European Aviation Safety Agency

EASA

TYPE-CERTIFICATE DATA SHEET

Number : E.034
Issue : 06
Date : 07 November 2013
Type : PowerJet S.A.
SaM146 series engines

Model
SaM146-1S17
SaM146-1S18

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I. General

1. Type/Model:

SaM146-1S17/ SaM146-1S18
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

EASA Design Organisation Approval N° 21J.218

3. Manufacturer:

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

EASA Production Certificate N° FR.21G.0007

3.2 OAO NPO 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. Certification Application Date:

SaM146-1S17: 29 September 2003
SaM146-1S18: 27 September 2010

5. Reference date for determining applicable airworthiness requirements:

For SaM146-1S17 and -1S18: 30 June 2007

6. EASA Certification Date:

SaM146-1S17: 23 June 2010
SaM146-1S18: 17 January 2012

II. Certification Basis

1. Airworthiness Standards and Environmental Requirements:

1.1 CS-E, Amendment 1, dated 10 December 2007.
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.
1.3 EASA CS-34.2 equivalent to ICAO Annex 16, Volume II, Amendment 6, July 2008; CAEP/6 NOx Standard as applicable to turbofan engines according to Part III, Chapter 2. Paragraph 2.3.2 d) 1) ii). .

2. **Special Conditions:** None

3. **Deviations:** None

4. Equivalent Safety Findings: None

III. Technical Characteristics

1. Type Design Definition:

SaM146 Type Design definition is identified as follows:

Engine Parts List
SaM146-1S17G01
SaM146-1S18G01

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

*: including Mixer

5. Dry Weight:

Dry engine weight (kg)	1708

6. Ratings:

The sea-level static thrust ratings are:

Rating		SaM146-1S17	SaM146-1S18
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 Note 3 and 4

8. Fluids:

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

Static Dissipator Additive (SDA)	**Temperature range -55 °C to + 55°C**
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.

	ACCESSORY	
	INTEGRATED DRIVE GENERATOR	**HYDRAULIC PUMP**
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. Operational 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 – Trimmed (°C)

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 Model	SaM146-1S18 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 (°C)

The Minimum Fuel Inlet Temperature is –45°C or fuel freeze point temperature, whichever is higher, without anti-icing additive.

The Maximum Fuel Inlet Temperature is +55°C.

1.4 Oil temperature (°C)

Maximum allowable steady state oil supply temperature to the engine is 140°C. During transients within the flight envelope an oil supply temperature rise up to 155°C is allowed.

2. Pressure Limits:

2.1 Fuel pressure (kPa)

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 JET A TS-1 RT	0.40 bar absolute

- 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 JET A TS-1 RT	0.20 bar absolute	0.45

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 (kPa)

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" manoeuvres 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 (rpm):

	Low pressure rotor speed N1	High pressure rotor speed N2
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.

V. Operating and Service Instructions

Document	
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.