# PSR Jet System

PSR T01 engine and PSR R01 retraction system

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## PSR Jet System an auxiliary engine for gliders of the 15 and 18m class

The PSR Jet System consists of

- engine, **PSR T01 engine**, Gas Start
- engine service data terminal
- engine control unit
- engine fuel board
- retraction system, **PSR R01 retraction system**
- fuel and electrical lines

## engine figure 1, page 6

The basic data of the engine are

- single spool turbojet engine with radial compressor and axial turbine
- thrust 230N at rotspeed 108500rpm, fuel consumption 640g/min
- thrust 180N at rotspeed 100000rpm, fuel consumption 480g/min
- started using gas and operated using kerosene

## engine service data terminal figure 2, page 6

The engine service data terminal is used to deploy, start, operate, stop and retract the engine.

The display shows software version, remaining fuel volume and elapsed runtime after connecting the battery. During engine operation the display shows rotspeed **rpm**, exhaust gas temperature **egt**, throttle **thro** and remaining fuel volume **fuel**.

The engine is operated as follows

- **engine deployment**
  press **jet-out**
  deployment of engine and power on of engine control unit
- **engine start**
  open gas tank
  switch from **stop** to **run**
  automatic start of engine
  engine is calibrated while green **calib** LED is blinking

- **engine operation**

  use throttle-knob to select throttle

  rotspeed, redline, 108500rpm, maximum 5min per engine run

  rotspeed, maximum continuous, 100000rpm

- **engine stop**

  use throttle-knob to select idle

  switch from **run** to **a.st**, auto stop

  automatic stop of engine

  Engine restart is possible in case of exhaust gas temperature below 88°C.

  Engine retraction is possible in case of exhaust gas temperature below 50°C.

  switch to **stop**

  close gas tank

- **engine retraction**

  press **jet-in**

  retraction of engine and power off of engine control unit

- **engine glow-plug check**

  The engine is equipped with two redundant engine glow-plugs.

  In order to check engine glow-plugs, set throttle-knob to 30 and press **func**. The lit green **calib** LED indicates that both engine glow-plugs are functioning. A blinking red **temp** LED indicates a single and a lit red **temp** LED indicates a double engine glow-plug failure.

- **program fuel volume**

  During engine stop press **tank** and program the initial fuel volume by means of throttle-knob.

- **fuel system purge**

  To ensure a smooth engine start after fuel system venting the fuel system could be purged.

  Disconnect engine fuel line from engine and locate engine fuel line inside of collecting vessel. Set throttle-knob to 50 and press **func** until fuel is emitting from engine fuel line. Connect engine fuel line to engine.

  The fuel system purge function is disabled in flight.

- **other functions**

  set throttle-knob to 80, press **func**, run engine starter motor continuously

  set throttle-knob to 90, press **func**, run engine starter motor in alternation

  set throttle-knob to 100, press **func**, run engine starter motor until exhaust gas temperature below 88°C

## engine control unit figure 3, page 7

The engine is controlled by the engine control unit. Control inputs are exhaust gas temperature, engine rotspeed sensor, battery voltage and commands from the engine service data terminal. The output controls engine starter motor, engine fuel pump, valves and engine glow-plugs. The engine service data terminal functions are generated by the engine control unit.

The engine control unit includes the following safety mechanisms

- rotspeed higher than 112000rpm, engine stop
- engine rotspeed sensor failure, engine stop
- fuel pump voltage above limit, engine stop
- software problem, engine stop
- engine thermocouple failure, engine does not start
- compressorblade counting failure, fuel pump voltage will not be increased

In addition the fuel pump voltage level is monitored by an autonomous engine safety circuit. If the maximum fuel pump voltage is exceeded, the power supply of the engine fuel pump is interrupted and the engine stops.

## engine fuel board figure 4, page 7

The engine fuel board mounts the following components

- gas system: engine gas filter, engine gas valve and engine gas needle valve
- fuel system: engine fuel filter, engine fuel flow meter, engine fuel pump and engine fuel valve

## fuel and electrical lines

The engine fuel lines are fire resistant. The electrical system, consisting of engine, engine service data terminal, engine control unit and electrical lines, is electromagnetic compatibility tested.

## fuel system

The fuel system consists of two flexible wing tanks and fuel collection tank. Flexible wing tanks do not need to be air refreshed. A special condition regarding flexible wing tanks in combination with the usage of kerosene is to be issued by EASA.

Alternatively a vented tank could be installed in the fuselage.

Propane for engine start is available from the gas tank.

### retraction system figure 5, page 8

The retraction system is driven by a single geared motor and two tooth wheels.

The retraction time is two seconds.

The retraction system is small and retrofitable for most sailplanes.

The installation of the PSR Jet System on sailplanes is covered by EASA Supplemental Type Certificates.

## development

The following improvements were invented

- containment of compressor and turbine
- reliability of engine start was improved
  two redundant engine glow-plugs
  engine gas needle valve to adjust proper gas flow
- elapsed runtime counter[1] was implemented
- fuel system purge function is now disabled in flight

The following tests were performed

- bench test, 700 engine starts and 150 hours runtime accumulated
- flight test, 600 engine starts and 40 hours runtime accumulated
- fatigue strength of components was proven
- functioning of compressor and turbine containment was proven
- bench test, endurance and vibration test, FH-Aachen
- smoke number measurement, AMT Geldrop, DLR Stuttgart
- fire resistance test of fuel lines, Draline Nederweert
- noise measurement, OUV Augsburg

[1] the equivalent elapsed runtime is deduced from the number of revolutions

figure 1: engine


figure 2: engine service data terminal


figure 3: engine control unit


figure 4: engine fuel board

figure 5: retraction system

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