

PRELIMINARY Instruction manual
V5 and 6 ECU
Behotec JB55, 66, 130, 165, 180 and 200

Behotec 55, 66, 130, 165, 180 and 200



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Terms and Conditions

- Behotec engines are warranted for 1 year.
- Behotec and Altecare warrant that these model engines for model aircraft, cars or boats are free from defects in materials and workmanship during normal usage.
- The warranty extends to the original purchaser of the Model Engine and is assignable or transferable to any subsequent purchaser / end-user.
- Warranty coverage begins the day you buy the Model Engine.
- During the warranty period, Altecare will repair or replace, at Altecare's discretion, any defective parts with new or factory rebuilt replacement items if such repair or replacement is needed because of Model Engine malfunction or failure during normal usage. No charge will be made to the Buyer for any such parts. Altecare will also pay for the labor charges incurred by Altecare in repairing or replacing the defective parts.
- The Buyer must operate and maintain the Behotec Engines in accordance to the Model Engine manual.
- The Buyer shall have no coverage or benefits if the Model Engine has been damaged from external causes such as crash damage, foreign object damage, weather, Act of God, improper electrical connections, or connections to other products not recommend for interconnection by Altecare.
- If a problem develops during or after the warranty period, the Buyer shall send an email to service@altecare.com requesting a Return Material Authorization prior to shipping any engine, detailing full name and address, engine model and date of purchase, as well as a brief description of the problem.

Introduction

Thank you for purchasing the Behotec model turbine engine. Behotec is situated in Bavaria, south West Germany, and is a small modern company producing components for BMW at Munich some 15 kilometers away, as well as the Jetstream range of turbines and model related products. The factory has the latest CNC machinery, balancing and test equipment. Altecare Inc. sell, supports and services the Behotec series of turbine engines. Our engines are designed and manufactured in Germany and have undergone extensive testing and redesign, in order to ensure they are safe and reliable.

Please read the manual thoroughly and familiarize yourself with the engine and its accessories as well as its operating procedure.

Safety Precautions

- The Gas Turbine Builders Association (GTBA) has compiled a set of recommended rules for the safe operation of gas turbines. These can found on the GTBA website (<http://www.gtba.cnuce.cnr.it>). A copy can be sent to you if you do not have access to the internet.
- The start-up of all gas turbines can be dangerous if procedures are not adhered to. You must ensure that no debris, foreign objects, tools, fuel pipes etc., are in the suction area of the compressor.
- Please note that gas turbines differ substantially from piston engines in that rotational speeds are very much higher reaching 120,000 rpm. Turbine powered model aircraft need to be substantially stronger than other models as the forces imposed are greater. Servos should be selected for their high torque to combat blow back of the control surfaces (here digital servos are best employed).
- Turbine powered models can reach high speeds (approaching 250 mph) so models must be selected carefully for design and strength. However, they do not have to be flown flat out as the turbine can be throttled. It is up to the individual to have "mechanical sympathy" with the airframe and to fly within his/her own, and the models capabilities.

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- You can quickly run out of flying room. There is also a danger of developing control surface flutter or mechanical overload, causing the model to fail in flight. When piloting a turbine powered aircraft, one must properly control the throttle.
- Ensure you are capable of starting and operating your turbine safely at all times.
- Ensure all equipment; parts, tubing, valves, etc. are secured so that they cannot be sucked into the turbine intake. Any part sucked into the intake will cause damage to any turbine engine
- Have a CO2 or Halotron fire extinguisher always ready and near by. Powdered extinguishers are not recommended.
- Pay attention to the fuel system, ensuring there are no leaks.
- Keep your hands away from the turbine when running. The front compressor has a high suction and will suck in your fingers; also the rear of the turbine is very hot at 650°C.
- Always ensure proper minimum safety distance as follows
 - In front of the turbine = 15 feet
 - On the side of the turbine = 25 feet
 - Behind the turbine = 15 feet
- Always use hearing protection when you are near a running turbine engine to the avoid hearing damage
- Always exercise caution around the hot parts of the turbine. Exhaust gas temperature is around 650°C.
- Fuel should be mixed with 5% turbine oil like Aero shell 500 or similar.
- Never run the turbine in a closed area or an area near any kind of flammable matter. Do not fly turbine-powered aircraft near flammable materials, nor in forested tracts or areas experiencing drought or dryness. Obey all forest fire regulations and warnings by refraining from operating in restricted fire zones. Never operate model turbine jet aircraft in or around residential or heavily populated areas.

Technical Data

	JB180	JB165	JB130	JB66	JB55
Diameter (mm)	113	113	113	112	86
Length (mm) with starter motor	320	315	315	292	245
Weight (gr)	1,600	1,500	1,500	1,350	800
Max. thrust (N) @ 120,000 - JB55 @ 165,000	180 43lbs	165 37lbs	135 31lbs	85 19lbs	70 15lbs
Min. thrust @ 35,000	7.5	7.5	6.8	4.5	3.5
Consumption at max rpm (ml/min)	580	550	500	280	230
Exhaust temp °C	650	670	650	630	630

Before starting your turbine

- Make sure your ECU and Rx batteries are charged
- Always ensure a fire extinguisher is available and accessible
- Check that your fuel lines filters are clean and free from restrictions
- Your fuel overflow or vent must be unobstructed
- Mix 5 % oil in your fuel (i.e.: 1 quart per 5 gallons of kerosene). Behotec engines operate on Jet A, Kerosene and clean Diesel fuels
- Make sure the main and header tanks (air trap) are full and the full lines are free from air bubbles
- Fill your Propane starting gas tank. If using Kerosene start, refer to section ???? for details
- Turn on receiver switch
- Connect your ECU battery to the ECU
- Place the model with nose into the wind
- Prime your fuel system, refer to the **Projet Manual**

After shutting down your turbine

- Turn model into the wind
- The engine will auto cool down
- After cool down turn off your Rx battery
- Disconnect your ECU battery. Note: You can leave the ECU battery plugged-in while at the flying field. The ECU requires both RX and ECU batteries to operate. Once you are done flying for the day, make sure you disconnect your ECU battery

ECU Battery

- The Behotec engine is supplied with everything you need to get started. We do not supply a battery, however a battery cable soldered to a connector are supplied. All you need to do is select the battery of your choice.
- The system takes all kinds of batteries available today from 6, 7 or 8 cell NiCd or NiMH packs, 2 or 3 LiPo, 2 or 3 Type 123 battery packs, 2 or 3 LiMg or any other battery available that can deliver 7.2 to 12V.
- We recommend 3 cell LiPo or similar for best performance if you are using Kerosene start. The ECU can handle all these battery types. You will need to tell the ECU, menu 90, what type of cell count you are using and that is simply to set your minimum voltage alarm.
- A typical consumption is anywhere from 300 to 360mAh per flight. Choose a battery capacity that suits your flying habits and weight limitation of your model. For Kerosene start we recommend a minimum of 2,500mAh capacity.

Fuel System

- Behotec engines operate on Jet A, Kerosene and clean Diesel fuels.
- The fuel needs to be mixed with 5 % turbine oil like Aeroshell 500 or similar (1 quart per 5 gallons of kerosene).
- A hopper tank also commonly known as Air Trap is not necessary with Behotec engines since we supply a felt clunk with every engine. Having said that, it is now common practice to use such an accessory. You can choose the Air trap of your choice.

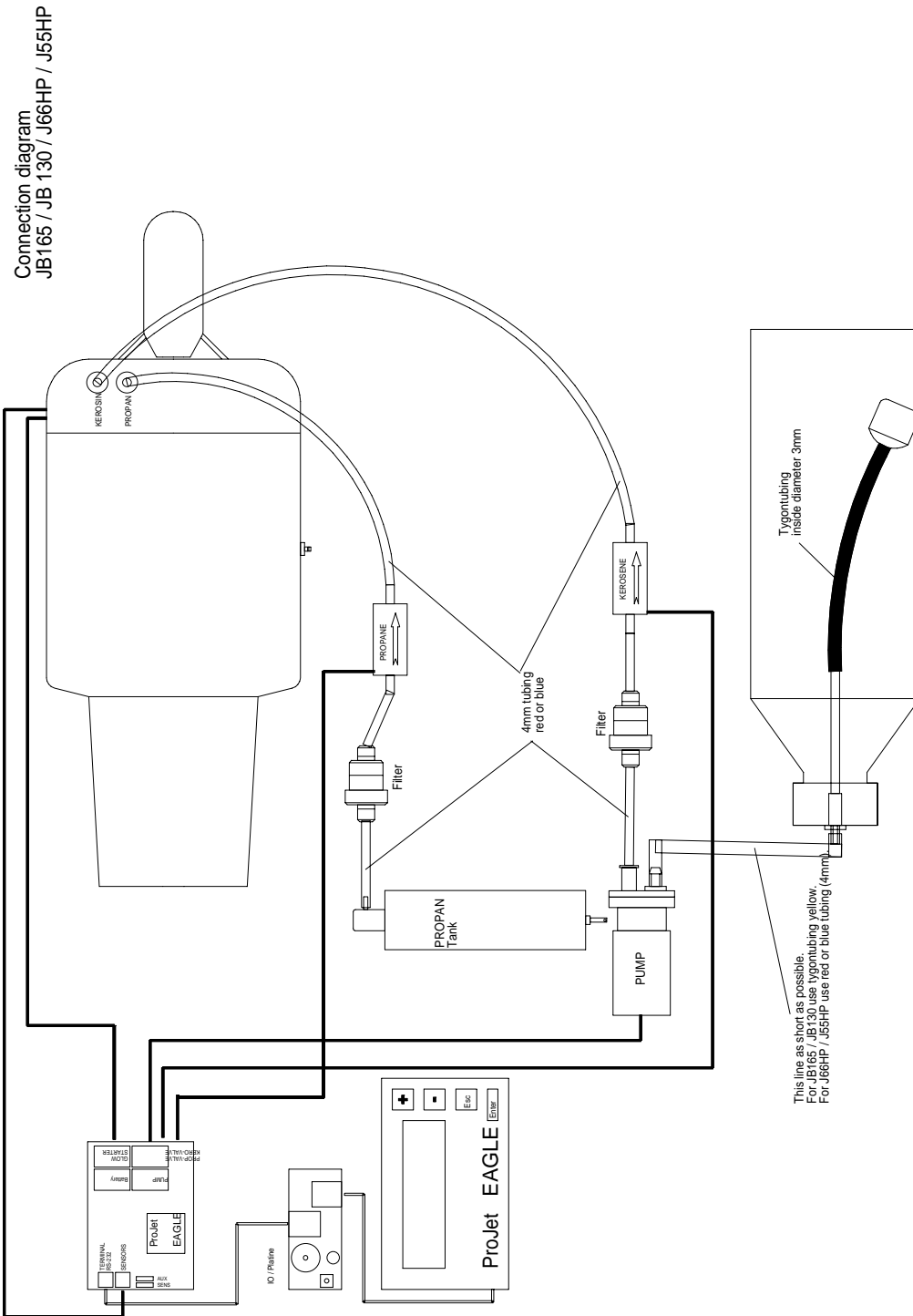
Mounting your Turbine

- The Behotec turbine can be installed using the 4 latches, a jubilee clip or the mounting ring supplied. If the latches are used they must be attached to an annular former where all 4 latches are used to spread out the thrust load, make sure the latches are square on to the annular mounting face to prevent twisting of the turbine case. If a jubilee type clip is used (must be 20mm wide) this must be attached within an area of 10mm in front of and 25mm behind the turbine latch attachment points.
- When installing a turbine in a model, best running results are achieved if the turbine glow plug is positioned at 9 o'clock. A deviation of +/- 75 degrees is also possible. If your installation requires that you install the engine inverted. We have tested such a set-up and it worked fine.
- We recommend using the Rossi # 8 glow plug. Other glow plugs can be used however they will not last as long as the Rossi. Pull a couple of coils prior to expose the element prior to installing a new glow plug. CAUTION: You need to anneal the filament and then carefully with a pin pull the filament out of the body of the plug, making sure that the coils are not touching each other or the body of the plug. Failure to do so will break the element and damage the glow plug
- The choice of fuel tanks is diversified. Here are some guidelines that will help you choose your fuel tank capacity: a 3~4 litre tank will allow a flying time of approximately 15 minutes on the

JB55, 10 minutes on the JB66, 7 minutes on the JB130, JB165 and JB180.

- The fuel pump supplied is a high quality pump designed in-house and is a very reliable pump. Pay attention to the IN & OUT fittings when installing the fuel tubing. Never run the pump dry.
- The Fuel and Propane valves are clearly P and F. Pay attention to the flow direction marked with an arrow on the body of the valve. The cables from the valves are connected to the ECU. Propane valve connected to the top terminal (PROP VALVE). Kerosene valve connected to the bottom terminal (KERO VALVE) It does not matter which way the cables are plugged in as the wiring is figured (negative, plus, negative -+ -).
- The on-board gas canister can be placed vertically or at an angle of 45 degrees.
- The Electronic Control Unit or ECU comes already pre-programmed. On any new installation, a calibration run (menu 42) needs to be performed. Please refer to the **ProJet manual** for further information.

Typical System Installation



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Starting the turbine

- Fill the fuel tank. Make sure the vent is open.
- Follow the instructions in **the Projet manual** on how to set-up your transmitter. Familiarise yourself with the various menus. and how to use the menus especially menu 42 (CALIBRATION RUN). When you have done this and selected menu 42 and selected "YES" the turbine will automatically start. Turbine starts to turn over, glow plug switched on, gas is ignited, ECU reads EGT, fuel introduced and ignites, glow plug switched off, speed increases, starter disengages, speed increases to idle, increases to mid range ECU calibrates, speed increases to maximum, ECU calibrates and returns to idle. Leave the Throttle trim at maximum, and return the Throttle lever to idle. You now have control of the turbine.
- Should an Error arise the GSU will display the cause of the problem. Please refer to the **Projet manual** for more details. Adjustments to the ECU should not be necessary as they have been optimised by the factory, however the ECU is very flexible and will allow you to adjust almost any of the turbine settings.
- Maintenance and servicing of the turbines supplied by Behotec are to a large extent maintenance free under normal operating conditions. However some points are to be kept in mind in order to ensure perfect functioning of the turbine. Regular cleaning, keeping dust away, deposit of rubber type products on the compressor nut by the starter "O" ring, check to make sure the fuel filter is clean. When breaking down fuel lines do not allow dirt to enter into the lines. If the turbine is to be put away for a long time, pour in a thin engine oil as an inhibitor and swill around coating all surfaces, wrap in an oily cloth and store in a dry warm place.
- After 25 hours running time (Approx 180 flights) an internal inspection is advised to check the bearings.
- If the turbine has been crashed it should be returned for inspection.

- Repairs and maintenance can be performed through Altecare Inc. for North America, and through Behotec GmbH for the rest of the world. Disassembly of the turbine should only be carried out by trained technical personnel. All warranty returns should be handled by your local distributor. Only original Behotec parts should be used to replace defective turbine components. Always quote your S/N when requesting service. Your S/N is engraved on the turbines inside the cowl, and it is documented on the run certificate supplied with every engine.
- Behotec engines carry a warranty of one year and consists of a free repair and or replacement of parts that are proven to have a manufacturing fault in the first 12 months from the date of sale, or 10 running hours which ever is reached first.
- When returning an engine for warranty repairs, the ECU and pump should accompany the turbine for Behotec to establish the total running time. Transport packing and travel costs are to be covered by the buyer. Please supply detailed descriptions of the problems with as much details as possible.

TBA (details to follow)



Connect the turbine with the ECU. Use the black connecting cable. On the ECU you need the terminal point (Sensors).



Connect the turbine with the ECU, therefore you need the red / black power cable. On the ECU you need the terminal point (Glow / Starter).

Attach the ECU with the GSU and the I/O board. Use the black connection cables.

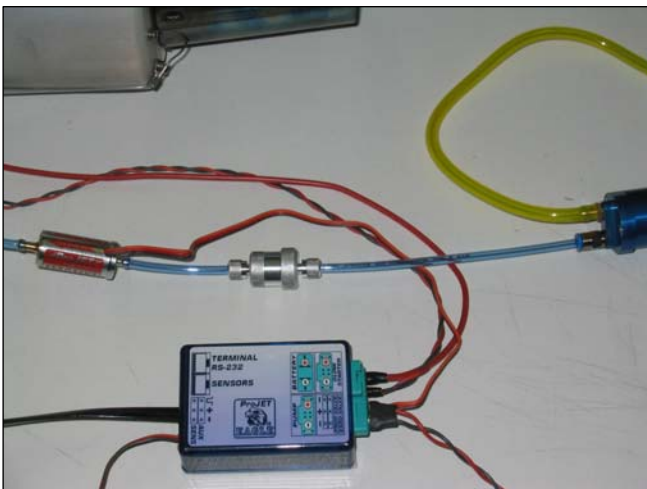




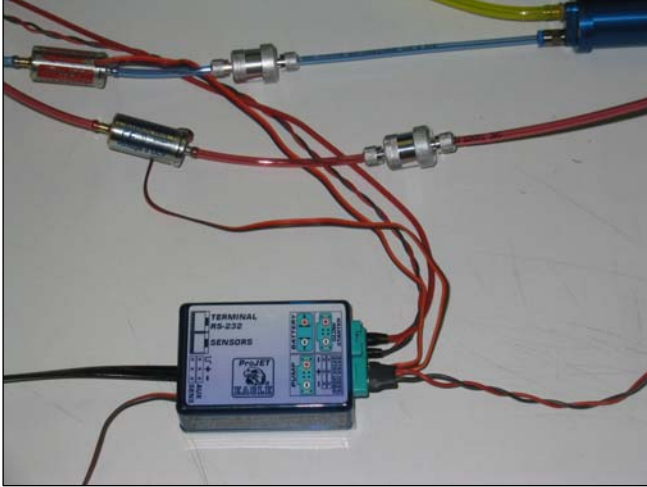
Connect the pump with the ECU.
On the ECU you need the terminal
point (Pump).



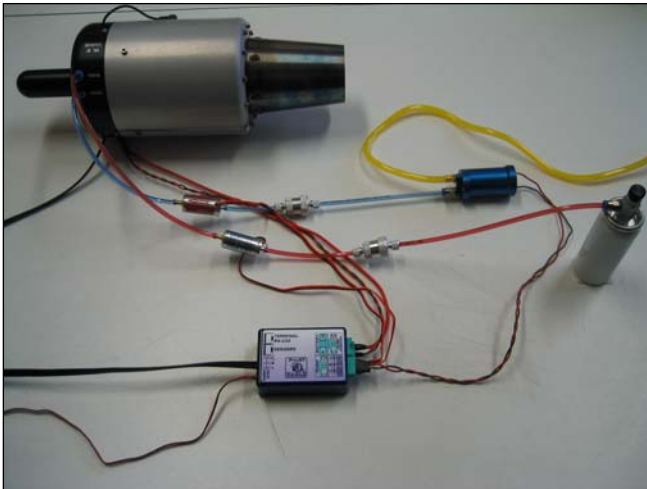
Now you have to produce a
kerosene line.
Therefore you need the red kerosene
valve and a filter. Pay attention to
the flow direction marked with an
arrow on the body of the valve. Also
you have to look at the fitting
position from the filter. Watch the
correct order (Pump, Filter, Valve,
turbine).



Connect the pump with the yellow
tygon tube (turbine JB130/JB165).
At turbine type J55HP/J66HP use
the red or blue tube 4mm.



Now you have to produce a propan line. Therefore you need the blue propan valve and a filter. Pay attention to the flow direction marked with an arrow on the body of the valve. Also you have to look at the fitting position from the filter. Watch the correct order (Gas canister, Filter, Valve, turbine).



Connect the gas canister with the red tube.



If you not use your turbine or you send it back to Behotec, you have to close the Kerosene and Propan connectors. Dirt can block the kerosene lines inside the turbine. Use the 4mm stopper.

Repaircosts up to 360,00 Euro are the result.



For tank assembly drill a hole with 6mm in a coke cap.





Use a shim 6mm and tygon tube with a length of 120-150mm.



Use wire to save the tygon tube.



Use wire to save the tygon tube.



To fill the gas canister connect this with a big gas canister. Open the pan head screw on the two valves. Now close the pan head screw and watch the gas flow, then open the pan head screw and disconnect the two gas canisters.

Instruction Manual
12V Kerosene Start System
 Part Number: KS-1



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Components list

- 1 x Kerosene burner
- 4 x O-Ring 6x1.5mm (seal)
- 2 x O-Ring 2x1.5mm (secure)
- 1 x Festo Y- connector (4mm)
- 1 x Kerosene tube clear (1m)
- 1 x soldering bush
- 1 x shrink hose
- 1 x Blanking plug for the propane line

ECU Requirements

To use the Kerosene Start System in your Behotec engine, the ECU firmware needs to be version 6.15 or higher, this can be updated by your dealer, or you can send it to Behotec for upgrade.

It is very important to use a good high capacity battery; we recommend a lithium polymer battery with 3 cells and 2500 mAh or more. NiCd and NiMh are also recommended however a pack with 8 cells and 2500 mAh capacity is needed. The ECU will take all these types of batteries automatically.

Please note:

The Kerosene start system must be installed vertically in the model. The Kero Start system must never be inverted or to the side in the model. Failure to do so can cause excessive flames and can cause turbine or model damage.

Operation

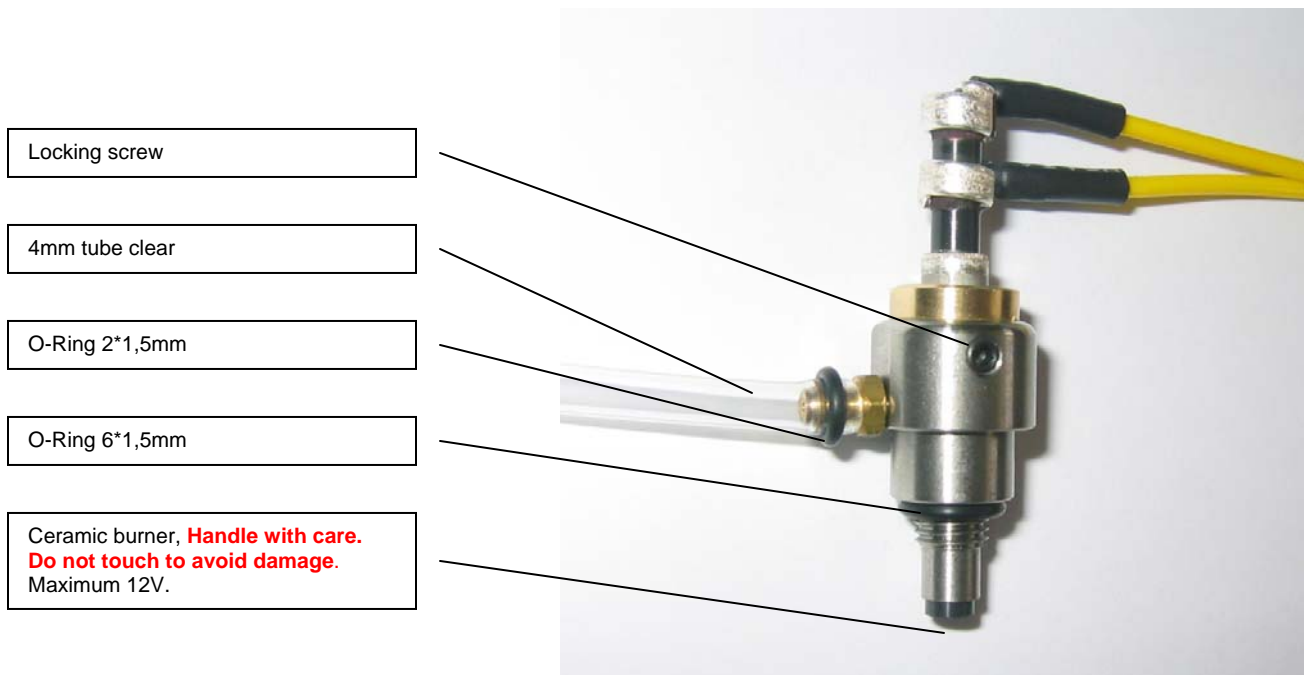
The Kerosene Start system operates in 4 phases as follows:

- The start is the same as propane.
- The burner preheats for 15 seconds.
- At this point the starter spins the turbine.
- After one second the pump starts to run (phase 1)
- The turbine accelerates gradually, the temperature climbs to 40°C. At this point, the heat-up phase starts (phase 2), the combustion chamber will be preheated for approximately 30 seconds (time varies from turbine to turbine)

- At the end of the heat-up phase the temperature rises (up to 250-300° C) and also the rpm climbs to 8.000 ~ 10.000 rpm (phase 3)
- The turbine now runs on kerosene from both lines and valves.
- After the start-up procedure, the turbine accelerates to idle (up to 15 seconds)
- ECU shuts off burner valve (phase 4)

The start up will take approximately 1 minute. The long heat-up phase is necessary to ensure a good combustion and no flames come out of the tail.

Installation

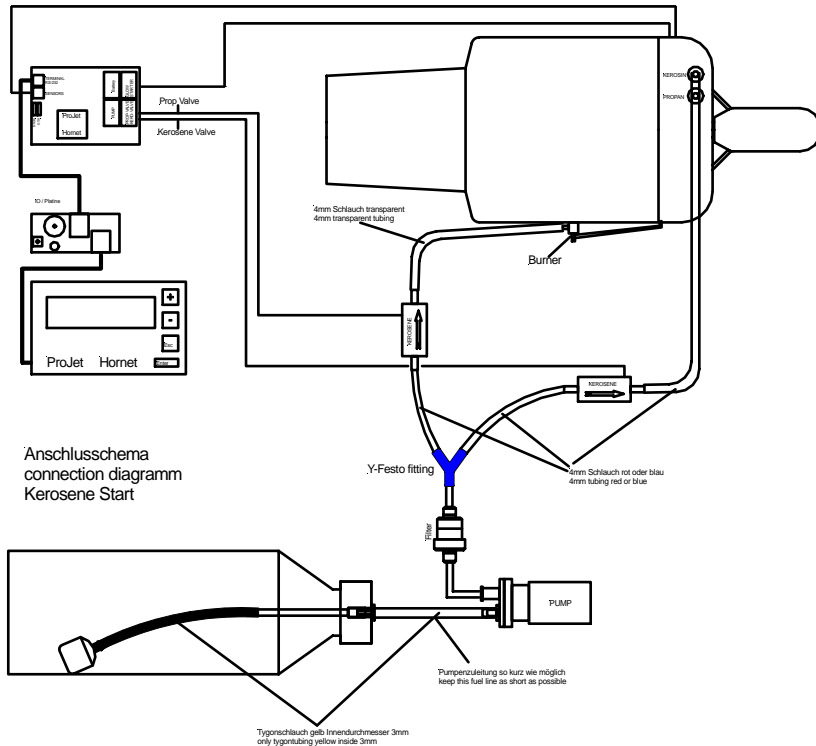


- Caution: Hand tighten Stainless adapter. Do not use tools to avoid damaging the thread
- Remove the glowplug.
- Slide-on one or two O-Rings (6x1.5mm) over the thread.
- Insert the ceramic burner. Carefully tighten the locking screw. Do not over-tighten to avoid damaging the ceramic burner.
- Place assembly on its side where the cables are soldered
- Remove turbine front cover.

- Cut the Glow plug cable and solder the kerosene burner cable. Also connect the ground (-ve) cable to the plate (see pictures below)



- Use the clear tube to connect the burner to the valve, to secure it you have to use the O-ring (2*1,5mm). This fitting does get very hot, it needs to be secured.
- Block the propane port with the blanking plug.



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Pre-start setup

ECU settings

Change the parameter settings from the Set-up Menu 60

- Menu Nr.61-1 to ON
- Menu Nr.61-2 to 40-50%
- Menu Nr.61-3 to 20%
- Menu Nr.61-4 to 40° C
- Menu Nr.61-5 to 7000 rpm
- Menu Nr.61-6 to 15.0 s
- Menu Nr.61-7 to 9 V
- Menu Nr.61-8 to 1.0 s
- Menu Nr.61-9 to 15 s

Change the parameter settings from the Set-up Menu 50

- Menu Nr.51 to 2.0 V
- Menu Nr.52 to 6.5 V
- Menu Nr.53 to 3.5 V
- Menu Nr.54 to 26.000 rpm
- Menu Nr.55 disabled
- Menu Nr.56 to 140° C
- Menu Nr.57 disabled
- Menu Nr.58 to 15.0 s
- Menu Nr.59 to 15.0 s

Then change the parameter settings from the Adjust and System Menus 70 and 90

- Adjust Menu Nr.70 to 12.0 V
- Adjust Menu Nr.71 see Pro Jet manual
- Adjust Menu Nr.72 see Pro Jet manual
- System Menu Nr.90 to 8 Cells
- System Menu Nr.93 to Optic (J66HP, JB130, JB165, JB180)
- System Menu Nr.98 to 2.0 V

Pre-start setup

Pump start voltage

Before starting the turbine you have to set the pump start voltage. This is normally done when a fuel pump is replaced in the system or when you switch to the kerosene start system. If you have a new turbine with kerosene start system, this is already done for you. And these values are recorded on the run certificate.

- Disconnect the kerosene line on the turbine and burner and place them in a container so fuel does not spill
- Set throttle and throttle trim to the off position, prime the system by pushing the button on the I/O board so both lines are primed with kerosene.
- Go to the test menu and run the pump by pressing the check mark. Fuel will begin to flow since the pump test voltage is set to 1V. Using the down key, reduce this voltage until the fuel just drips out of the fuel lines. Write this voltage down. Change the value back to 1V and exit the menu
- Go to menu 41 and enter the value you recorded but add 0.05V to it. Select the check mark to accept.
- Connect the kerosene lines to the turbine and burner

Priming the Kerosene line

Priming the kerosene lines is only necessary on the first start or if the fuel tanks and lines are empty after running out of fuel following a flight.

- Disconnect the kerosene lines from the turbine and burner and place them in a container so fuel does not spill
- Set the throttle and throttle trim to the off position, prime the system by pushing the button on the I/O board so both lines are primed with kerosene
- Connect the kerosene lines on the turbine and burner

First Start

- Make sure fuel lines are connected and primed as described above
- Make sure all the parameters are set as described above

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- Ensure a fire extinguisher (CO2 or equivalent) is accessible in case of emergency
- Initiate a start as you would normally start your Behotec turbine system (refer to operation above for details on the 4 phases)

Troubleshooting

If the Turbine does not start:

- Bad battery voltage under 9 volts - change battery
- Start-up aborted (phase 1) after the turbine spins - No fuel at the burner, the ECU cannot detect any acceleration (about 5,000rpm) no temperature increase (about 40°). Prime the kerosene and the burner lines
- Start up aborted (phase 1) after the turbine spins. No fuel at the burner, the ECU cannot detect any acceleration (about 5,000rpm) no temperature increase (about 40°) - Set the pump start voltage a little bit higher
- Normal Start-up, at the end of the heat-up phase no temperature increase and no acceleration (phase 3) - No fuel or fuel flow too little on the vaporiser sticks. A: Increase the kerosene valve setting by 5 ~ 10% B: set the pump start voltage a little bit higher
- Normal Start-up, at the end of the heat-up phase only a little temperature increase and acceleration (phase 3) with a lot of smoke - Not enough fuel flow to the vaporiser A: Increase the kerosene valve setting by 5 ~ 10% B: set the pump start voltage a little bit higher
- Start up (phase 1) and (phase 2) with heavy flames and a lot of smoke - Pump start voltage much too high or the setting in menu # 61-3 is wrong – Reduce pump start voltage and/or correct menu 61-3