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# TYPE-CERTIFICATE DATA SHEET

EASA.E.034

**for**  
SaM146 series engines

**Type Certificate Holder**

PowerJet S.A.  
2, Boulevard du Général Martial Valin  
75015 Paris  
France

For Models:

SaM146-1S17  
SaM146-1S17C  
SaM146-1S18  
SaM146-1S18C



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## **I. General**

### **1. Type / Model**

SaM146-1S17 / SaM146-1S17C / SaM146-1S18 / SaM146-1S18C

These Models are approved for use on multi-engined civil aircraft classified in the Transport Category (Passenger) at the ratings and within the operating limitations specified below, subject to compliance with the powerplant installation requirements appropriate to approved installations.

### **2. Type Certificate Holder**

PowerJet S.A.  
2, Boulevard du Général Martial Valin  
75015 PARIS  
FRANCE

DOA ref.: EASA.21J.218

### **3. Manufacturer**

3.1 Safran Aircraft Engines under license from PowerJet S.A.  
1, Rond point René Ravaud  
77550 Moissy-Cramayel, France

EASA Production Certificate N° FR.21G.0007

3.2 UEC Saturn under license from PowerJet S.A.  
163 Lenin Ave., Rybinsk  
152903, Yaroslavl region, Russian Federation

EASA Production Certificate N° EASA.21G.0025  
IAC-AR Production Certificate N° 06.19-359.

### **4. Date of Application**

SaM146-1S17: 29 September 2003

SaM146-1S18: 27 September 2010

SaM146-1S17C / SaM146-1S18C: 31 October 2013



## 5. Certification Reference Date

SaM146-1S17 and -1S18: 30 June 2007  
SaM146-1S17C / SaM146-1S18C: 30 June 2007

## 6. EASA Type Certification Date

SaM146-1S17: 23 June 2010  
SaM146-1S18: 17 January 2012  
SaM146-1S17C / SaM146-1S18C: 24 February 2014

## II. Certification Basis

### 1. EASA Certification Basis

#### 1.1. Airworthiness Standards

- 1.1.1 EASA CS-E, Amendment 1 dated 10 December 2007.
- 1.1.2 IAC AR 33.90 (2003 issue) and FAR 33.90 (a) Amendment 24: Initial Maintenance Inspection testing.  
IAC AR 33.88 (2003 issue) and FAR 33.88 Amendment 24: Turbine Rotor Overtemperature testing.
- 1.1.3 IAC AR 33.23 (b)(1\*) (2004 Edition). Engine mounts
- 1.1.4 EASA CS-E 1040, Amendment 4 dated 12 March 2015: ETOPS

#### 1.2. Special Conditions (SC)

None

#### 1.3. Equivalent Safety Findings (ESF)

None

#### 1.4. Deviations

None

#### 1.5. Environmental Protection

CS-34 Amendment 3 as implemented by ED Decision 2019/014/R (29th July 2019), ICAO Annex 16 Volume II, Amendment 9 applicable 1st January 2018 as implemented into EU legislation 11<sup>th</sup> September 2018. NO<sub>x</sub> levels in compliance with Part III, Chapter 2, § 2.3.2 d) (CAEP/6) of the above mentioned Annex. Maximum nvPM mass concentration levels in compliance with Part III, Chapter 4, paragraph 4.2.2 (CAEP/10) of the above mentioned Annex.



### **III. Technical Characteristics**

#### **1. Type Design Definition**

SaM146 Type Design definition is identified as follows:

<b>Engine Parts List</b>
SaM146-1S17G01
SaM146-1S18G01
SaM146-1S17CG01
SaM146-1S18CG01

#### **2. Description**

Dual rotor, axial flow, high bypass ratio turbofan with single stage fan, 3-stage low pressure compressor, 6-stage high pressure compressor, annular combustion chamber, single stage high pressure turbine, 3-stage low pressure turbine, a thrust reverser, aft core cowl, exhaust nozzle, starter, and a full authority digital engine control (FADEC).

#### **3. Equipment**

Equipment is included in the type design definition, engine mounts are not.

The Thrust Reverser Unit does not form part of the engine Type Design and is certified as part of the aircraft Type Design.

#### **4. Dimensions**

Overall Length *	3590 mm
Length from Fan Case to TRF aft Flange	2120 mm
Maximum cross-section	1670 mm x 1950 mm

\*: including Mixer

#### **5. Dry Weight**

Dry Engine Weight	1708 kg
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## 6. Ratings

The sea-level static thrust ratings are:

Rating		SaM146-1S17 / -1S17C	SaM146-1S18 / -1S18C
Thrust (daN)	Maximum Take-Off ISA +15 (see Notes 1 & 2 for usage limitations)	7684	7900
	Normal Take-Off ISA +15 (see Notes 1 & 2 for usage limitations)	6982	7332
	Maximum Continuous ISA +10	6637	6637

## 7. Control System

The engine is equipped with a Full Authority Digital Engine Control (FADEC) system.  
(See Notes 3 and 4)

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

### 8.1. Fuel and Additives

Approved Fuels:

- Jet A-1: specifications ASTM D1655, Def-Stan91-91, DCSEA134 and GOST R 52050
- Jet A: specification ASTM D1655
- TS-1: specification GOST 10227
- RT: specification GOST 10227

Fuel Additives:

Additives listed in tables below are acceptable for unlimited time on SaM146 engines.

Fuel System Icing Inhibitor (FSII)	Temperature range -55°C to + 55°C	Temperature range - 55°C to - 45°C
Liquid "I", specification GOST 8313-88 (EGME)	0.3 vol % maxi	0.12 vol % mini
Liquid "I-M", specification TU 6-10-1458-79 (50% EGME + 50% methanol)	0.3 % vol % maxi	0.09 vol % mini
DiEGME, specification Def Stan 68-252	0.15 % vol % maxi	0.12 vol % mini



<b>Static Dissipator Additive (SDA)</b>	<b>Temperature range -55 °C to + 55°C</b>
Sigbol: specification TU 38.101741-78	1.6 mg/l maxi
Stadis 450, specification ASTM D1655	3.0 mg/l maxi (a) 5.0 mg/l maxi (b)

Notes:

- a) First doping
- b) Redoping – cumulative concentration
- c) In case of fuel mixing, if one, or more constituent of the mixing is subject to limitations, the most severe limitations will be applicable to the mixing.

## 8.2. Oil

PowerJet Service Bulletin (N° 79-0001) lists the approved oil brands.)

Type I oils (MIL PRF 7808) shall be used in revenue service operation under extreme cold temperature down to -55°C but not above +30°C (soak conditions).

Type II oils (MIL PRF 23699 and SAE AS5780) are limited to a minimum oil temperature of -40°C (cold soak conditions) and a maximum oil temperature of +55°C (hot soak conditions).

## 9. Aircraft Accessory Drives

Accessory drives interfaces with A/C equipments are defined in table below.

	<b>ACCESSORY</b>	
	<b>INTEGRATED DRIVE GENERATOR</b>	<b>HYDRAULIC PUMP</b>
AGB Pad Definition (a)	Flange per AS969 modified to remove reaction studs and with a modified diameter	Flange per AS522A with modified locating pin centering diameter and pin diameter
Spline Lubrication	wet	wet
Rotation (b)	CW	CW
Pad Mating Face Material	Aluminium alloy	Aluminium alloy
Gear Ratio to Core	0.4496	0.2392
Max. Accessory Weight	33.24 kg (dry) 36.29 kg (wet)	6.5 kg (dry) 6.87 kg (wet)
Max. Overhung Static Moment	64.4 N.m (dry) 70.1 N.m (wet)	6.2 N.m (dry)
Pad Rating (c)	58.8 kW	56 N.m
Over-load	(d)	75.7 N.m (e)
Shear Torque (f)	384.1±28.2 N.m	226 N.m





**Notes:**

- a) Pads are only similar to "AS" references; refer to the applicable SaM146 installation drawing for specific interface requirement.
- b) Rotation is defined facing the AGB pad.
- c) IDG input speed: 7898 rpm
- d) 66.1 kW (4) for 5 minutes, occurs 1 time every 1000 Operating Hours  
92.5 kW (4) for 5 seconds, occurs 20 times over the life of the Aircraft (engine)  
104.5 kW (Max fault) for 5 seconds occurs 2 times over the life of the Aircraft (engine)
- e) Occurrence: 2.79 E-7/EFH; Duration: once the hydraulic pump failed, it will remain in the failed state for the remainder of the affected flight.
- f) Customer furnished accessories must allow the engine to meet CS-E requirements by providing assurance that the torque capability of the gearbox drive is not exceeded.

**10. Maximum Permissible Air Bleed Extraction**

Refer to Installation Manual

**IV. Operating Limitations**

**1. Temperature Limits**

**1.1. Climatic Operating Envelope**

The engine may be used in ambient temperatures up to ISA+35°C. Refer to the Installation Manual for details of the Operating Envelope, including the air inlet distortion at the engine inlet.

**1.2. Turbine Gas Temperature (TGT) – Trimmed**

Maximum permissible EGT limitations are defined in Table 1 for engines where the installed software version is prior to V5.1 (SB72-0045) and in Table 2 for engines where the installed software version is V5.1 (SB73-0013), or later:

TABLE 1

EGT (°C)	SaM146-1S17 / -1S17C Model	SaM146-1S18 / -1S18C Model
Maximum ground start	830	830
Maximum Take-Off	972	972
Normal Take-Off	940	940
Maximum continuous	928	928

TABLE 2

EGT (°C)	SaM146-1S17 Model	SaM146-1S18 Model
Maximum ground start	830	830
Maximum Take-Off	972	972
Maximum continuous	928	928



### 1.3. Fuel temperature

The Minimum Fuel Inlet Temperature is  $-45^{\circ}\text{C}$  or fuel freeze point temperature, whichever is higher, without anti-icing additive.

The Maximum Fuel Inlet Temperature is  $+55^{\circ}\text{C}$ .

### 1.4. Oil temperature

Maximum allowable steady state oil supply temperature to the engine is  $140^{\circ}\text{C}$ . During transients within the flight envelope an oil supply temperature rise up to  $155^{\circ}\text{C}$  is allowed.

## 2. Pressure Limits

### 2.1. Fuel pressure

#### Minimum fuel inlet pressure

- With A/C boost pump operative:

The minimum inlet pressure of the Fuel System with A/C boost pump operative is defined in the Table below.

Fuels	Minimum Fuel System Inlet Pressure
JET A-1	0.40 bar absolute
JET A	
TS-1	
RT	

- With A/C boost pump inoperative:

The minimum inlet pressure of the Fuel System with A/C boost pump inoperative is defined in the Table below.

Fuels	Minimum Fuel System Inlet Pressure	Maximum Vapour/Liquid Ratio
JET A-1	0.20 bar absolute	0.45
JET A		
TS-1		
RT		

#### Maximum fuel inlet pressure

The maximum fuel inlet pressure is 3.5 bars absolute when engine is on.

The maximum fuel inlet pressure is 4.5 bars absolute when engine is off.



## 2.2. Oil pressure

Pressure at idle is 150 kPa differential minimum.

The lube oil supply nominal operating pressure is a function of engine speed and is 530 kPa diff. at cruise thrust.

It will be limited during cold starts by a 2100 kPa diff. pressure-relief valve which returns the oil to the forward sump scavenge.

Deliberate operation of an engine with oil pressure below minimum 150 kPa diff. is not permitted. However, aircraft "negative g" maneuvers may cause temporary oil supply interruption. Under "negative g" operating condition only, it is permitted to operate the engine below minimum oil pressure 90 kPa diff. for a maximum of 30 seconds before engine shutdown is required.

Refer to the Installation Manual for more details.

## 3. Maximum Permissible Rotor Speeds

	Low pressure rotor speed N1 (rpm)	High pressure rotor speed N2 (rpm)
Reference speeds, 100%	6489	16839
Maximum for Take-Off (See Note 2)	6814	18523
Maximum Continuous	6814	18523

## 4. Installation Assumptions

Refer to Installation Manual for details.

## 5. Time Limited Dispatch

The engine has been approved for Time Limited Dispatch. The maximum rectification period for each dispatchable state is specified in the Airworthiness Limitations Section of the Engine Shop Manual.

## 6. ETOPS Capability

The SaM146 series engines are approved for ETOPS capability in accordance with CS-E1040 Amendment 4 by EASA Approval 10067163 for a Maximum Approved Diversion Time of 120 minutes at Maximum Continuous thrust. This approval does not constitute an approval to conduct ETOPS operations. (See also Note 8)



## **V. Operating and Service Instructions**

<b>Document</b>	
Installation Manual	SaM146.PWJ.TEC.PRO.00648
Specific Operating Instructions	SaM146.PWJ.TEC.PRO.00653
Engine Shop Manual	PWJ-TP.EM.01
Service Bulletins	as applicable

## **VI. Notes**

1. Engine ratings are based on calibrated test stand performance and documented in the "Production Test Requirements" document. These calculations assume the following conditions:
  - Static sea level standard conditions of 15°C and 101.32 kPa
  - No aircraft accessory loads or air extraction
  - 100% inlet recovery and zero humidity
  - Production engine inlet and production exhaust system
2. The engine is equipped with an Automatic Power Reserve function in case of one engine inoperative. Following thrust failure detection by the engine control system, the FADEC sends a signal to the healthy engine which automatically increases its thrust at the same throttle position. This additional thrust is provided only in the Take-Off envelop (below 15000ft and below Mach=0.34). When Automatic Power Reserve is activated from Normal Take-Off (NTO) rating, the increased thrust is equal to the thrust of the Maximum Take-Off (MTO) rating. When activated from another throttle position, the increase of thrust is relative to the delta thrust between NTO and MTO.  
The increase of thrust between NTO and MTO depends on altitude and Mach number conditions and is limited to 10%.  
During take-off, the pilot can also access manually to the MTO rating by throttle selection, in case of emergency.  
The time limit at the NTO rating is five minutes and shall include any time accumulated above the NTO rating for that Take-Off. The 5-minute Take-Off time limit may be extended to 10 minutes for one engine inoperative operation in multi-engine aircraft.
3. The software of the Engine Electronic Control is designated Level "A" according to EUROCAE ED 12B/RTCA DO178B.
4. Electro-Magnetic Interference (EMI), High Intensity Radiated Fields (HIRF) and Lightning (Refer to Installation Manual for details).
5. The engine is equipped with a thrust reverser: Operation of these thrust reversers is approved for ground use only. Power back is prohibited. Usage is only permitted with Aircelle Thrust Reverser system SML3020-06-0 for Reverser LH and SML5020-06-0 for Reverser RH.
6. The EASA approved Airworthiness Limitations Section of the Instructions for Continued Airworthiness is published in the Engine Shop Manual, chapter 5 "Airworthiness Limitations"
7. During ground operation in icing conditions with an outside air temperature (OAT) of +3.0°C or less, periodic engine run ups must be performed to shed ice from the spinner, fan blades, and low pressure compressor stators. Run ups must be to a minimum of 70 % N1 at intervals not to exceed 30 minutes,



and must include taxi-out, ground holding, and taxi-in time. Refer to the applicable engine Specific Operating Instructions document.

8. The SaM146 series engines, approved for 120 minute ETOPS operation must have the following modification incorporated:  
PowerJet S.A. Service Bulletin 72-0173, latest approved revision.  
ETOPS does not require any special engine limitation, marking placard or configuration other than as instructed by the Service Bulletin.

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**SECTION: ADMINISTRATIVE**

**I. Acronyms and Abbreviations**

N/A

**II. Type Certificate Holder Record**

N/A

**III. Change Record**

<b>Issue</b>	<b>Date</b>	<b>Changes</b>	<b>TC issue</b>
Issue 01	23 June 2010	Initial Issue for the SaM146-1S17 model	23 June 2010
Issue 02	23 November 2010	New DECU Software version identified as Major Change Approval 10032688	
Issue 03	05 September 2011	Introduction of ECU Software (AS) V5.0 as Major Change Approval 10036080	
Issue 04	17 January 2012	Addition of SaM146-1S18 model	17 January 2012
Issue 05	07 February 2012	Editorial changes	
Issue 06	07 November 2013	Approval of DECU Software V5.1 (Major Change Approval 10046791) and SaM146-1S18 Thrust Optimization (Major Change Approval 10046792)	
Issue 07	24 February 2014	Addition of SaM146-1S17C and SaM146-1S18C models	24 February 2014
Issue 08	13 December 2018	Addition of 120 Minutes Extended Operations (ETOPS) capability (Major Change Approval 10067163); New TCDS Format	
Issue 09	16 December 2019	Introduction of CAEP/10 compliance for nvPM emissions (EASA Major Change Approval 10072021)	

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