).

In Flight – One Engine Inoperative:

	Continuous OEI	2-minute OEI	30-second OEI
ARDIDEN 1H	1174 K	1193 K	1229 K
ARDIDEN 1H1	1197 K	1215 K	1251 K
ARDIDEN 1U	N/A	N/A	N/A

1.2 Fuel temperature

Maximum temperature – refer to the applicable Installation and Operating Manual
Minimum temperature for engine starting – refer to the applicable Installation and Operating Manual
For the ARDIDEN 1H, use of anti-icing additive is mandatory for fuel temperature below +5°C
For the ARDIDEN 1H1 and ARDIDEN 1U, use of anti-icing additive is mandatory for fuel temperature below -20°C (except for JP8 and JP5 (F44) fuel – refer to the Installation and Operating Manual)

1.3 Oil temperature

	Minimum oil temperature for engine starting	Minimum oil temperature before applying power	Maximum oil temperature
ARDIDEN 1H	-15°C for oil with a 5x10-6 m2/s kinematic viscosity -15°C for oil with a 3 to 3.9x10-6 m2/s kinematic viscosity	10°C for oil with a 5x10-6 m2/s kinematic viscosity 0°C for oil with a 3 to 3.9x10-6 m2/s kinematic viscosity	110°C
ARDIDEN 1H1 ARDIDEN 1U	-30°C for oil with a 5x10-6 m2/s kinematic viscosity -40°C for oil with a 3x10-6 m2/s kinematic viscosity	10°C for oil with a 5x10-6 m2/s kinematic viscosity 0°C for oil with a 3x10-6 m2/s kinematic viscosity	110°C

2. Speed Limits

2.1 Gas generator speed (N1)

100% N1 = 39 598 rpm

Maximum stabilised speed – All Engines Operative:

	Maximum Continuous	Take-off	30-minute AEO
ARDIDEN 1H	97.08% (38 442 rpm)	99.42% (39 368 rpm)	99.42% (39 368 rpm)
ARDIDEN 1H1	98.5% (39 000 rpm)	101.3% (40 095 rpm)	101.3% (40 095 rpm)
ARDIDEN 1U	99% (39 211 rpm)	101.6% (40 239 rpm)	101.6% (40 239 rpm)

Maximum stabilised speed – One Engine Inoperative:

	Continuous OEI	2-minute OEI	30-second OEI
ARDIDEN 1H	99.13% (39 253 rpm)	100.03% (39 610 rpm)	102.98% (40 778 rpm)
ARDIDEN 1H1	100.5% (39 795 rpm)	102.0% (40 381 rpm)	104.8% (41 499 rpm)
ARDIDEN 1U	N/A	N/A	N/A

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

ARDIDEN 1H	102.1% (40 430 rpm)
ARDIDEN 1H1	102.0% (40 495 rpm)
ARDIDEN 1U	102.3% (40 510 rpm)

2.2 Power turbine speed (N2)

100% N2 = 20 889 rpm

The power turbine nominal speed corresponds to 6000 rpm at the power off-take.

Limit values authorised for an unlimited duration:
minimum stabilised – 90% (18 806 rpm)
maximum stabilised – 108.4% (22 650 rpm)

Transient limits:
minimum transient (20 s) – 85.9% (17 944 rpm) for ARDIDEN 1H
minimum transient (20 s) – 84% (17 547 rpm) for ARDIDEN 1H1 and ARDIDEN 1U
maximum transient (20 s) – 114.5% (23 918 rpm)

These Maximum Inadvertent Overspeeds have been certified for the ARDIDEN 1 engines. This means the maximum N2 speed for which inadvertent occurrence of up to 20 seconds has been agreed not to require rejection of the engine from service or maintenance action (other than to correct the cause).

3. Torque Limits

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

	Max Continuous	Take-off	30-minute AEO	Maximum transient (1) overtorque (< 20 s)
ARDIDEN 1H	115.0	136.0	136.0	144.4
ARDIDEN 1H1	103.4	117.9	117.9	144.4
ARDIDEN 1U	114.8	130.8	130.8	144.4

(1) These Maximum Inadvertent Overtorques have been certified for the ARDIDEN 1 engines. This means the maximum torque in AEO conditions for which inadvertent occurrence of up to 20 seconds has been agreed not to require rejection of the engine from service or maintenance action (other than to correct the cause).

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

	Continuous OEI	2-minute OEI	30-second OEI
ARDIDEN 1H	135.0	160.0	170.5
ARDIDEN 1H1	138.2	153.3	161.5
ARDIDEN 1U	N/A	N/A	N/A

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

4. Pressure Limits:

4.1 Oil pressure

Minimum oil pressure: refer to the applicable Installation and Operating Manual.
Maximum oil pressure: refer to the applicable Installation and Operating Manual.
Normal operating range: 250 – 900 kPa gauge

4.2 Fuel pressure

Refer to the applicable Installation and Operating Manual.

5. Installation Assumptions:

Refer to the applicable Installation and Operating Manual.

6. Time Limited Dispatch:

The ARDIDEN 1H, ARDIDEN 1H1 and ARDIDEN 1U engines have not been approved for Time Limited Dispatch.

V. Operating and Service Instructions

Manuals	Installation and Operating Manual	Performance Brochure
ARDIDEN 1H	X 421 C6 001 2	X 421 C6 002 2
ARDIDEN 1H1	X 421 C8 001 2	X 421 C8 002 2
ARDIDEN 1U	X 421 U8 001 2	X 421 1U 001 2

Instructions for Continued Airworthiness	Maintenance Manual	Overhaul Manual	Service Letters and Service Bulletins
ARDIDEN 1H	X 421 C6 452 2	X 421 C6 500 2	refer to the SB and SL directory
ARDIDEN 1H1	X 421 C8 300 2	X 421 C8 500 2	refer to the SB and SL directory
ARDIDEN 1U	X 421 1U 300 2	X 421 C8 500 2	refer to the SB and SL directory

VI. Notes

1. The ARDIDEN 1H and ARDIDEN 1H1 engines are approved for use on twin-engine helicopters.
   The ARDIDEN 1U engine is approved for use on single-engine helicopters.

2. The operating and starting envelopes are defined in the applicable Installation and Operating Manual.

3. Air intake:
   The helicopter air intake design shall be such as to prevent instantaneous ingestion of maximum ice and water quantities, as defined in the applicable Installation and Operating Manual.
   For all Ardiden 1 variants, following CS-E 790 (d) and CS-E 800 (f)(5), protection against hail strike and bird strike has not been demonstrated at engine level. Reliance is placed on the air intake that has to be fitted by the aircraft manufacturer in compliance with the installation instructions provided in the applicable Installation and Operating Manual.

4. ARDIDEN 1H and ARDIDEN 1H1: The electronic control system provides a “TRAINING” function for training crews in an engine failure situation. Characteristics are defined in the applicable Installation and Operating Manual.
   ARDIDEN 1U: The DECU provides a “TRAINING” function for training crews in a main control system failure situation. Characteristics are defined in the applicable Installation and Operating Manual.

5. The DECU and the EACB must not be installed in a designated fire zone. Installation requirements are defined in the applicable Installation and Operating Manual.

6. Protection requirements against lightning and electromagnetic interference are defined in the applicable Installation and Operating Manual.

7. Vibrations are measured by two sensors on the reduction gearbox casing and combustion chamber casing flanges: refer to the applicable Installation and Operating Manual.

8. Overspeed: the ARDIDEN 1H and ARDIDEN 1H1 engines are equipped with a shut-down device in case of power turbine or gas generator overspeed. This device does not exist on ARDIDEN 1U.

9. "APU" function: the fuel control system has an "APU" function for on-ground electrical and hydraulic power generation (not available on ARDIDEN 1U).

10. The EASA approved Airworthiness Limitations Section of the Instructions for Continued Airworthiness is published in the Engine Maintenance Manual and Overhaul Manual documents, chapter 5 "Airworthiness Limitations".

11. The DECU software has been validated according to EUROCAE ED12B (RTCA/DO-178B) Level A requirements.

12. For the ARDIDEN 1H, take-off with the outside air temperature less than +5°C is not allowed.

SECTION: ADMINISTRATIVE

I. Acronyms and Abbreviations

n/a

II. Type Certificate Holder Record

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

III. Change Record

Issue	Date	Changes	TC issue
Issue 01	20 December 2007	Initial Issue	Initial Issue, 20 Dec. 2007
Issue 02	11 March 2009	Add Ardiden 1H1 engine model	11 March 009
Issue 03	04 Feb. 2010	Major Change EASA Approval 10028708	
Issue 04	01 August 2016	Name change from Turbomeca to Safran Helicopter Engines	01 August 2016
Issue 05	01 February 2017	Major Change EASA Approval 0010040652	01 February 2017
Issue 06	31 October 2019	Add Ardiden 1U engine model	31 October 2019

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