

Manual for Trudo Turbine range:

Trudo Turbine

Welcome to the world of Micro turbines!

A Turbine is the latest innovation in the world of modelling

A great sound and thrust making your model really scale

What is in the package

- 1 Turbine
- 2 ECU (turbine controller)
- 3 HDT (hand data Terminal)
- 4 1 x propane/butane gas Valve
- 5 1 x Fuel valve
- 6 1 meter of 3mm gas tube
- 7 1 meter of 4 mm fuel tube
- 8 ECU extension lead
- 9 Fuel filter

**WARNING!! A Turbine is not a toy!!!**

**it generates a lot of noise and heat!**

**Temperatures up to 1100 degrees Celsius can be reached!**

**Make sure you read this manual carefully and ALWAYS respect the material used**

**Make sure spectators stand clear at least 10 to 15 meters away and aside from the turbine, Always stand aside of the turbine not in front or back!**

Warranty:

1 year after purchase or 250 starts or 25 hours whatever comes first

Connections:

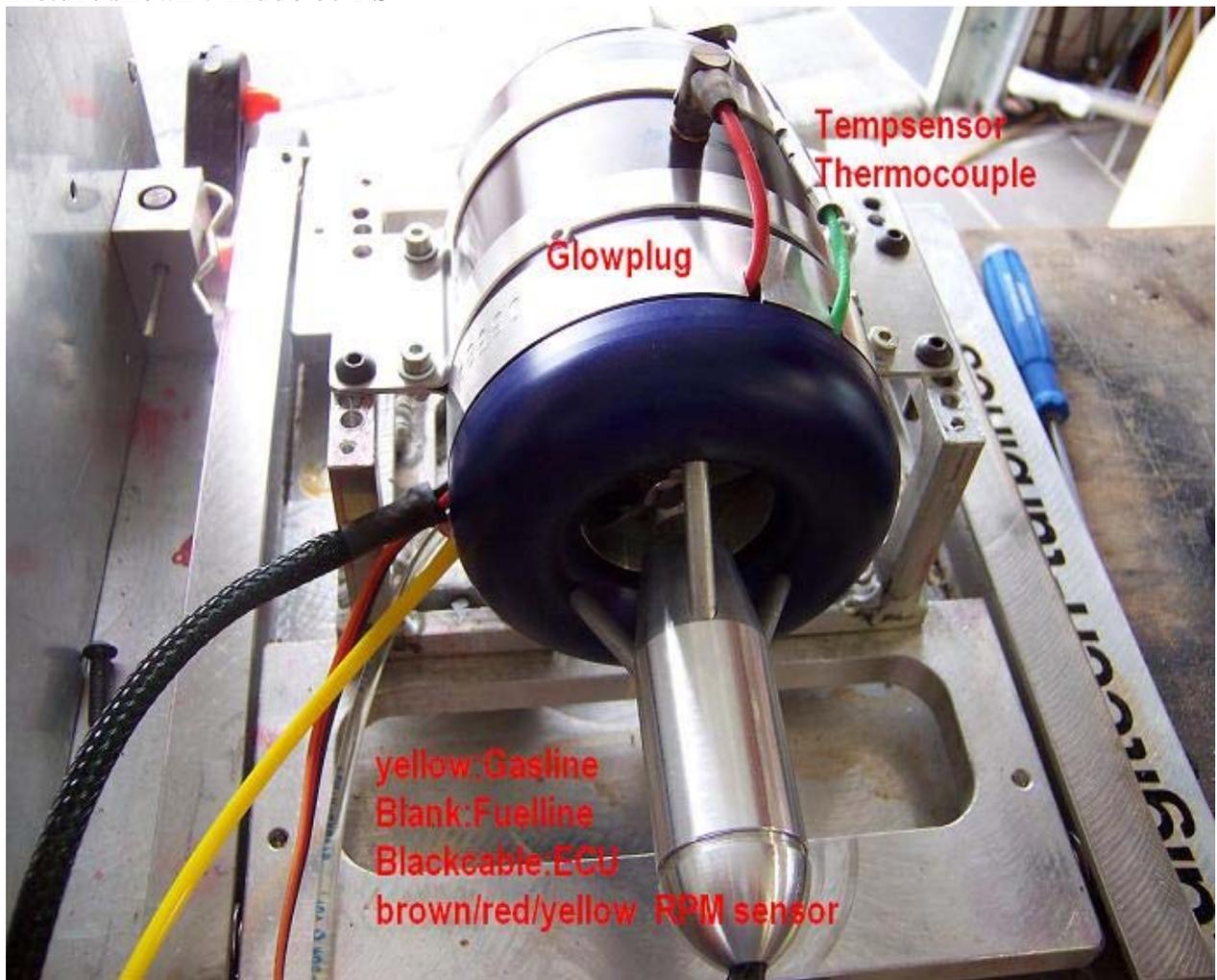
As seen on picture:

Yellow: Gasline

Transparent : Fuel line

Brown/red/orange: rpm sensor (goes to ecu)  
Black isolated cable:ECU (starter and glowplug)  
Red cable on top : Glowplug lead for starting on Propane  
Green cable on top : Thermocouple/Tempsensor

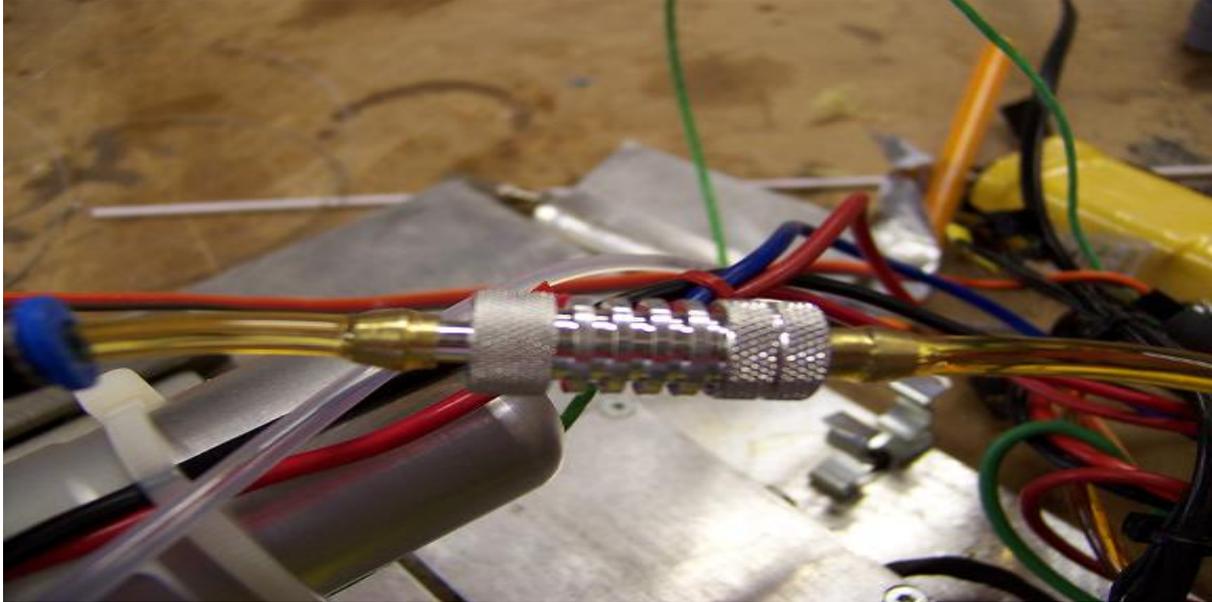
**NOTE: the picture shown is a typical Trudo Turbine  
However there could be small differences!  
Picture shown : Trudo 80 RS**



Fuelfilter

ALWAYS use a fuel filter , this is needed to keep out the fine particles that could clog up the fuel sticks inside the turbine , when this would happen the repairs for cleaning are

expensive



Mounting the turbine

**The greatest risk of damaging your turbine is F.O.D**

**Foreign Object Damage**

**Remember a turbine is like a big vacuum cleaner it wil suck out EVERYTHING you left in the fuselage!**

**Make sure your fuselage is clean of any wood , small screws etc etc**

**The best way to prevent this is to make a F.O.D Screen**

**A simple fod screen could be made of a small filter used for tea or coffee**

**Ask your dealer for one!**

Mounting the fuel pump

It is important to mount the pump somewhere in between the turbine and the tank

Remember the longer the fuel lines the harder the pump must work!

**IMPORTANT**

**Mounting the pump , the pump needs to be mounted with the electric motor UP**



Example:

As you can see motor is up fuel lines are down

Connections of the pump:

The arrow show the in out position

**NOTE: picture shown is a Flightworks 200 pump as used on our smaller series**

**Your pump could be different!**

**Always mount the electric motor up!**

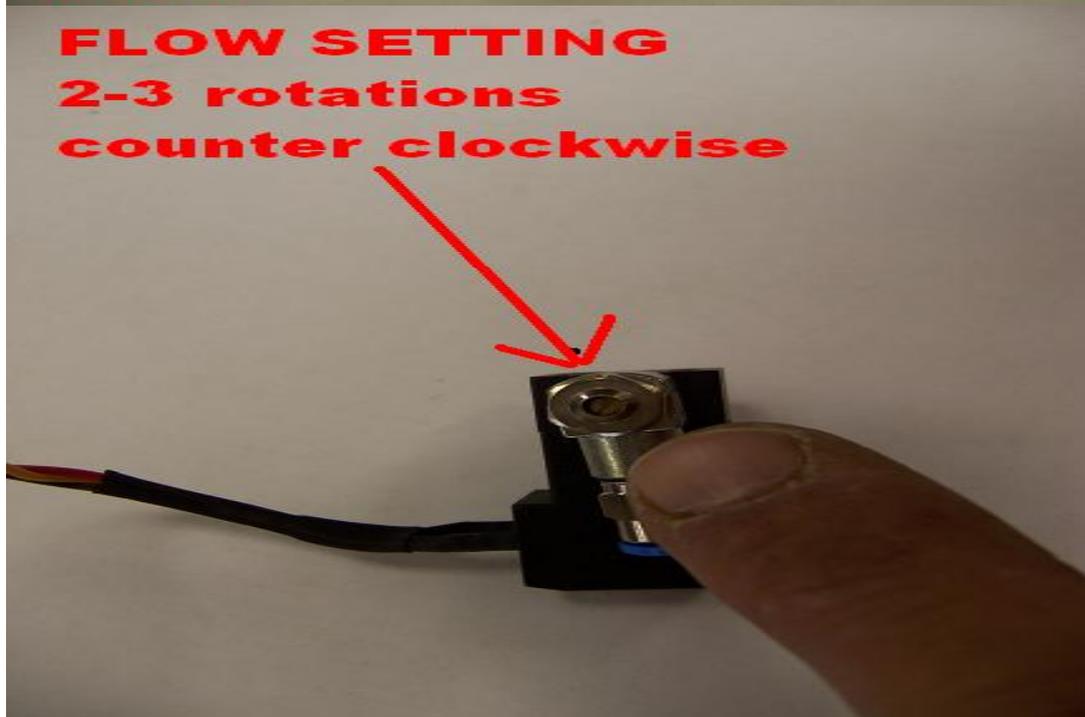
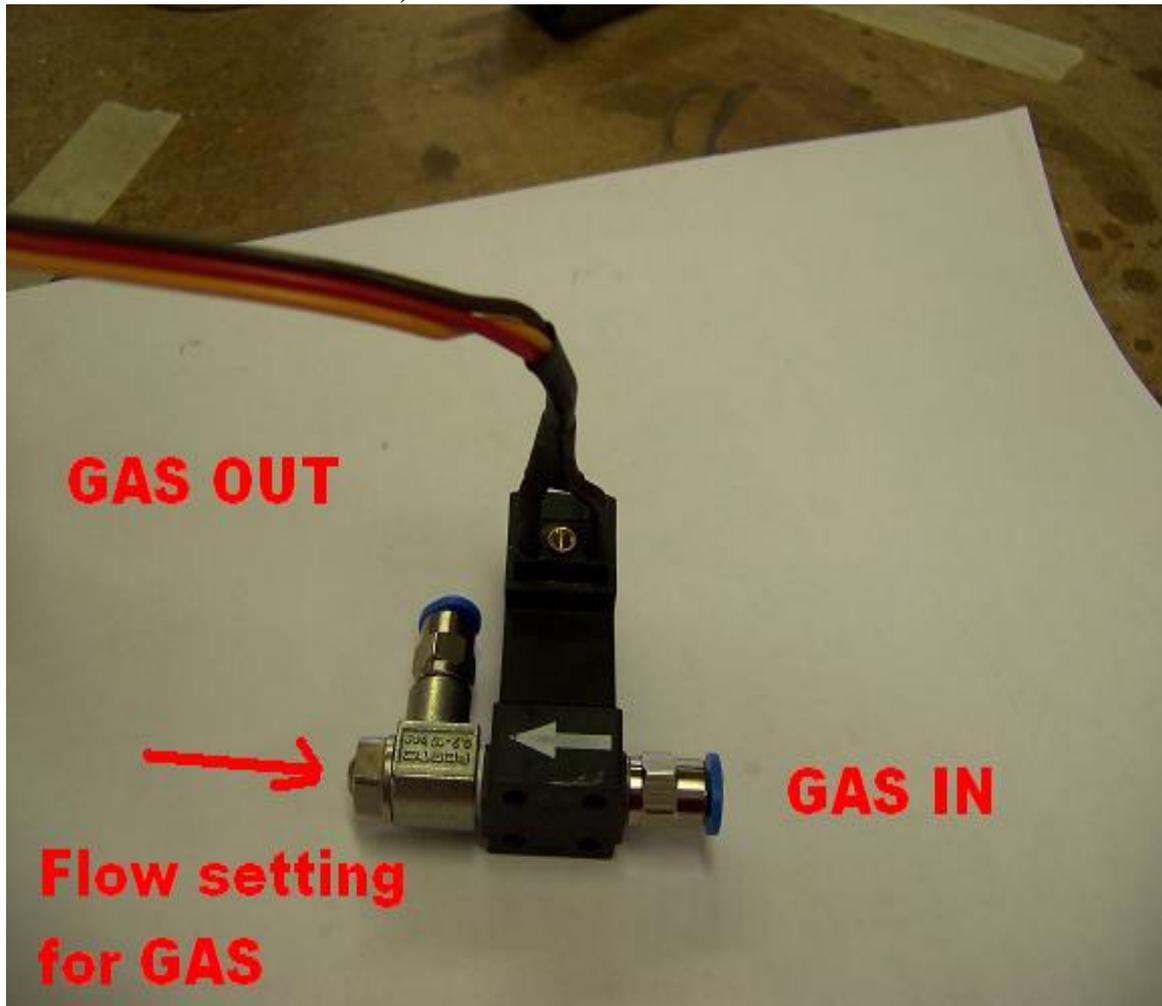
VALVES

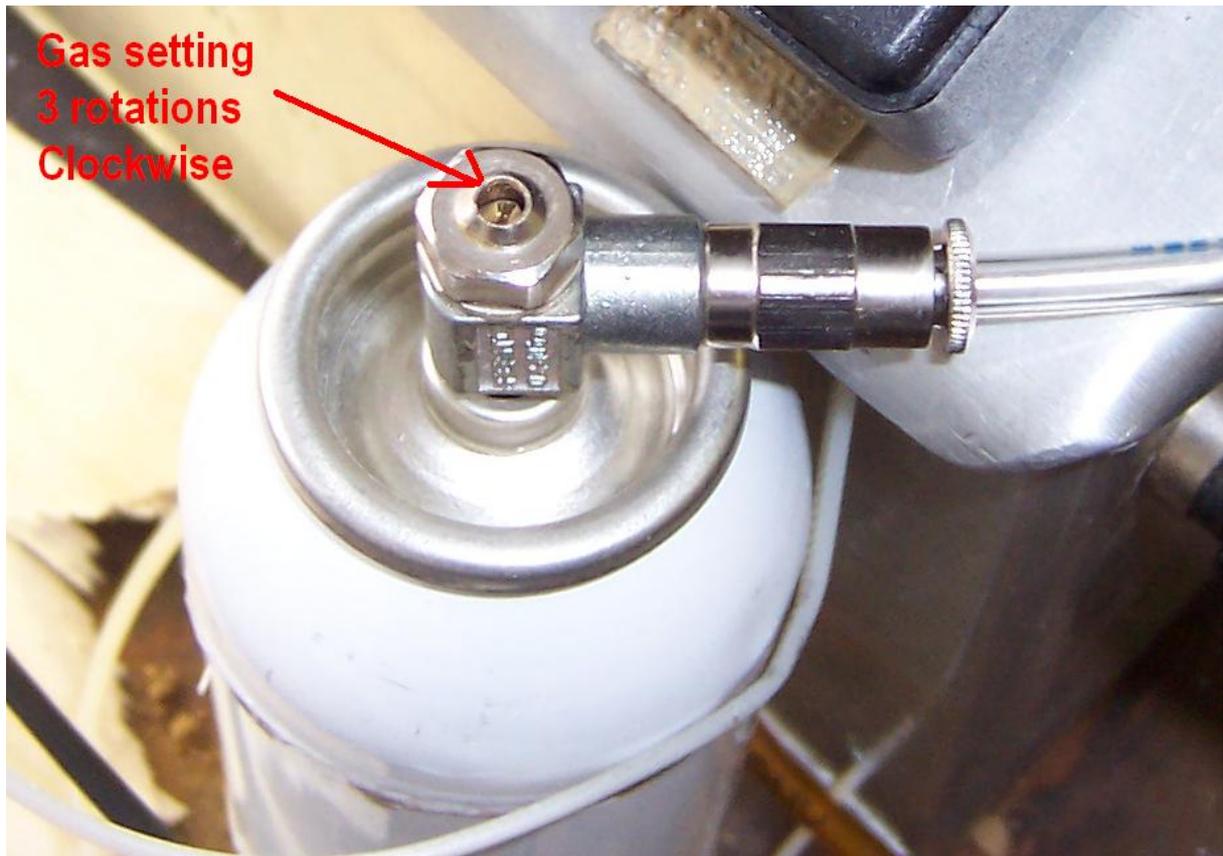
For the auto start to work correctly it is important that you connect the valves correctly

For any valve to work correctly it is important to mount them always on the pressure side!

There is also a arrow pointing the flow thru

Example of the gas valve: (NOTE: sometime the valve can be found on top of the gas container instead on the valve )





Also as you can see are the presets for the gas valve to work Normally this is already done for you.

**NOTE: if you use a outside model gas canister you CAN set the pressure to the engine yourself by opening the bottle manual , in the beginning very slow so you here a plop when starting , after starting you open the bottle even more after reaching 420 degrees you may close the bottle and disconnect from valve**

**To use the manual setting you MUST set the flow of the valve high! Typical 3 rotation counter clockwise is ok**

**NOTE: from 07/2005 the restrictors have changed to a Festo type**

**Fuel valve:**

**This valve is mounted AFTER the fuelpump**

**Fuel manual valve is also mounted AFTER the valve**

**After all the valves you mount the fuel filter!**

**Not connecting it like this can cause a flame out! (air trapped due to cavitations)**

Mounting the ECU

**For all your RC stuff to work correctly it is important you mount all the turbine electronics incl the fuel pump as far away as you can from your RX equipment!**

**Programming ECU to Transmitter**

**DISCONNECT the Start battery from the ECU first!!**

### Aligning transmitter with ecu

As the display does not photograph well we have reproduced the display readings as a green box.

Turn on the transmitter and receiver. The opening screen should show as below: (If the temp" probe is not connected it will show as O'C). "T" = ambient temp'.

### **Aligning transmitter with ecu (continued)**

```
Trim Low      T=020' C
RPM 00000    PW 000
```

Note there are four buttons on the display, two on the left and two on the right hand side. The left buttons move to the different screens and the right buttons are used to change the values stored.

Press the second, left button and scroll through the menus until you find the one showing :

```
Transmitter    yes
adjust
```

Press the right hand button (+) and the screen will change to:

```
Stick Up Trim Up
(Full power)
```



On your transmitter, raise the throttle stick and trim to full. Ensure stick is firmly against the stop.

Now holding the stick against the stop, press the right button (+) to set the value into the ECU.

The screen will now change to:

```
Stick Down
Trim Down (Stop)
```

### Aligning transmitter with ecu (continued)



Move the trim (or switch the "engine cut" switch to on) and throttle stick back to zero and again press the right hand button (+).

The display will now change to:

```
Stick Down  
Trim Up      (Idle)
```

Leaving the throttle stick in the minimum position, raise the throttle trim to the full up position or switch "Engine Cut" switch to off, and again press the "+" button.

If you have done all steps correctly the green LED located directly above the data terminal socket will light up in the ECU when the "Idle" command, trim and throttle stick set to idle positions is on the transmitter.



Lower your throttle trim and the green LED will go out indicating correct reading of the transmitter engine shut off signal by the Fadec ecu.

**Aligning transmitter with ecu (continued)**

On rare occasions, usually when using a Futaba transmitter, it has been found that the throttle channel the sense of movement may require reversing (Servo reverse) and repeat the transmitter alignment.

Correct reading of throttle % by the ecu can be verified in the second screen, percentage of the throttle position is shown on, 0% in the position of engine stop (trim and stick down), 100% with stick/trim full up and between 10% and 30% at idle.

This now completes your radio setup and should only need doing again if the radio settings are changed significantly.

## Fuel and Oil

1. Use CLEAN well filtered Jet A1 or kerosene fuel which is available from most airports, or paraffin (K1) used for greenhouses available from most hardware stores.
2. Ensure the fuel is clean and filtered at each stage of mixing and transfer to the model fuel tank.

Please note the importance of using clean fuel. Failure to do so will result in blockages of the fine fuel injectors in the engine or blockage of the engine lubrication system and subsequent bearing damage. Do not install filters in the feed line from the fuel tank to the fuel pump as this is known the cause aeration of the fuel and flow disturbances resulting in flameout (cessation of the combustion process).

3. Ensure the fuel is free from moisture (water is heavier than fuel and will settle at the bottom of the container).
4. Use good quality aircraft turbine oils e.g. Aeroshell 500, Exxon 2380, Mobil JetOil II, Mobil DTE Light turbine oil.
5. The fuel must be mixed with turbo oil in the ratio of 4% oil to 96% fuel (ratio 1:24). Too little oil will shorten the bearings life and too much oil will reduce engine performance causing undue stress on the bearings.

Please remember to always handle fuel and oils with care! Avoid all direct contact with skin - in case of contact wash all affected areas with soap and warm water immediately.

## Feed Pipes

All the pipes must be Polyurethane or nylon as provided by Jets Munt or Tygon (like the ones used by gasoline engines). Do not use Tygon on the pressure side of the fuel pump. Silicone tubing must not be used anywhere in the installation as it is dissolved by fuel and oil. If in doubt, take a small piece of tube and submerge it in kerosene for a few days and verify that it's characteristics have not change.

## Starting Gas

The starting gas is required to provide pre-heating of the combustion chamber in advance of the liquid fuel feed.

Once the fuel flow is started the gas is no longer required.

For quick ignition a propane/butane gas mixture works well.

In **warm climates over 20°C** a 10% Propane, 90% Butane is a good combination whilst in **colder climates below 20°C**, a 30% Propane, 70% Butane mix is suggested.

The gas supply can be from a canister, like the type typically used for camping and plumbing.



For filling of the optional onboard tank the canister should be inverted to allow a flow of liquid. Care must be taken not to allow any liquid gas to be introduced during engine starting, all gas canisters and onboard tanks should sit upright with the gas feeding from the top.

## Connecting the start battery

Use a lithium-polymer only

2 cell package of 1500 Mah or 2200 Mah (7,4 volts) Depending of type of turbine

Now comes the fun part:

Becoming a turbine operator!

You have checked the full installation  
All the fuel lines are set  
Battery's are full  
Rx is ok

**Priming the fuel system:**

- Both fuel and gas lines need purging of all air after initial installation. Take extra care when priming fuel line, ensure fuel line is primed only up to engine; too much fuel inside engine will cause excessive flaming during start sequence.
- Priming is achieved by keeping Transmitter trim in shutoff position while applying full throttle, after a short delay fuel pump will operate at 25% power for a maximum of 1 sec. Please observe fuel line to engine very carefully and pull throttle back to shutoff as soon as fuel reaches engine. Process can be repeated if required by switching Rx off and back on again.

**IMPORTANT:** The prime procedure should be done only to fill the fuel tubes and filters in the case of a first installation or in case of disassembling of the tubes. Do not run the prime function so that the engine becomes flooded by fuel, as this will cause an uncontrolled fire at next startup.

### Starting the engine.

Set the throttle stick down and the trim up. "Idle" - Confirm that the green LED in the ecu is illuminated and the screen shows "Ready" - !Ready to start!. Move the stick to 100% and then back to idle again. Do not leave the stick at 100% more than 3 seconds. The Ecu will automatically check the glow plug circuit and if OK energize it, wait 1 second then apply power to the starter and open the gas solenoid. In the screen of the Ecu it will show the word "Ignition"

- The gas will ignite. You will hear a "POP" confirming this, the temperature indicator in the screen of the Ecu will begin to raise.
- When the Ecu detects an increase in temperature of 50°C from the temperature read at the moment the start is initiated, the screen will change to "preheating". The fuel pump will begin to operate and power to the glow plug will be disconnected.
- Next the screen will change to "Fuel ramp". In this phase the Ecu will be gradually increasing the starter power and fuel flow. When 16.000 RPM is reached the Ecu will automatically disconnect power to both the starter and gas solenoid valve.
- When the rotor speed reaches idle, the screen will change to "running" and the engine speed stabilized.

### *The engine is running!*

Control of engine power/rpm is now handed back to the transmitter and controlled by the position of the throttle stick. Increase/decrease the throttle slowly, verifying that the engine accelerates/decelerates.

Take special care around the engine intake, keep your hands at a safe distance along with any other objects as they can be easily ingested.

### Engine shut down procedure:

To shut down the engine lower the trim and the stick. Is recommendable that before shutting down the engine please restrain the model then raise the throttle stick to approximately 50%, allowing temperatures to stabilise for around 5 seconds before carrying out the shutdown procedure.

### **Flying:**

#### **Getting used to your turbine**

**The ECU tries to spin up your turbine as fast as possible**

**Still it will need about 3 seconds to reach full power from idle**

**Keeping this in mind , you will notice that you will need maybe to practice your landings!**

**Having some experience with this**

**We always fly with half throttle since the most of the thrust is gone for manoeuvring**

**Landing we come in with a quarter of throttle after we see we can make it we pull back the stick and set her down.**

**If not we set full power and keep the plane level until you can notice the thrust coming**

**Trouble shooting:**

## WHAT TO DO IN THE CASE OF AN EMERGENCY

During the start sequence the Ecu will be in charge of everything, controlling temperature and RPM. The only thing the user can do, is to abort the sequence by lowering the trim in the case that something abnormal (excessive flames in the exhaust, etc).

If a problem is detected, first:

- Move the trim to the low position to abort the sequence.
- If there is a fire in the engine and the problem is because the starter has failed or the engine is seized (not turning) , **IMMEDIATELY APPLY THE FIRE EXTINGUISHER** through the intake side of the engine, never by the exhaust.
- If there is a fire, but the rotor remains free to spin and the starter is OK, raise the trim and stick to the full power position this will connect the starter manually to ventilate the engine and extinguish the fire. The throttle channel acts as a starter switch if the temperature is over 100°C after an aborted start.

### List of ECU message codes

Here is a list of possible messages shown on the data terminal screen and their meaning.

#### Starting:

**TrimLow:** Indicates that the signal received from the transmitter corresponds to the lowered trim, that is to say, engine OFF.

**Ready:** Indicates that the engine is ready for starting, and that the transmitter signal corresponds to IDLE, (green LED lit)

**StickLo!:** This indicates that the throttle stick is in a position above IDLE, the engine will not start with the stick I this position.

**Glow Test:** Verification of glow plug circuit continuity

## Diagnoses (continued):

Also, after each cycle of operation, the Ecu stores the last cause of shut down and the values of RPM, temperature and pump power. In order to access these measures, it is necessary to shut down and power-up the Ecu. Set the trim down (trimLow) and push the left button on the display. The Ecu will show the cause of shutdown and the parameter values at the moment of shut down. These are as follows:

### Diagnosis messages:

**UserOff:** The engine has been shut down because it has received the shut down command from the transmitter.

**FailSafe:** The engine has been shut down because of loss of the control signal from the transmitter. Once the Ecu detects a loss or invalid RC signal, it sets engine power to idle, and if after another 1,5seconds a valid signal is still not received the engine is shut down.

**LowRPM:** The engine has been shut down because the RPM has dropped below a minimum. Cause could be lack of fuel, air bubbles, problem with the batteries, or defective RPM sensor.

**FlameOut:** The engine has been shutdown because the temperature has dropped below the minimum of (100°C). (Usually a thermocouple failure).

**RCPwFail:** Lack of power from the radio receiver.

### ECU message codes (continued)

**StartOn:** Test of the starter

**Ignition:** Gas ignition phase.

**Preheat:** Phase of heating of the combustion chamber after detecting the gas ignition.

**FuelRamp:** Phase of acceleration until speed of slow motion.

**Running:** Engine working correctly you have full control of engine power.

**Stop:** Engine off.

**Cooling:** Starter operating to cool the engine.

### ECU error messages:

**GlowBad:** Defective or disconnected spark plug or ecu battery disconnected.

**StartBad:** Defective starter, insufficient RPM reached during start.

**Low RPM:** Engine speed below the minimum.

**HighTemp:** Excessive temperature

**FlameOut:** Exhaust GAS Temperature below the minimum.

### Diagnoses:

During engine operation the Ecu measures and stores all the engine operating parameters recorded during the last the 51 minutes of operation. These measures can be downloaded later to a PC to study the behaviour of the engine in flight and to diagnose any possible problems.

## Maintenance

1. Always keep the engine and its accessories clean and dry.
2. Regularly check wires for chafing or insulation breakdown etc.
3. Regularly check fuel and gas pipelines for chafing and /or leaks at joints.
4. Check the temperature probe is correctly positioned
5. Check the engine and mounting for loose fittings and secure if required.
6. Ensure the fuel system is kept free from dust and dirt inclusion and that fuel is carefully filtered.

### **Blown the glowplug?**

Glowplugs do not last forever and you may need to change one at some point due to a blown element. To work correctly the element must be exposed tease it out with a pin to the shape shown, (the washer is not required).



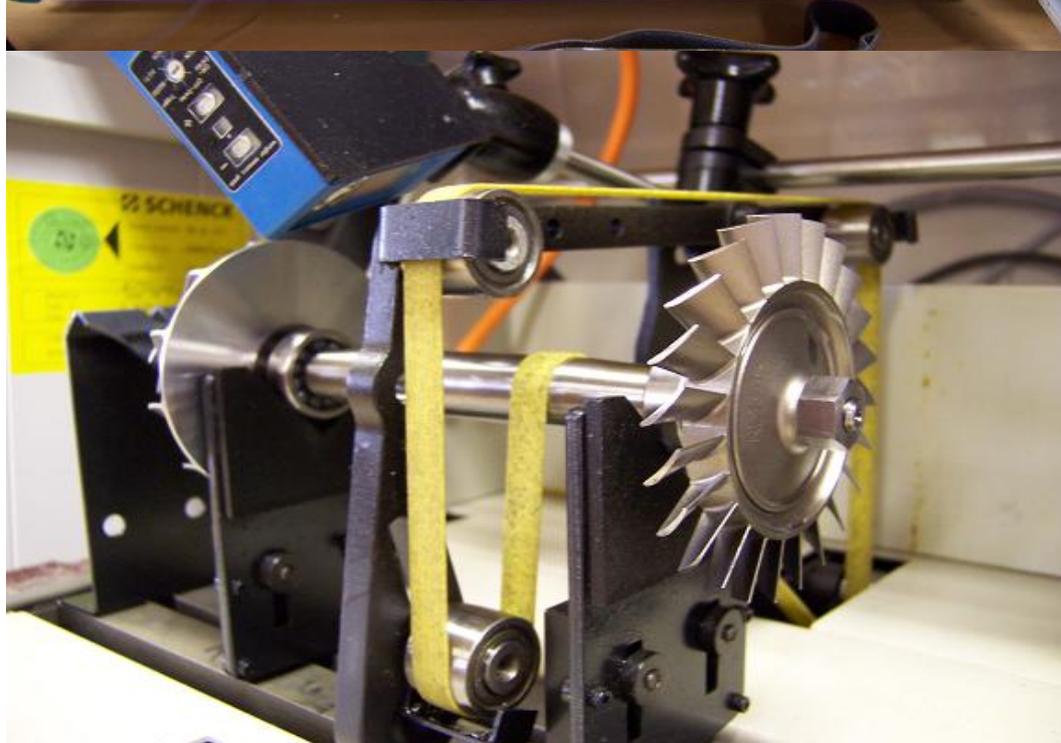
You can use any type of plug, the cold ones last longer e.g. Rossi R8. Remember to adjust the power to the plug in the ecu after changing the plug type.

:

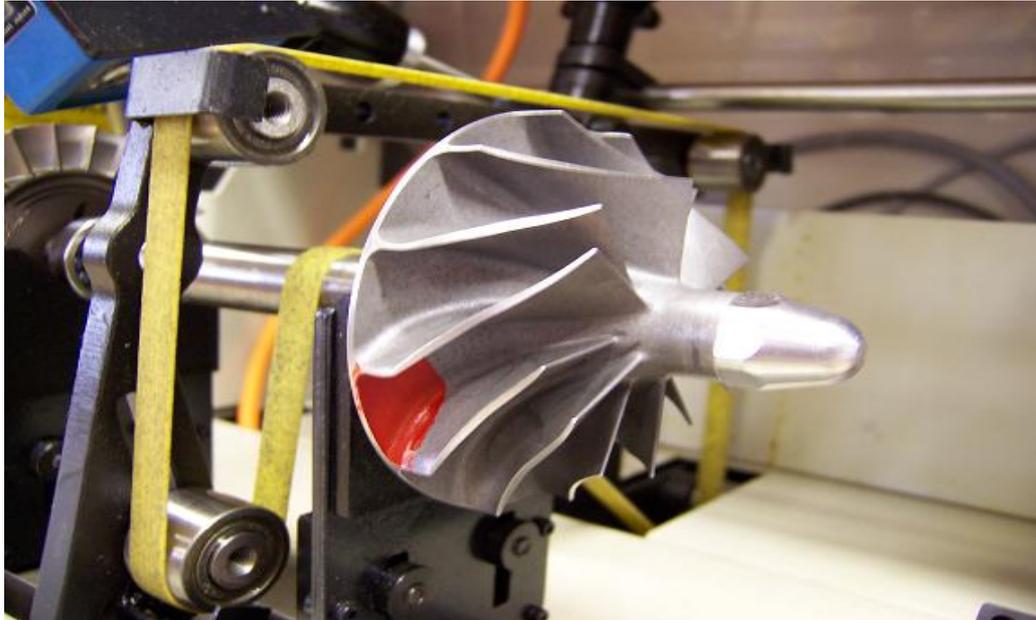
**Bearings need to be replaced after about 25 hours of use**  
**After a yearly inspection we will decide if new bearings are needed**  
**A inspection means we will clean out the turbine . rebalance**  
**Do NOT try to repair the turbine yourself this will you lose the warranty**  
**You need special equipment to service the engine**  
**Warranty does NOT cover any F.O.D Damage**  
**Or bearings due to crashes , dust , fuel blockage overheating , unbalance!**  
**Maintain your fuel to be clean , use correctly turbine oil only!**  
**Areoshell , Exxon etc etc are suitable oils**

<u>PROBLEMS</u>	<u>SOLUTIONS</u>
There is no reading on the screen	<ol style="list-style-type: none"> <li>1. Disconnected receiver or the ecu/receiver batteries are empty</li> <li>2. The display is badly connected</li> <li>3. Problem in the ecu or display</li> </ol>
The gas does not ignite	<ol style="list-style-type: none"> <li>1. The gas canister is empty/low or cold.</li> <li>2. The gas solenoid valve is not connected properly or installed gas shut off valve is closed.</li> <li>3. There is too much gas and the needle valve on the solenoid needs adjusting</li> <li>4. Glow voltage needs adjustment</li> </ol>
There is little increase of RPM when the fuel ignites	<ol style="list-style-type: none"> <li>1. The fuel valve is partially open</li> <li>2. There is air in the line of fuel</li> <li>3. The filters are blocked</li> </ol>
The engine reduces the power of it is stopped during starting	<ol style="list-style-type: none"> <li>1. The ecu has detected temperatures over 800°C due to too slow starting</li> <li>2. There is low battery or air in the tubes- Therefore let it cool and retry</li> </ol>
Engine does not accelerate to maximum set rpm	<ol style="list-style-type: none"> <li>1. There is insufficient fuel or air bubble entering the engine during the initial start up.</li> <li>2. Low battery capacity</li> </ol>
The engine loses power in flight	<ol style="list-style-type: none"> <li>1. The ECU battery is empty: recharge</li> <li>2. The filters are dirty</li> </ol>
The engine stops in flight	<ol style="list-style-type: none"> <li>1. The fuel level is low and/or there is air in the pipes</li> <li>2. There is a poor connection between the battery and pump</li> <li>3. Interference</li> </ol>
There is excessive vibration and unusual noise	<ol style="list-style-type: none"> <li>1. The engine is unbalanced by the ingestion of a foreign object. Do not use the engine and send it in for service.</li> </ol>

Here is our balancing machine we use to precisely to rebalance your engine



Balancing the turbine wheel:



Balancing the compressor

Logbook:

