Manual & ENGINE LOG (V 2.17)

Olympus HP ©

- ☐ Electric start engine
- ☐ Air start engine

Serial number N L

AMT Netherlands

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The table of contents serves as a means to check the completeness and validity of this owners manual. With each update of this manual, the revised pages will be sent to the owners, if necessary.

Each page can be recognised in the header by:
- chapter number and description
- page number in the chapter
- revision number

Text pages have been included as right-facing pages.
Pages with drawings have been included as left-facing pages and have been inserted opposite the relevant text, when possible. Pages with drawings have a reference to the matching text page in the header.

1.1 Profile of Advanced Micro Turbines

Advanced Micro Turbines develops small gas turbines for the propulsion of radio-controlled flying airplanes, remote heat/power generators, and auxiliary power units.

The company originates from Jet Team Holland, which has been giving flight demonstrations with jet propelled models since 1987, both in the Netherlands and abroad.

Our first turbojet, the Pegasus MK-1, which was developed in 1991 and 1992 had a thrust of 90 Newton at 90,000 rpm. In 1995 the Olympus was developed with a thrust of 170 Newton and further refined specifications. AMT's latest version of this engine the Olympus HP now provides a thrust of 230 Newton at 108,000 RPM.

The production version of the Olympus HP turbojet has been developed from knowledge gained during design and operation of the Mercury HP, Pegasus HP and Olympus motors, and it has specifications and performance which have never been achieved before in a motor of this size.

In 2004 the **E**lectric **S**tart version of the Olympus HP was developed together with a new type of ECU capable of fully automatic start with our own newly developed electric starter.

All materials used in all AMT's turbojets are carefully selected according to extensive calculations and operational tests, and our stringent quality controls.

1.2 Description of Olympus HP and HP ES

The Olympus HP has been constructed from a single radial compressor and an axial flow turbine. The Olympus HP owes much of its excellent performance and superb power/weight ratio to this turbine wheel which was designed by AMT staff especially for our motors. The time required for the turbojet to spool up and down is also positively influenced by the low mass of the axial turbine wheel, taking less than 4 seconds and from min. to max. rpm and only 3 seconds from max. rpm to min. rpm.

The combustion chamber is of the annular type, which is fitted with a unique "low pressure" fuel system, also developed by AMT Netherlands. Both the front and the rear hybrid bearings are also lubricated and cooled by the fuel system, and therefore the motor requires no separate lubrication system or oil tank.

The turbine is protected from misuse and accidental damage by means of a microprocessor based controller (ECU) which regulates the maximum performance within preprogrammed software limits. The ECU is fully automatic and needs no adjustment by the operator.

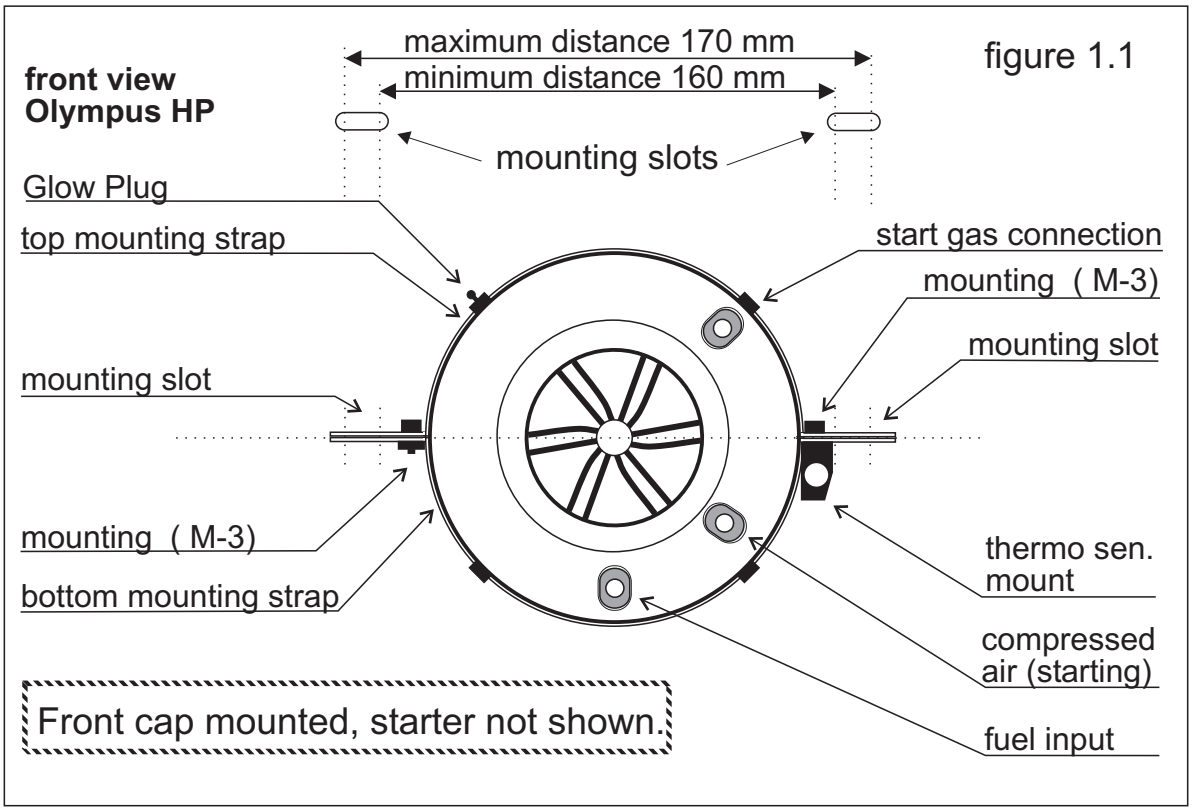


figure 1.1

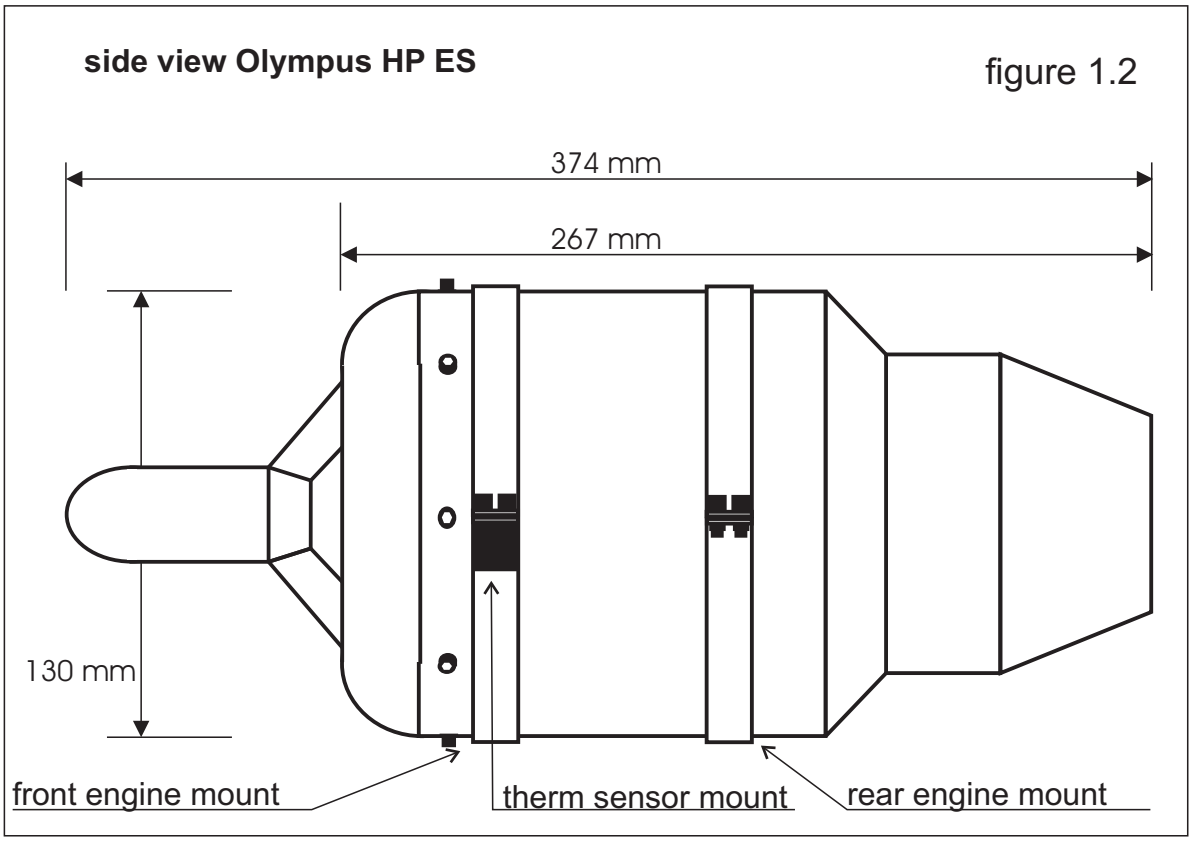


figure 1.2

1.3 Technical data for Olympus HP and HP ES* (*Electric Start)

All data at S.T.P: 15°C and 1013 mBar (59°F and 29.91 in)

Diameter	130	mm	5.1	inch
Length (Air start)	267	mm	10.5	inch
Length (Electric start)	374	mm	14.7	inch
Weight turbine (Air start)	2475	gr	5.4	Lbs
Weight turbine (Electric start)	2850	gr	6.3	Lbs
System airborne weight ***** (Air start)	3150	gr	6.9	Lbs
System airborne weight ***** (Electric start)	3795	gr	8.35	Lbs
Thrust @ max. RPM	230	N	51.7	Lbf
Thrust @ min. RPM	10	N	1.8	Lbf
Pressure ratio @ max. RPM	4:1		4:1	
Mass flow @ max. RPM	450	gr/sec	0.99	Lb/sec
Maximum RPM	108,000		108,000	
Maximum allowed RPM	112,000		112,000	
Exhaust temperature	700	°C	1290	°F
Maximum exhaust temperature	750	°C	1382	°F
Fuel usage @ max. RPM	640	gr/min	22.5	oz/min
Fuel type	kerosene/paraffin/A-1/white spirit			

(* System airborne weight: engine ECU,pump,battery,solenoid valves,thermosensor,mounting straps)

For general turbine dimensions see half size drawings (figures 1.1 and 1.2) on opposite page.

*** DELIVERY FORM ***

Heistraat 89
5701 HJ Helmond
Phone : (INT+31) 492-545801
Fax : (INT+31) 492-550379

Engine number :
Fuel pump number :
HW number :
SW number :

Date of transport : .. - .. - 2008
Transport by : 0 TNT 0 DHL 0 FEDEX
Set complete : .....

number	article description		items
20350300	Olympus HP E-start engine	(engine->)	1
05890102	ECU electric control unit V.2	(cable -> 03 JR (Graup))	1
67420120	Olympus HP E-start gas container		1
89500308	Solenoid valve propane		1
89500309	Solenoid valve kerosine		1
89500340	CTF switch		1
25310105	Fuel pump Olympus	(pump ->)	1
27390107	Rear engine mount Olympus		1
27390106	Front engine mount Olympus		1
05030487	Accu pack nicad 12 volt / 1700 Mah.		1
05030510	Accu pack charge cable		1
05030513	Safety clip	(for RPM detector)	1
89500341	Glow plug connector Olympus HP E-start + extender		1
05400101	Thermo sensor (K-type)		1
05030101	Glow plug wrench		1
07031010	Glow plug		1
08440112	Turbine oil Shell		1
24890501	Manual Olympus HP E-start		1
24890503	Warranty card		1
04890601	2 x sticker		1
08470510	Festo PP3 Tube (3 meter)	(pump to engine, gas system)	1
08470511	Festo PP4 Tube (2 meter)	(fuel tank to pump)	1
08470520	Festo fuel filter	(between tank and pump)	1
05890111	Engine data terminal		1
05030515	E.D.T charge cable		1
05300151	Telemetry software V2 ecu + cable		1

2.1 Turbine

The kit consists of a turbine, manufactured with the utmost precision and care, and it is important that you, as a user, treat the motor as a precision instrument.
Each new motor has undergone 3 test runs before delivery, during which the running capacities and performance have been checked.

2.2 Electronic Control Unit (ECU)

The ECU is a control unit, controlled by a microprocessor, which is powered from the fuel pump battery. The control unit has two inputs which are connected to your radio control system, and also inputs for the Exhaust Gas Temperature (EGT) and the RPM of the motor which are used to make sure that the motor cannot exceed the maximum design RPM or EGT.

2.3 Fuel pump

The fuel pump is a type built from two gear-wheels running in a high-precision chamber. Therefore it is very important that you use a fuel which is absolutely clean and pure, in order to prevent blockages in the fuel system. Taking the pump apart can lead to irrepairable damage.

2.4 Owners Manual

It is very important that you study this manual closely before installing or starting the motor, in order to understand the Olympus HP (ES) and its systems properly.
If there are updates of this manual which are important for safety or operation, then AMT will make sure these are sent to you.

2.5 Sundries

The kit also contains a number of additional items such as tubes, Festo connectors, battery charging cables etc. We recommend that you only use tubing from "FESTO" to fit onto the motor and pump connectorions, as this guarantees that everything fits properly. If the availability of FESTO components is a problem for you, then please contact AMT NL or your AMT dealer for supplies.

The total quantity of the delivered goods is to be found in the packing list.

3.1 Fuel

Several types of fuel can be used. However, AMT NL recommends that you stick with a fuel type once it has been chosen. It is important to get information about the local availability of your choice of fuel before making this decision.

Fuel types

1: JP-4/Kerosene	This fuel type is used in the military aviation.
2: Paraffin	This fuel type is mostly used in oil stoves.
3: Jet A-1	This fuel type is used in commercial aviation.

The Olympus HP and HP ES also uses the fuel for lubrication, so the fuel must be pre-mixed with 4,5% Aeroshell 500 turbine oil before use. This oil takes care of the lubrication during start-up and power-down sequences. When a power-down is activated the fuel flow stops and each of the above fuel types will vaporise in the hot turbine. At that moment the oil takes care of the lubrication. This remaining oil also lubricates the turbine during the next start-up sequence.

Important: Be sure that you use clean fuel, and always use a fuel filter in the tube between the external fuel supply container and the fuel tanks for the motor.

3.2 Starting gas

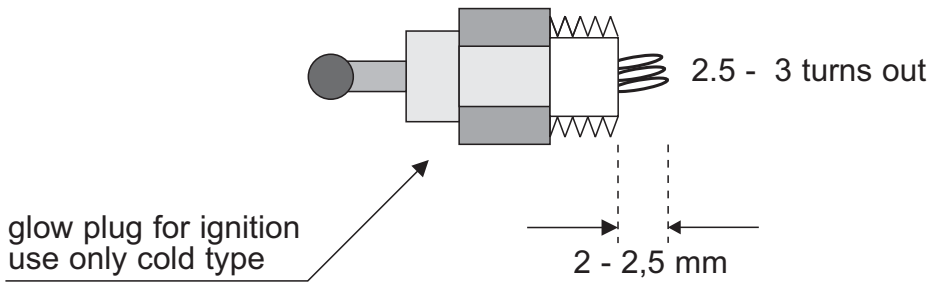
The starting gas used for the pre-heating of the motor is **propane**. This gas type is often used for hobby blowlamps and has a pressure of approx. 4 Bar at a temperature of 10°C. Starting using a mixture of butane/propane gas is not so reliable, especially in colder climates.

The external gas bottle has to be provided with a regulator valve that needs at least three full turns to be completely open. This is necessary so that you can control the amount of gas supplied when using it for starting the motor, and also during the filling of the internal gas container.

When you do not use the internal gas container, and use an external one for starting, make sure that the gas container is stable enough and cannot fall over during start-up, as the propane must be supplied to the motor in gaseous form for starting.

(NB: If the external propane container falls over it will supply liquid gas, which can be dangerous.)

figure 3.1
scale 3:1



Note: The glowplug in the Olympus HP engine is fitted with a brass “glowplug extender”, when the glowplug needs to be changed, replace the glowplug extender using a HEX wrench of 1.5 mm in size.

3.3 Compressed air

For the air start version of the Olympus HP you need compressed air with a pressure of 10-12 Bar, and starting will use approx. 50 litres per 5 seconds. The simplest way is to use a high-pressure air bottle (scuba diving tank) with a capacity of 10 litres, fitted with a 1st stage regulator set to 10 – 12 Bar. Normally these bottles are filled to a pressure of 200 Bar. Therefore with a 10 litre bottle you have 2000 litres of air, which is enough for 10-15 start-ups and cool-downs.

3.4 Ignition

The Olympus HP uses a normal model glow plug (type "cold") for ignition (Rossi R8 supplied). These are available in most hobby stores and must be modified as shown in figure 3.1. The easiest way to do this is by using a piece of bent 1mm steel wire, or a pair of tweezers.

These glow plugs are lit by connecting the right voltage. This is often indicated on the package, and is normally 1.5 or 2 volts. It is of the utmost importance that you are absolutely sure that the glow plug is functioning properly before you begin with the start-up procedure. With a defective glow plug you run the risk of too much gas in the motor, which might lead to a fire. When you have problems starting the engine, please check the glow plug first, it should be glowing very bright yellow.

Note: From ECU software version V23 and higher you will not get “start clearance” on the EDT display when the glowplug is faulty. However, when *all other* conditions for start clearance are OK (ie: EGT below 88 deg C, charged pump battery, shaft rpm less than 500) the ECU will *still* allow you to start the engine, using an external ignition source (such as a cigarette lighter). When you put the 3 position switch in the ‘start’ position the ECU will *still* try to start the motor, and proceed with the normal start-up sequence.

This is a useful feature in an emergency, such as during a competition when you only have a certain time to commence your scoring flight.

Warning: When using an external ignition source, like a cigarette lighter, please be extremely careful of the exhaust heat at ignition. Of course, this method is not recommended by AMT Netherlands, expect in emergency cases.

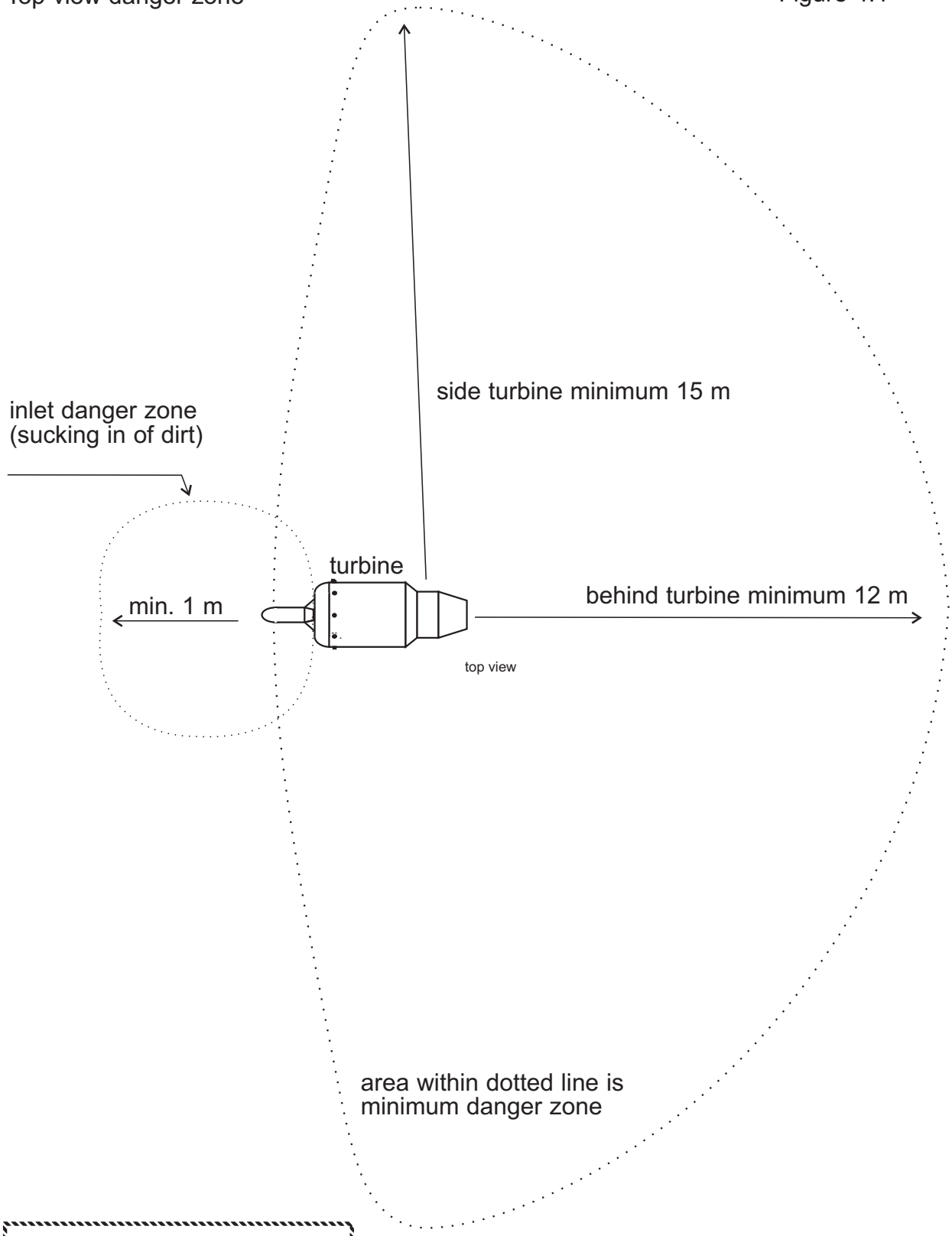
3.5 Fire extinguisher

Safety is of the utmost importance, so please make sure that you have a properly functioning fire extinguisher within reach, and take care that at least one of your assistants is able to handle it.

A fire extinguisher filled with CO2 or Halon is preferred, because these do not leave harmful residues in the turbine.

Top view danger zone

Figure 4.1



turbine and danger zone not drawn on same scale !

4.1 General

A turbine is a type of motor that needs more safety precautions than the average propulsion system, such as a ducted-fan unit.
Therefore it is of the utmost importance that the safety precautions mentioned below are taken into account.

4.2 Assistance

Make sure that you have at least one assistant when starting up the turbine. This assistant has to get acquainted with the turbine, just like you.

4.3 Handling the turbine

It is advisable to make a test stand to learn about starting and handling the turbine, before installing it in a model. You should make enough test starts in a "clean" space, or better still "outside", until you can handle the turbine properly and with confidence.

4.4 Danger zones

Figure 4.1 indicates which areas your assistant, and also bystanders, need to avoid.
In any case, do not start the turbine if there are people in these danger zones.

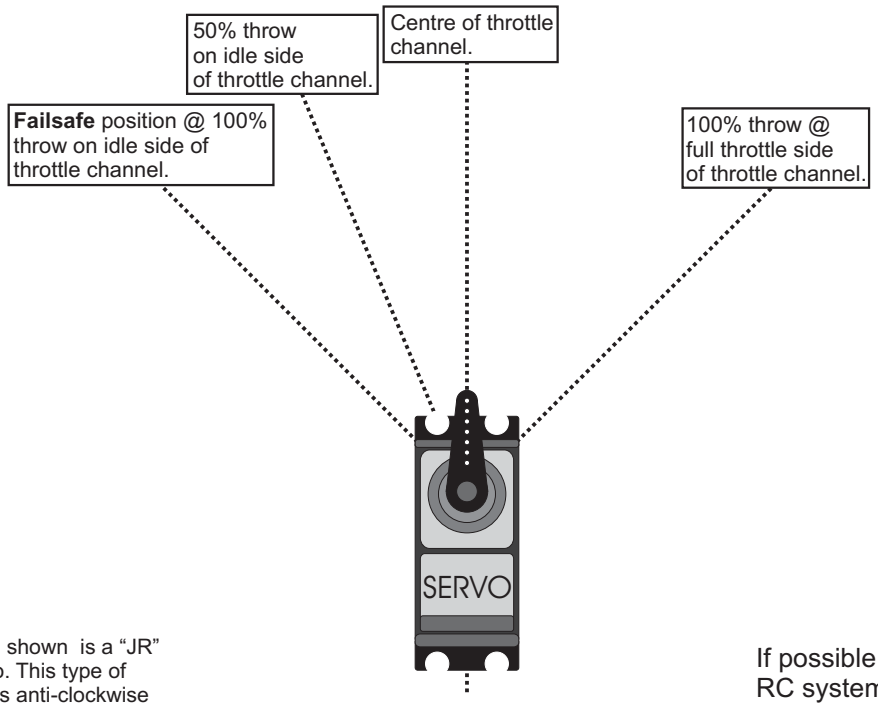
4.5 Noise production

A turbine mainly produces noise in the high frequencies. Often these noises are not experienced as annoying, but prolonged exposure may still harm your hearing, and especially as an operator you are intensively exposed to this noise. Therefore please wear sufficient hearing protection when running the turbine.

4.6 Liability

AMT Netherlands is not liable in any way for whatever damage or injury, resulting from the use of the Olympus HP and Olympus HP ES turbine.

figure 5.1



Note:
The servo shown is a “JR” type servo. This type of servo goes anti-clockwise at an input with a pulse with of 1.0 milli second.

If possible at your RC system; switch “off ” trim when using dual-channel operation.

Version 2 ECU.

figure 5.2

5.1 Description of ECU

The Electronic Control Unit (ECU) controls the gasturbine within the safe software limits, which are pre-set by **AMT Netherlands.**

5.2 Which radio system, PPM or PCM are you going to use.

In general there are 2 transmission systems available on the market, the older transmission system is called PPM, PPM stands for **P**ulse **P**osition **M**odulation and there is a PCM, PCM stands for **P**ulse **C**ode **M**odulation. When you decide to use a PPM system please go to chapter 5.3, as the failsafe option is not available in a PPM system.

If you are going to use a PCM system you can use the failsafe option of this type of ECU. AMT advises to use a PCM system.

5.2.1 Using a PCM system

When you are using a PCM system it is necessary to study the failsafe options of your radio first, best is to power up the TX, connect 2 servo's and a battery to the receiver and get used to the radio. By doing this the operator can observe, visually, by the movement of the servos, the signals going to the ecu.

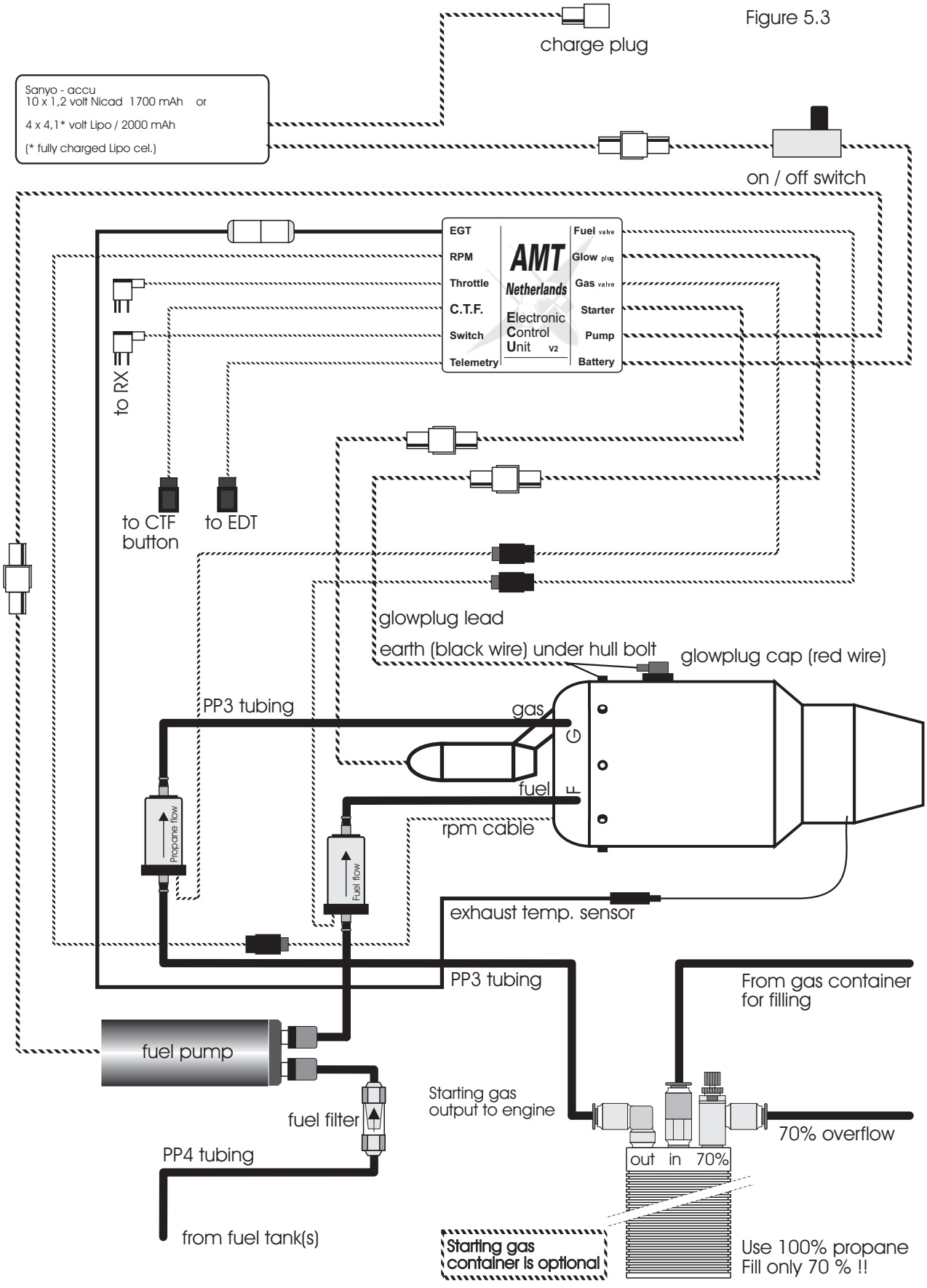
Program the throw for throttle and switch channel, if you are using dual channel operation, to 100% throw on both sides of the channel. If you are going to use dual channel operation switch off the trim of the throttle channel, if this is not possible leave the trim in the middle position and do not use it during calibration or later when you are operating the turbine.

Now go to the failsafe menu of your transmitter and set the failsafe function for your throttle and program the channel to go to "idle" in case of a failsafe condition.
Check with a servo connected to the receivers throttle channel if the servo moves to the idle position in case of a failsafe condition. You can generate a failsafe to switch off your transmitter, at switching on the transmitter the servo should move again to the actual throttle position.

After the failsafe is programmed and tested the throw of the throttle channel has to be adjusted to 50% throw on the "idle" side of the throttle channel, the other side of the channel the "full throttle side" must remain on 100% throw.

Please check the throttle channel with a servo connected to the receiver and check if the failsafe indeed goes 10-20 deg further that the idle position. Later the ECU will detect this failsafe position and will shutdown the engine after the programmed failsafe time in the ECU. As standard, this failsafe timer is set to a 1-second delay.

Figure 5.3


charge plug
Sanyo - accu
10 x 1,2 volt Nicad 1700 mAh or
4 x 4,1* volt Lipo / 2000 mAh
(* fully charged Lipo cel.)
on / off switch
EGT
RPM
Throttle
C.T.F.
Switch
Telemetry
AMT
Netherlands
Electronic
Control
Unit v2
Fuel valve
Glow plug
Gas valve
Starter
Pump
Battery
to RX
to CTF button
to EDT
glowplug lead
earth (black wire) under hull bolt
glowplug cap (red wire)
PP3 tubing
gas
fuel
rpm cable
Propane flow
Fuel flow
exhaust temp. sensor
PP3 tubing
From gas container for filling
fuel pump
Starting gas output to engine
fuel filter
70% overflow
out in 70%
PP4 tubing
from fuel tank(s)
Starting gas container is optional
Use 100% propane
Fill only 70 % !!

5.3 Definition of input channels

The ECU uses as inputs:

- A: Exhaust gas temperature (EGT).
- B: Rotation speed (RPM).
- C: Throttle channel (receiver).
- D: CTF input and ASU control for air start engines
- E: Switch channel (receiver).
- F: Nicad 12,0 volt (10cell) / 1700 mAH or
  Lipo 16,4 volt (4 cell) / 2000 mAH.

The outputs present are:

- A: Fuel valve connection.
- B: Glow plug connection.
- C: Gas valve connection.
- D: Electric starter connection.
- E: Fuel pump connection.
- F: Telemetry, also for EDT connection.

5.3.1 Temperature input A

To this input channel a type K (Ni-Cr/Ni) thermo-couple must be connected.
The end of the thermo-couple has to be mounted in the appropriate place in the exhaust nozzle of the turbine. (1 - 2 mm inside the exhaust nozzle)
Be careful of the polarity of the thermo-couple, the plug and socket have one wide contact and one narrow contact.

5.3.2 RPM input B

To this input channel, which records the rate of shaft rotation, connect the plug from the RPM sensor. It is recommended that you use the supplied safety clip to properly fix the RPM connector. If necessary an extension cable is available. (JR type, max. 100cm)

5.3.3 Regulator channel input D

This input channel is connected to the receiver channel, which is controlled by the throttle stick of your transmitter.

5.3.4 CTF input E

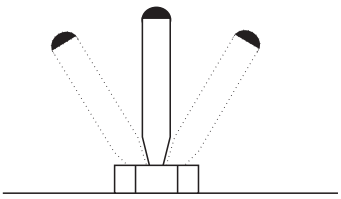
5.3.4.1 CTF input E (Dual channel operation)

This input channel is to “teach” the ECU the pulse width of your radio system.
To program the pulse width connect the CTF lead (Futaba plug) to the CTF input on the ECU, and leave the JR lead of the CTF switch unconnected.

figure 5.4

3 position switch on transmitter to control the switch channel for dual channel operation.

position 1 position 2 position 3



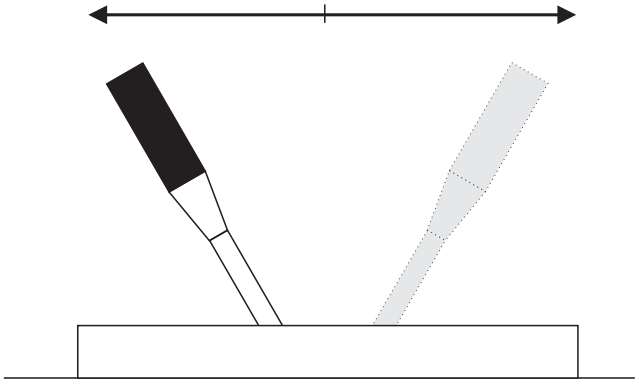
side view switch on transmitter

pos.	tone	function
1.	low	system off
2.	middle	power down seq.
3.	high	starting & running

figure 5.5

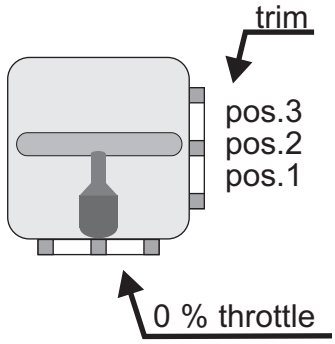
Throttle stick on transmitter which controls the regulator channel (input D)

min. RPM 50 % RPM max. RPM



Side view transmitter throttle stick

Stick	RPM	Thrust
min.	35.000	< 8 Newton
50 %	70.000	~ 70 Newton
max.	108.000	>230 Newton

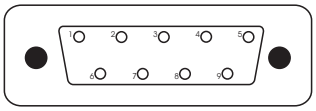


Trim position when CTF active

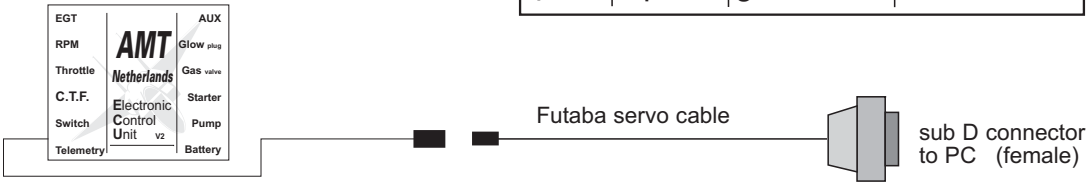
pos.	tone	function
1.	low	system off
2.	middle	power down seq.
3.	high	starting & running

figure 5.6 (cable is optional)

Rear view 9 pol. connector to P.C.



25 pin sub D	9 pin sub D	description	Futaba
pin 3	pin 2	RX	black
pin 2	pin 3	TX	white
pin 7	pin 5	ground	red



To program two channel motor operation follow this sequence:

1 Connect the throttle lead to the correct channel on your receiver.
2 Connect the switch lead to the correct channel on your receiver.
3 Switch “on” Transmitter and receiver.
4 Push down the CTF button, and hold it pushed down.
5 Switch “on” the ECU, after a few seconds you will hear a beep.
6 Release the CTF button.
7 Put the 3 pos. switch in the “Off” position and push and release the CTF button. (ECU will giving a beep for confirmation)
8 Put the 3 pos. switch in the “Middle” position and push and release the CTF button. (ECU will giving a beep for confirmation)
9 Put the 3 pos. switch in the “Start” position and push and release the CTF button. (ECU will giving a beep for confirmation)
10 Put the Throttle stick in the “Idle” position and push and release the CTF button. (ECU will giving a beep for confirmation)
11 Put the Throttle stick in the “Max throttle” position and push and release the CTF button. (ECU will giving a beep for confirmation)

Directly after program sequence no.11 the ECU will give a confirmation beep that all pulse widths are stored in the ECU. When no changes are made in the programming of throttle or switch channels in your transmitter you do not have to do this sequence again before each motor run.

You can now disconnect the CTF cord, and it is best to store it in your Transmitter case or to mount it in your model.

When you are using a PCM system you can check the failsafe routine by switching OFF your transmitter.

When the failsafe time has passed the ECU will sound with a **high/ low** beep tone. This failsafe beep tone has to be reset like an engine error, see chapter 5.5.2

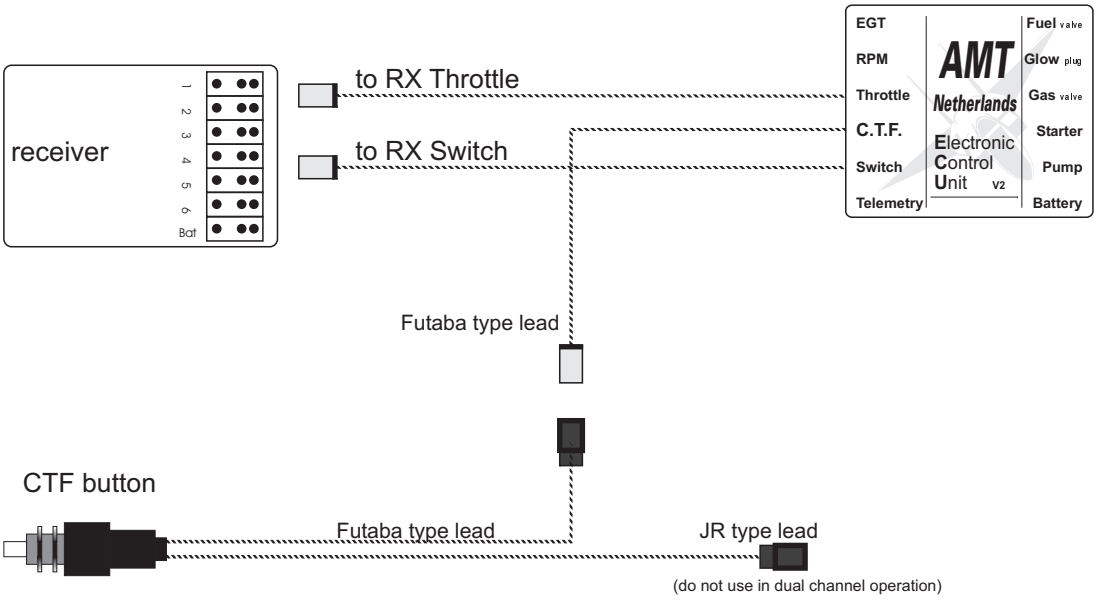
Note:

AMT Netherlands recommends using the dual channel motor operation because it gives the best possibilities for operation of the turbine, meaning a separate switch for starting and stopping the turbine.

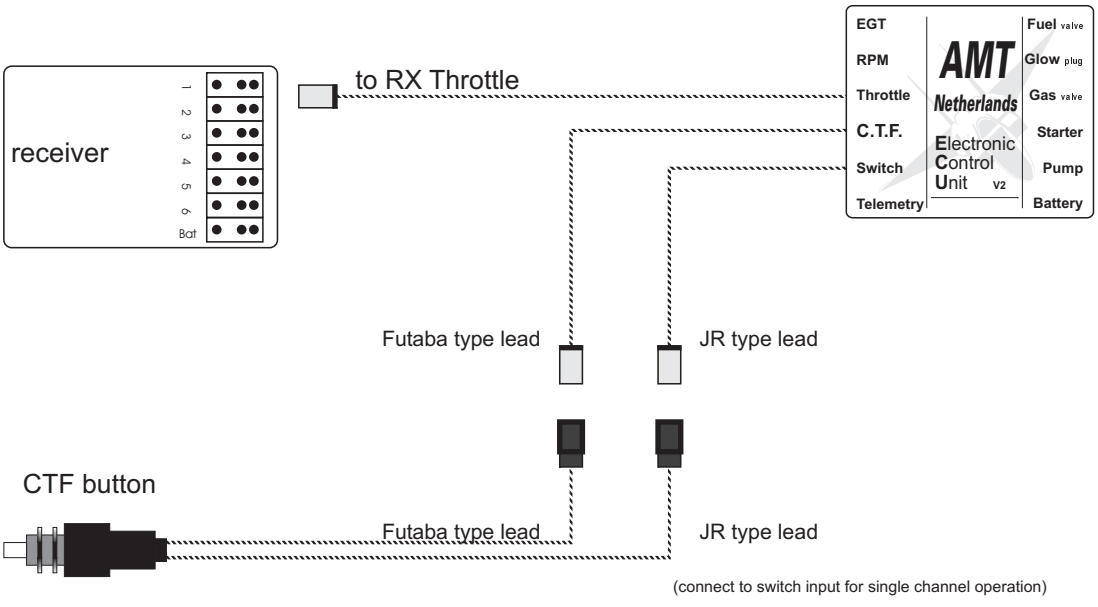
However if you fly a complicated model and you have only one channel left for operating the turbine you can use the combined throttle function as described in the next paragraph. With this combined throttle function the trim lever on your throttle channel acts as the three-position switch as described above.

When using the single channel function it is probably better to use a transmitter with a mechanical throttle trim rather than an electronic trim. A mechanical trim allows rapid and accurate positioning of the trim switch, important when the trim position is used to control engine functions as in single channel operation.

Wiring diagram of CTF button for dual channel operation. figure 5.7



Wiring diagram of CTF button for single channel operation. figure 5.8



5.3.4.2 CTF input E (Single channel operation)

This input channel is to “teach” the ECU the pulse width of your radio system.

Connect the CTF lead (Futaba plug) to the ECU and plug the other side of the CTF lead (JR plug) to the switch channel input of the ECU.

Note: The moment you connect the switch channel input of the ECU into the JR side of the CTF lead, the ECU operates in single channel mode. (**C**ombined **T**hrottle **F**unction)

To program the single channel operation follow this sequence:

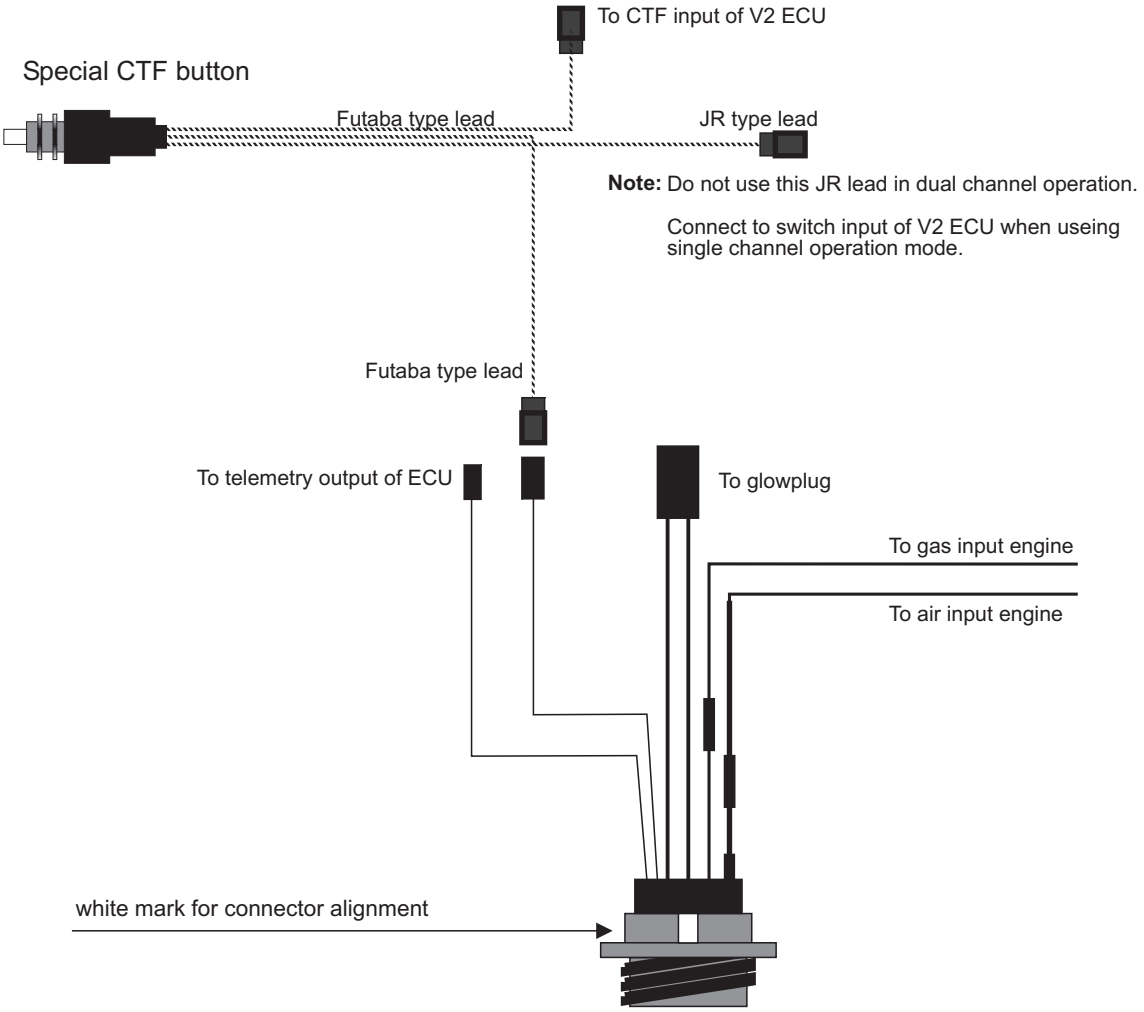
1 Connect the throttle lead to the correct channel on your receiver.
2 Connect the switch lead on the ECU to the CTF lead (JR plug).
3 Switch “on” Transmitter and receiver.
4 Push down the CTF button, and hold it pushed down.
5 Switch “on” the ECU after a few seconds you will hear a beep.
6 Release the CTF button.
7 Put the throttle stick in the “Idle” position and put the trim of your throttle channel on your transmitter in the “Off” position which must be in the same direction as the “idle” position of your throttle stick and push and release the CTF button. ECU will give a beep for confirmation.
8 Put the trim of your throttle channel on your transmitter in the “Middle” position and push and release the CTF button. ECU will give a beep for confirmation.
9 Put the trim of your throttle channel on your transmitter in the “On” position which must be in the same direction as the “full throttle” position of your throttle stick and push and release the CTF button. ECU will give a beep for confirmation.
10 Leave the throttle stick in the “Idle” position and push and release the CTF button. ECU will giving a beep for confirmation.
11 Put the throttle stick in the “Max throttle” position and push and release the CTF button. ECU will give a beep for confirmation.

Directly after program sequence no.11 the ECU will give a confirmation beep that all pulse widths are stored in the ECU. When no changes are made in the programming of throttle or switch channels in your transmitter you do not have to do this sequence again before each motor run. You must leave the CTF cord connected to the ECU, and it should be mounted in a safe place in the model.

Note:
Be sure you have enough “throw” on your throttle trim when your throttle stick is set in the “idle” and in “max” throttle positions. If you are not sure check the throw with a servo connected to your receiver throttle channel.

The trim lever of your throttle channel now acts like a three position switch when your throttle stick is at the “idle” position. Best is to go to idle with your throttle stick and only then use the trim for switching purposes.

Wiring diagram of special CTF button for **airstart engine** to use with an ASU. figure 5.9



Wiring diagram for **female ASU connector**, for use with Automatic Startup Unit

When you are using a PCM system you can check the failsafe routine by switching OFF your transmitter.

When the failsafe time has passed the ECU will sound with a high low beep tone. This failsafe beep tone has to be reset like an engine error, see chapter 5.5.2

5.3.4.3 CTF input E to operate Automatic Start-up Unit (air start)

For operating and air start engine together with an **Automatic Start-up Unit** the CTF input also controls the starting sequence of the ASU unit.
The instructions for wiring the ASU to the new V2 ECU will be included in the box with the with the Automatic Start-up Unit.

5.3.5 Switch channel input C

For two-channel operation this input must be connected to the receiver channel that is controlled by a 3-position switch on the transmitter. This switch is used to switch the turbine into 'off', 'power-down' and 'start-up/run' modes.
When you are using single channel operation this input must be connected to the CTF switch.

5.4 Definition of output channels

5.4.1 Fuel valve connection output A

This output must be connected to the (red) fuel solenoid valve. When you connect the pp3 tubes to the valve be careful of the correct flow direction, which is clearly marked on the valve with an arrow.

5.4.2 Glow plug connection output B

This output must be connected to the glow plug and “earth/negative” of the engine. Only use Rossi 8 glow plugs, as the high current of the ECU internal glow driver will destroy most other glowplugs. For the “earth” connection you should use one of the eight bolts of the engine casing.

5.4.3 Gas valve connection output C

This output must be connected to the (blue) propane solenoid valve. When you connect the pp3 tubes to the valve be careful of the correct flow direction, which is clearly marked on the valve with an arrow.

5.4.4 Electric starter connection output D

This output must be connected to the electric starter of the engine.

5.4.5 Fuel pump output E

The fuel pump is connected to this output channel with cables of a minimum cross-section area of 1,5 mm^2. The maximum recommended length of cable from the fuel pump to the ECU is 50 cm.

5.4.6 Serial port output F

This output can be connected to the **E**ngine **D**ata **T**erminal or to the serial port of a personal computer, which allows the input data to be visible on the screen. The telemetry software is available from your dealer or direct from AMT Netherlands.

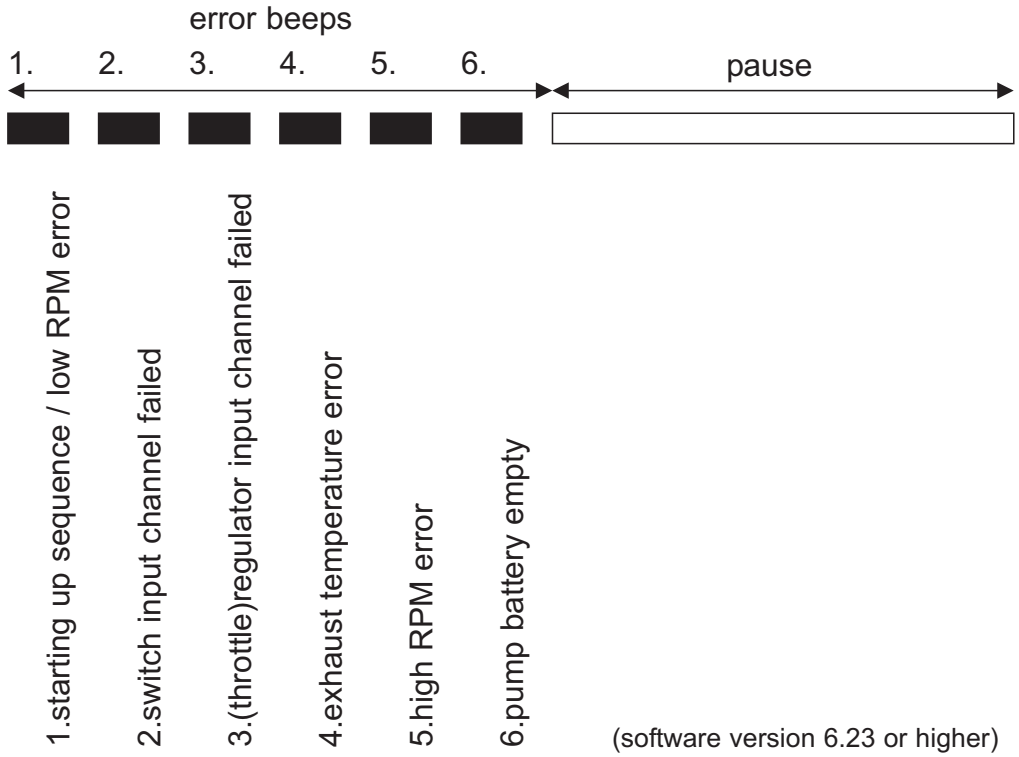
5.5 Buzzer

5.5.1 Buzzer beeps

The ECU has a built in buzzer which functions as an indicator of the actual state of the system. The different kind of beeps are:

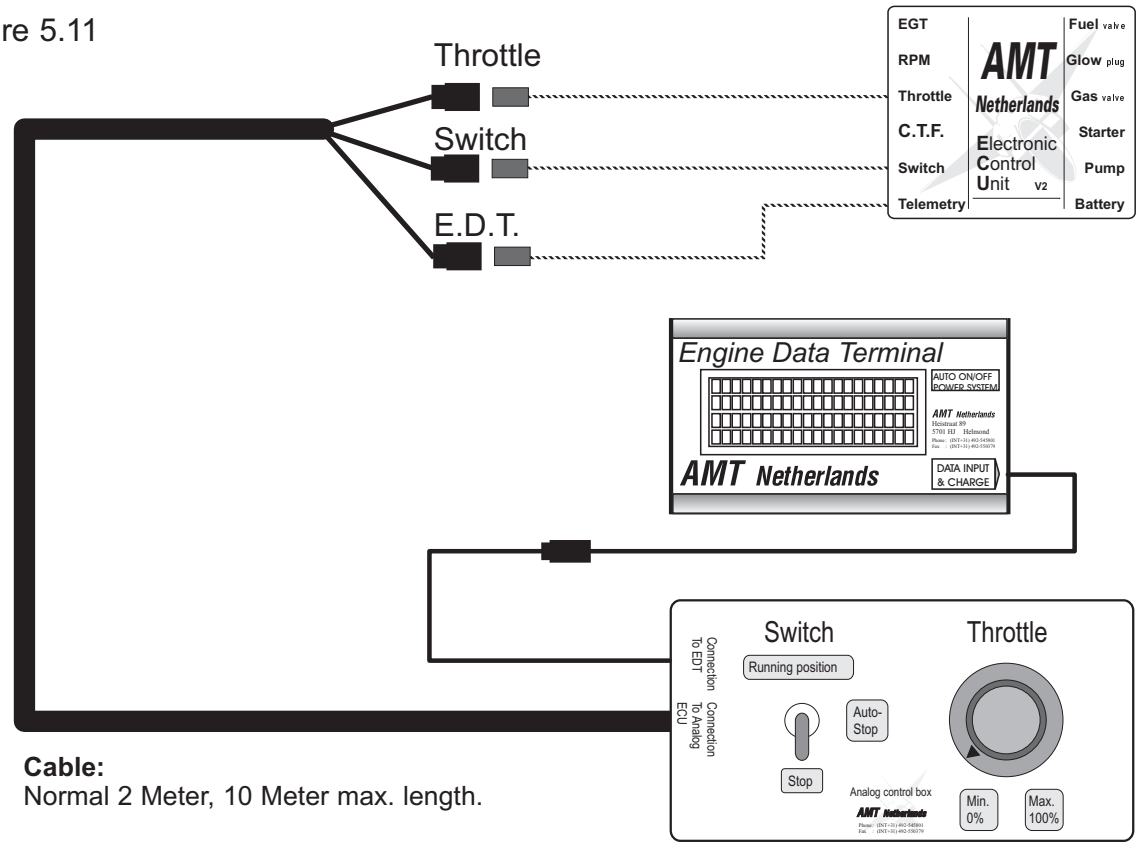
OK beep:	This beep is a low pitch tone, immediately followed by a high pitch tone.
Starting beep:	When you activate the starting sequence you will hear a *series* of 5 beeps, after the fifth beep the starting sequence will take place.
No radio beep:	This beep is a low pitch tone with short intervals. It occurs when no switch channel is connected, or when the receiver is off (self resetting).
No start-up beep:	This beep is a high pitch tone with short intervals. It occurs when you attempt to start up your engine and the exhaust temperature is too high or thermo-couple is disconnected (self resetting).
Failsafe beep:	This beep is a high / low pitch tone. It occurs when the failsafe condition of the ECU is active.
Error beep:	This beep occurs when there is a system error. It consists of six short beeps with a high or low pitched tone. The high or low pitched tone indicates a non-fault, or Fault, condition. The position of the low pitch tone in the six beeps indicates the kind of error. This beep is not self resetting!

figure 5.10



(software version 6.23 or higher)

figure 5.11



Cable:
Normal 2 Meter, 10 Meter max. length.

position 1: start-up sequence error or low RPM error.
position 2: switch input channel failed.
position 3: regulator input channel failed.
position 4: exhaust temperature error.
position 5: high RPM error.
position 6: pump battery empty.

When an error occurs the type of error will be displayed on the bottom line of text on the EDT. When you reset the ECU error (5.4.2) also the error message in the EDT will be removed from the bottom line.

5.5.2 Resetting the error beep.

When an error beep occurs, it must be reset before normal operation can proceed.

Resetting errors for dual channel operation.

To reset an error beep you must put the 3-position switch on the transmitter into the switch into the ‘off’ position (low pitch tone) and put the throttle stick into the full throttle position (high pitch tone). For a description of controls see manual section 7.2.

Also switching the ECU power off will reset the error message.

Resetting errors for single channel operation.

To reset an error beep you must put the throttle trim on the transmitter into the ‘off’ position (low pitch tone) and put the throttle stick into the idle throttle position (low pitch tone). Now push the CTF switch for 2-3 seconds to reset the error message.

For a description of controls see section 7.2 of the manual.

Also switching the ECU power off will reset the error message.

5.6 Analog ECU and control box.

AMT Netherlands can supply an “analog “ ECU and control box, this type of ECU is often used when the turbine engine is used stationary in for example a university.

With this ECU you do not need to use an RC equipment to operate the engine, this ”analog” ECU works except for the 2 inputs, throttle and switch, the same as the “normal” ECU. For a description of controls see figure on the left.

5.7 Extra features.

From software version **V24** and higher this Version 2 ECU has several options which are very useful especially when you are installing the system into a jet model.

As mentioned above these options are available in Version 24, probably higher versions will have more features as mentioned below. To know which version is available at this moment you can send an E-mail to versioninfo@amtjets.com, the AMT Netherlands E-mail server will send an E-mail with the current version number and its extra features in a list like below.

10%	Not in use at this moment.	
20%	Not in use at this moment.	
30%	**Glow plug switches on.**	(will switch on glow plug.)
40%	Not in use at this moment.	
50%	**Priming function.**	(will open fuel valve and activate fuel pump.)
60%	Not in use at this moment.	
70%	Not in use at this moment.	
80%	**Activation of starter motor .**	(will activate electric starter.)
90%	**Clutch check.**	(will activate clutch check, on/off for 0,5 second interval.)
100%	**Quick cooling function.**	(will activate speed-cooling* function.)

*At activating the quick cooling function, the E starter motor will keep the turbine shaft continuously spinning, even with released CTF button, until cool-down temperature is reached. A timeout of 1 minute will stop the E-starter in case of a damaged EGT probe.

The above features only with the ECU working in the dual channel mode, because the 3-position switch and the throttle stick have its unique position. To find an exact position of the throttle stick an **E**ngine **D**ata **T**erminal or a computer with our Telemetry program is necessary to use the above features.

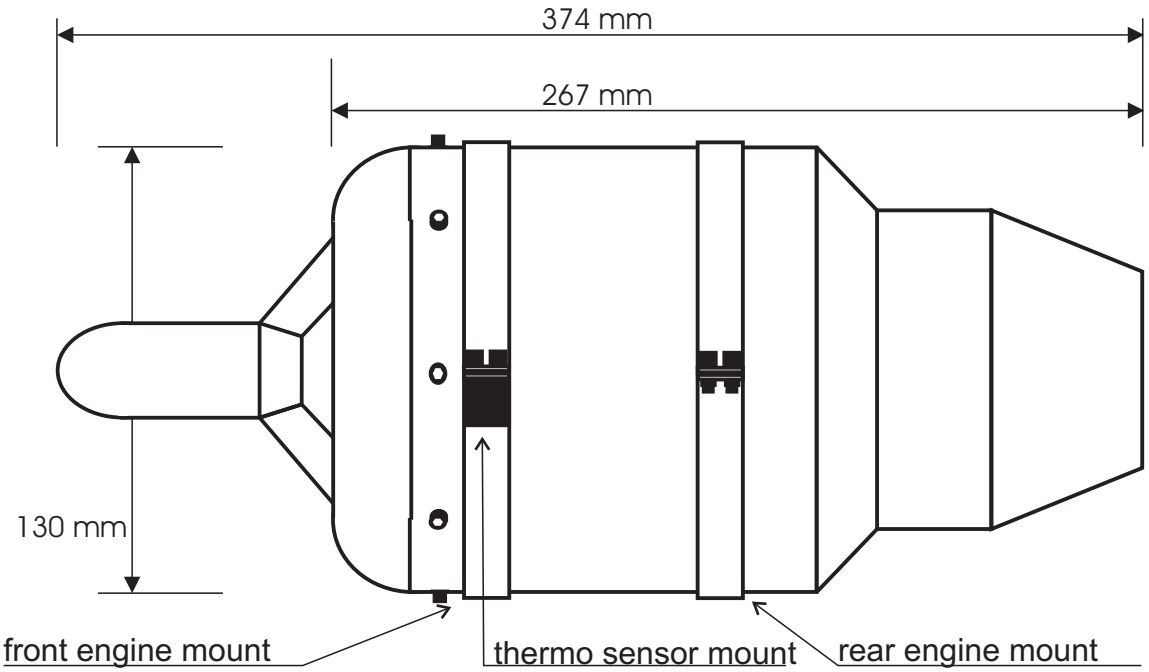
To activate one of these features please handle as follows:

- Switch on the TX, RX and the ECU.
- Calibrate the ECU as described in chapter **5.3.4.1** for dual channel operation, when ECU was already in dual channel operation you do not have to do this again.
- Put the 3 position in the “off” position.
- Put your throttle stick the desired position. (e.g. 50% for the priming function).
- Now push the C.T.F. switch, after 2 seconds the selected feature will be activated.
- Releasing the C.T.F. switch will deactivate the function.

When there is a function which would be useful and not available in the above list please send us an E-mail with a description of its function.

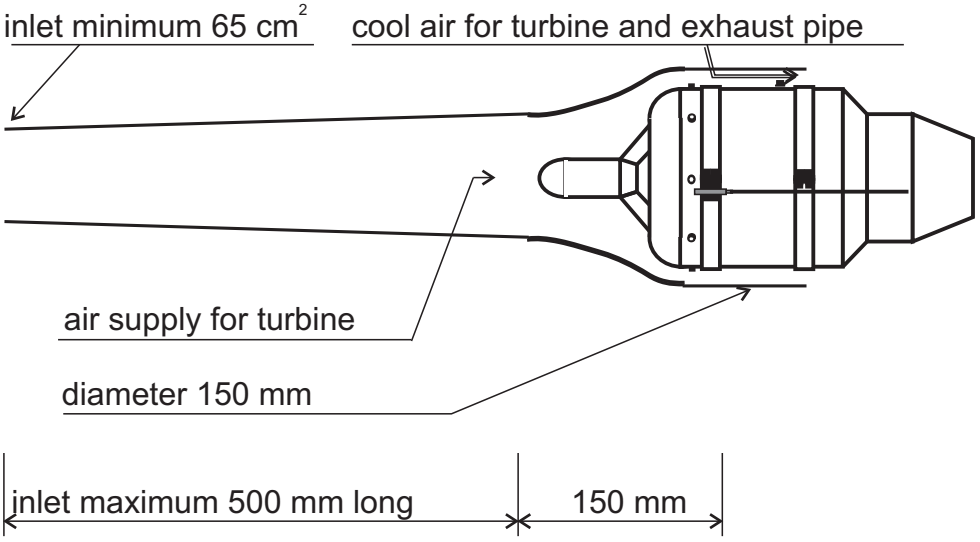
side view Olympus HP ES

figure 6.1



inlet shape

figure 6.2
scale 1:4



6.1 Dimensions of Olympus HP E-start.

Figure 6.1 shows in scale 1:2 the dimensions of the Olympus HP ES. Note that the 130mm dimension is the max. diameter of the casing, and does not include the mounting brackets and external connections etc.

6.2 Position of Turbine.

The Olympus HP ES should be mounted in such a way that the fuel connection is approximately at the bottom of the engine (see figure 1.1, chapter 1).

Positioning of the turbine behind the 'Centre of Gravity' of the model is usually preferable because then the exhaust ducting does not need to be unnecessarily long. You also save space at the 'Centre of Gravity' position, which is the optimum position for the fuel tanks. You must ensure a minimum clear distance of 10mm all around the turbine casing, between it and the bypass ducting (if used) or any bulkheads or formers in the model. A continuous air stream all around the motor must be maintained for proper cooling.

6.3.1 Inlet shape and dimensions.

The Olympus HP ES has an inlet of 64mm in diameter. This is equal to a surface area of 32,15 cm^2. The air inlet duct of your model needs a minimum area of 65 cm^2 (see figure 6.2). In case the total inlet length is more than 50 cm, then it is recommended to use an inlet area of at least 85 cm^2.

6.3.2 Air inlet duct.

The air inlet duct to the Olympus HP ES may not have sharp angles or edges, these should be smooth and aerodynamic. A bad aerodynamic shape, and/or not enough air flow, will have a negative influence on the Olympus HP ES, and this will result in a higher exhaust temperature and a higher noise level on the inlet side of the engine.

As material for the inlet and engine bypass duct we recommend the use of a high quality temperature-resistant epoxy resin, which is resistant to approximately 100 C° (after curing), because the front of the motor casing has a temperature of approx. 100 C° at full power. When the turbine is running the continuous air stream between the outside of the motor casing and the inside of the fibreglass ducting around the motor (which should have an inside diameter of 150mm) is being cooled properly.

The moment the motor is switched off, the most critical phase for the inlet and engine ducting begins, because there is no cooling anymore. A small external electric fan (like that used for cooling inside PC’s) can be applied to the inlet duct to assist in cooling the turbine and ducting, if necessary.

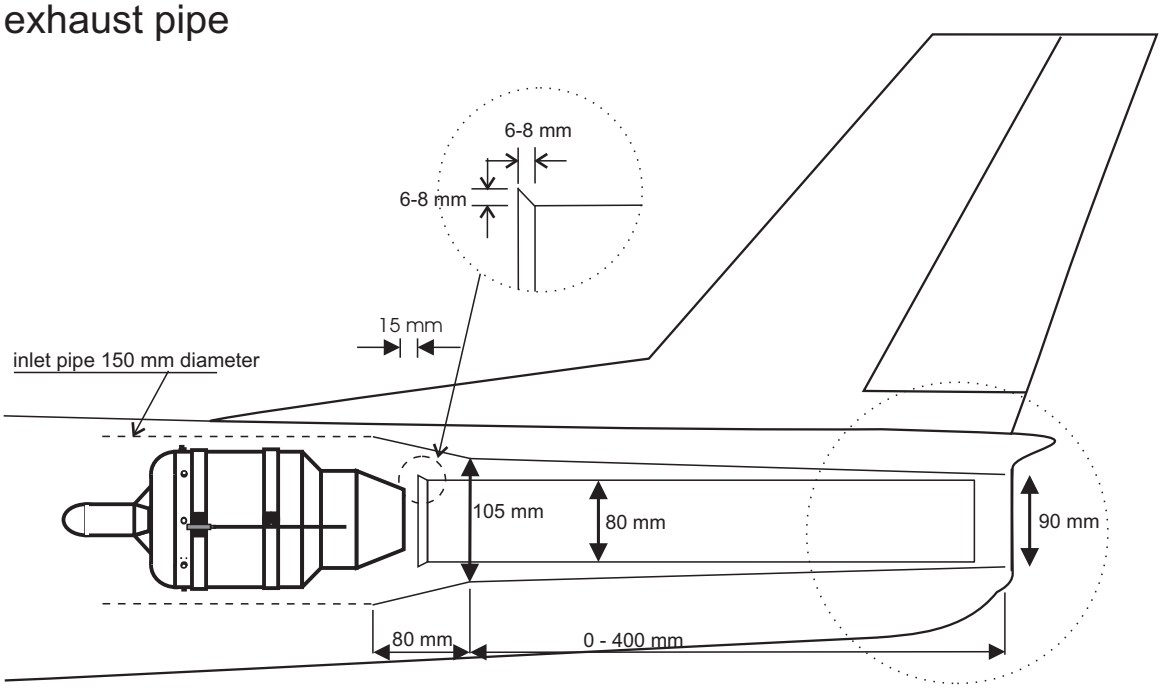


figure 6.3

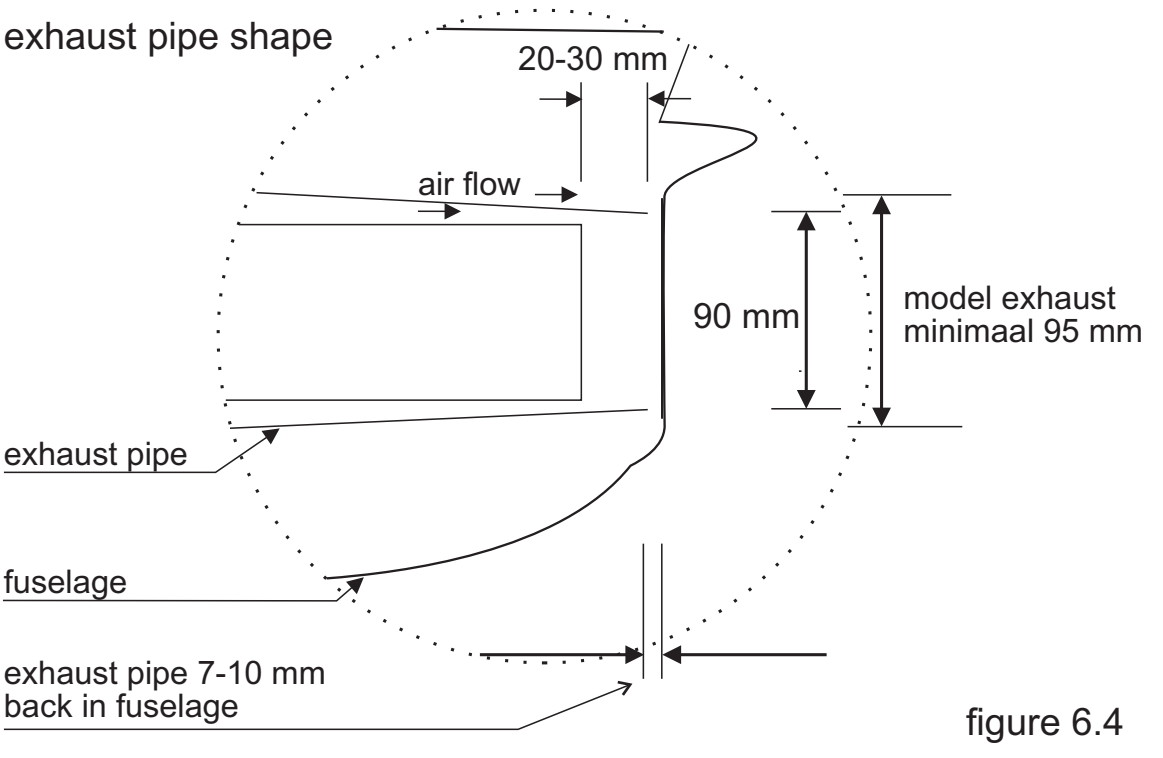


figure 6.4

6.4.1 Exhaust duct and dimensions.

Figure 6.3 shows an example of the dimensions for a cylindrical dual-tube exhaust duct with a total length of 480 mm. These typical dimensions can be used for ducts with an internal tube length of between 10mm and 400mm. (see figure 6.3).

As material for the inner tube you can use a heat resistant CrNi steel with a gauge of 0.15 to 0.3mm. Stainless steel type 316, or inconel 600, are some useful types. With these materials you can produce excellent spot-welded connections, but connections with steel pop-rivets can also be used.
The outer tube can be made from the same material, but it only needs to be 0.1 or 0.15mm thick (to save weight) because it does not have to withstand such high temperatures. Some customers have also successfully used 0.2mm thick aluminium for the outer tube.

6.4.2 Exhaust duct cooling.

Because the Olympus HP ES blows exhaust gases into the inside duct tube at high speed, cold air from around the outside of the motor is also sucked into the inner tube, and this cold air mixes with the hot exhaust gases. In this manner the inner tube does not become warmer than 300 - 400ºC (see figures 6.3 and 6.4).

As the inner tube is mounted 20 - 30 mm inside the back end of the outer tube, cold air from around the outside of the engine is also sucked between the 2 tubes, and this also helps to cool the exhaust ducting and keep the inside of the plane cool. With this dual-tube exhaust duct design the outer tube does not become warmer than 60-90ºC (see figure 6.4).

Note that the outer tube should be mounted approx. 7 -10mm inside the back of the models fuselage (see figure 6.4), as this will also create a small negative pressure inside the fuselage which will give a positive airflow through the fuselage helping to cool it and the outer tube.

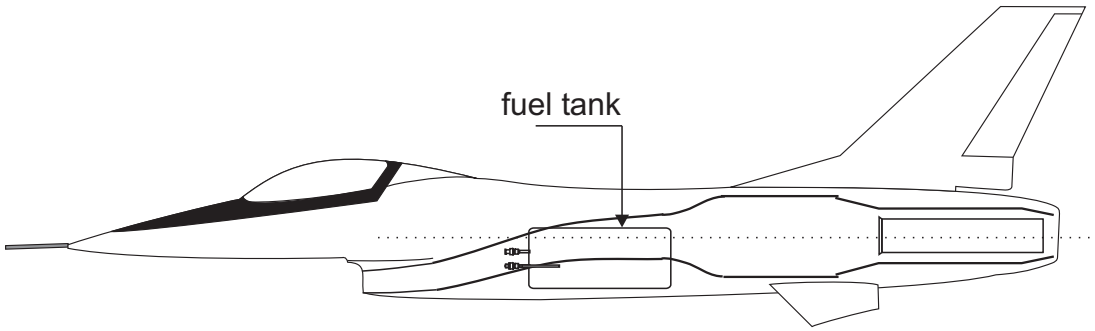
6.4.3 Installing the Exhaust duct.

It is very important to mount the exhaust duct is mounted exactly centrally behind the Olympus HP ES. Any deviation will result in a duct that does not function properly, and can affect the performance of the engine.

6.5 On-board fuel pump.

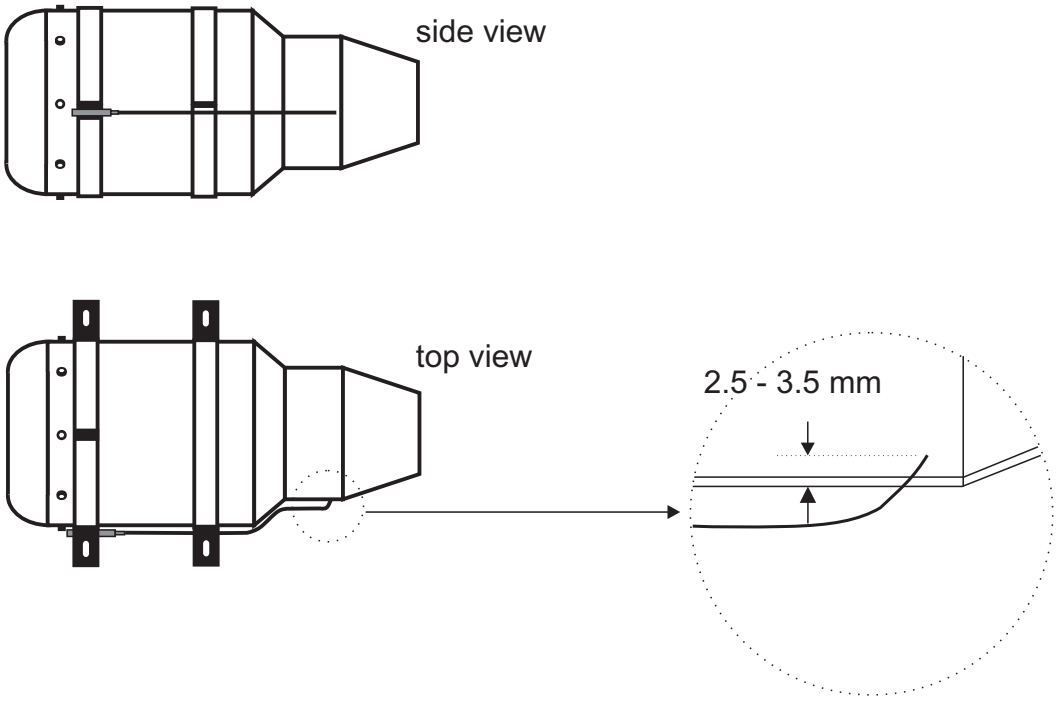
The fuel pump should preferably be located slightly below the level of the fuel tank. The reason for this position is the guaranteed fuel supply when starting the turbine.
The maximum total length of tubing between fuel pump and turbine may be 150 cm with an internal tube diameter of 3mm (PP3). The total length of tubing between fuel pump and fuel tank may be a maximum of 100cm with an internal tube diameter of 4mm (PP4). If two separate fuel tanks are used the total length of tubing between tanks and pump may be 150cm with an internal tube diameter of 4mm (PP4).

figure 6.6



In this example of an F16, 2 fuel tanks are placed left and right of the air inlet duct.

figure 6.7



Shown is Olympus HP air start

Note: put thermo couple
2.5 - 3.5 mm inside exhaust.

6.6 On-board propane container (optional item)

6.6.1 Installing the gas container in the model.

Find an easy accessible place for mounting the gas container, because you have to connect the filling bottle to it and also be able to open the 70% overflow valve, with a small screwdriver. For mounting you can use the 3 mounting holes in the top the cap. The diameter of the container is 40 mm. For correct operation of the 70% overflow valve, the container must be placed vertically with a tolerance of plus or minus 5 Degrees.

6.6.2 Container connections.

"IN" connection: This push-in self-closing connector is where you connect the pp3 tube for filling the gas container.

"OUT" connection: This is the output connection which is normally connected to the gas solenoid valve.
Note: This is *not* a one-way, self-closing valve, so *do not* disconnect the tube when the gas container is full.

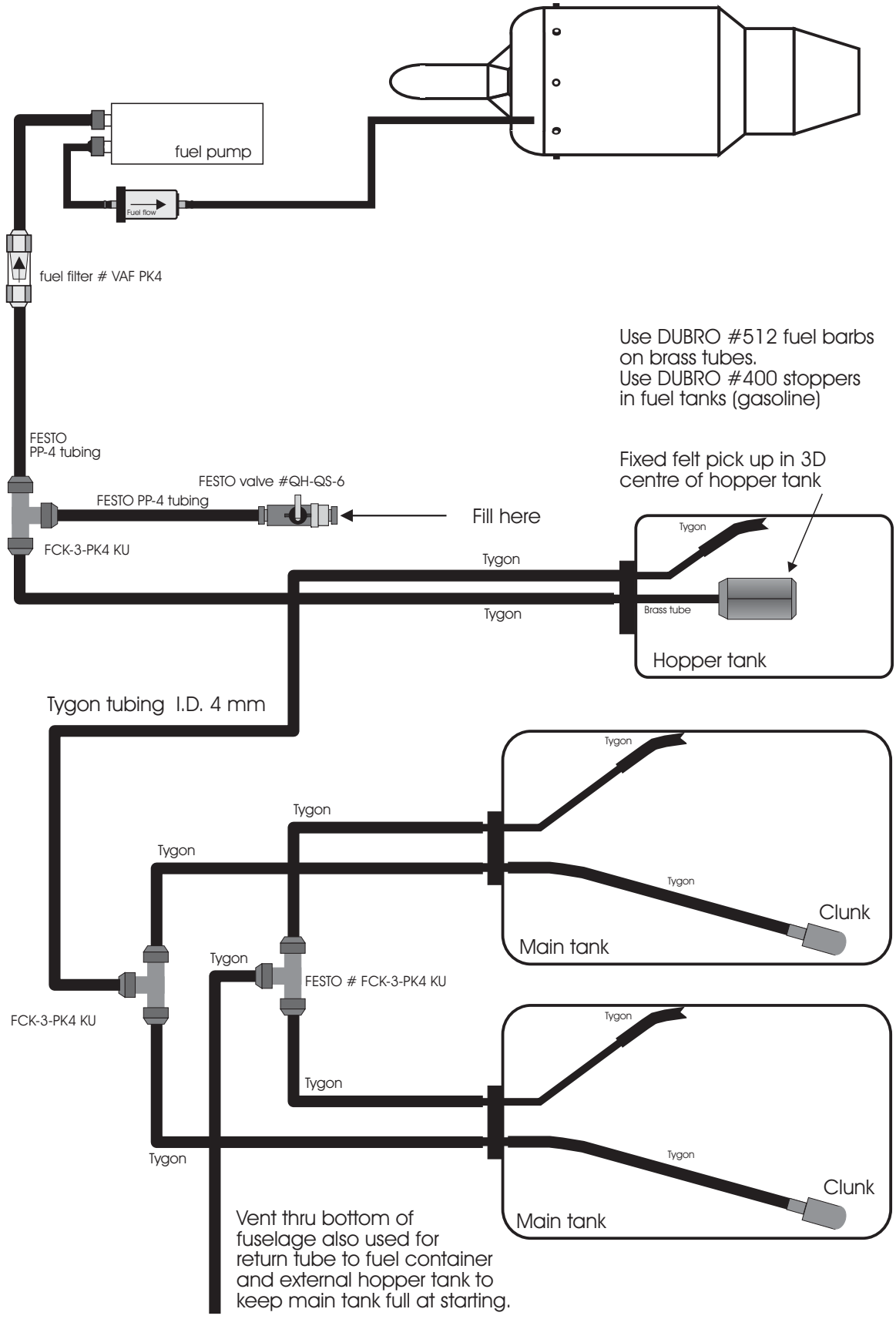
"70%" connection: This is an 'overflow' valve to prevent over-filling of the gas container, which would allow liquid gas to go to the turbine. When filling the container this valve must be open, and liquid propane will come out when the container is full. Lead the PP3 tube from this valve downwards to the *outside* of the model - otherwise you will fill the model with vapourised gas !

6.7 Mounting the thermo-couple.

The K-type thermo-couple, isolated type, is to be mounted in the block in the front engine mount. The end of this thermo sensor has to be mounted in the exhaust gas flow, 1.5 – 2.5 mm, seen from the inside of the exhaust nozzle of the turbine. A 1,6 mm diameter hole is made in the turbine nozzle for this purpose. Do not attempt to mount the thermo-couple more than 3.0 mm inside the exhaust nozzle, as this might give incorrect temperature readings and damage the thermocouple.
To mount the thermo-couple it should be bent as shown in figure 6.7.
The sensor has a lead of 90 cm, but it may be shortened. (watch the polarity)**.**

Hard Tank fuel system

Figure 6.8



6.8 On-board ECU.

The ECU is made of valuable and sensitive electronic components, and therefore it should be installed in a shock absorbing material (foam). AMT advises installation of the ECU, battery and fuel pump near to each other so that the standard length cables on all these items are long enough. A longer RPM-sensor cable can be supplied by us (JR type, max. 100cm) if desired.

Please do ***not*** modify, lengthen, or change the cables, plug connectors or ECU switch on the battery, pump or ECU on your own. These high-quality parts have been specially selected for this purpose, and changing them may affect the proper operation of the turbine, or void the warranty.

6.9 Hard fuel tank installation

Many modellers wish to fit hard tanks in their jet models, instead of the plasma bag type. If this is required, please follow the recommendations and hints below, and the diagram (figure 6.8) on the opposite page.

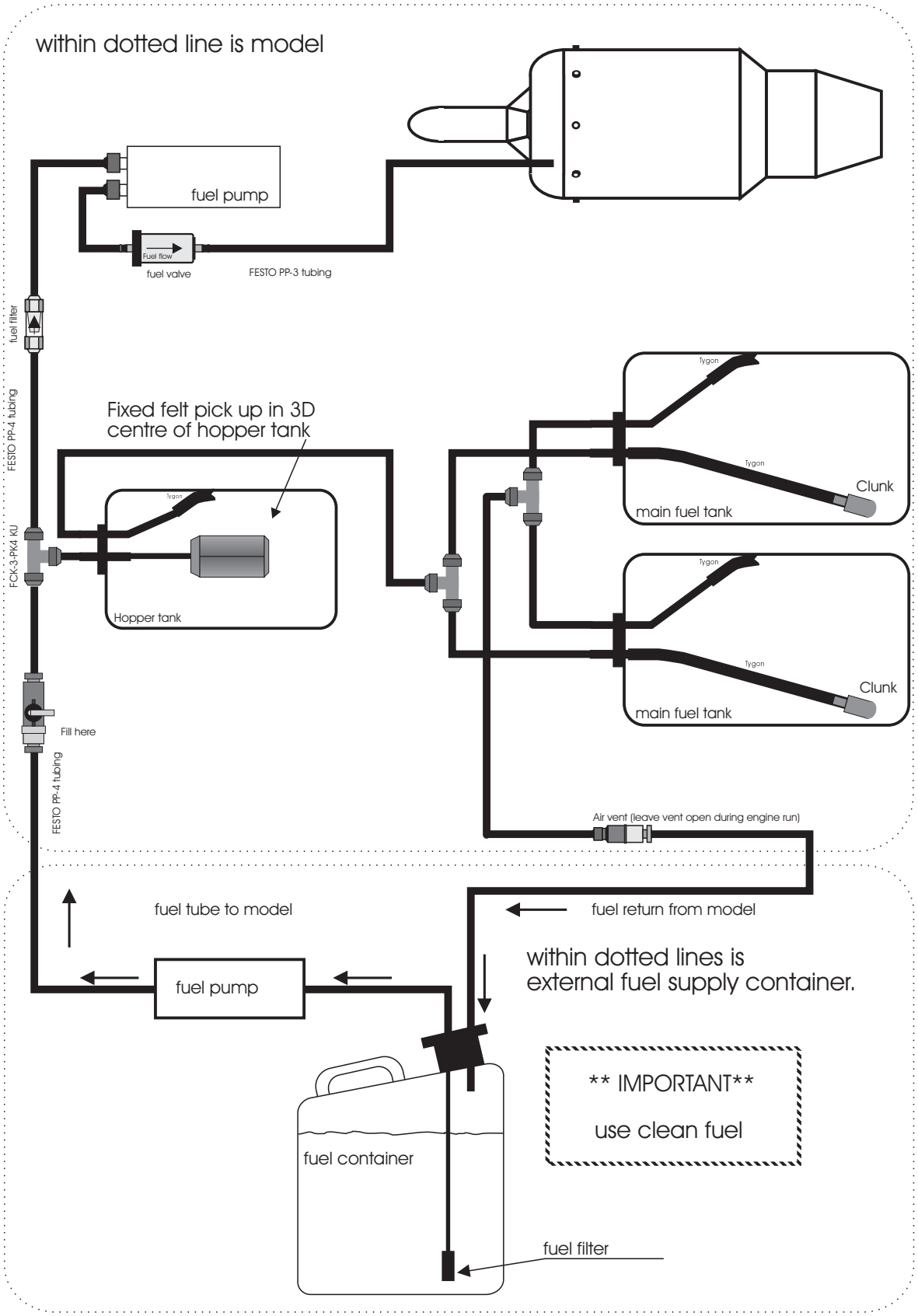
- Make sure all the stoppers in all main and hopper tanks are of the type suitable for gasoline and kerosene. The plastic stoppers normally supplied with most model fuel tanks are only suitable for Methanol based fuel and will be damaged by kerosene fuels. Replace these with stoppers designed for petrol.(e.g.: Dubro part# 400)

- All the tubing used in the fuel system must be suited to kerosene type fuels. The yellow Tygon tubing, and Festo PP3 and PP4 tubes supplied with your AMT turbine are all suitable for use with kerosene based fuels.

- It is very important that no big air bubbles can be drawn into the fuel pump, so we recommend that you install a Hopper tank between the main tank(s) and the pump. The feed tube inside the hopper tank, that takes fuel to the pump, should be fitted with a felt-covered fuel pickup, which helps to prevent big air bubbles in the system. This felt pick-up should be fitted in a fixed position in the 3-D centre of the tank. We recommend that it is soldered (or glued with 24 hour epoxy) onto the end of the brass feed tube. It is best if the cross-sectional shape of the hopper tank is square or circular, rather than oval, so that there is the maximum distance between the pickup and the sides of the tank, where the air bubbles are. Suitable felt pickups include the Webra pt # 1122 for Olympus HP, available from AMT. We recommend a minimum hopper tank capacity of 400 ml (14 fl.oz) for the Olympus HP.

- To prevent any possibility of fuel being forced through the pump into the turbine during fuelling up the model (which would cause a ‘wet-start’), the Version 2 ECU controls a kerosine valve which only opens when the fuel pump is running.

Figure 6.9


within dotted line is model
fuel pump
Fuel flow
fuel valve
FESTO PP-3 tubing
fuel filter
FESTO PP-4 tubing
FCK-3-PK4 KU
Fixed felt pick up in 3D
centre of hopper tank
Tygon
Hopper tank
Tygon
Tygon
Clunk
main fuel tank
Tygon
Tygon
Clunk
main fuel tank
Fill here
FESTO PP-4 tubing
Air vent (leave vent open during engine run)
fuel tube to model
fuel return from model
fuel pump
within dotted lines is
external fuel supply container.
** IMPORTANT**
use clean fuel
fuel container
fuel filter

- If using 2, or more, main tanks that require Tee pieces, use the proper Festo Tee (part# FCK-3-PK4 KU), not the plastic tees that are supplied with most model fuel tanks as these are not suitable for kerosene, and may also allow air into the fuel system. Make sure that the length of tubing from each tank to the Tee piece is equal, so that the same amount of fuel is sucked from each tank during operation. It is also important that the level of both tanks in the model are equal.

- Use flexible yellow Tygon tubing between the brass feed tube in the tank stopper and the clunk weight inside the main tank(s). Make sure that the clunk weight is heavy enough to allow it to move easily during flying manoeuvres.

- The inside diameter of the tubes used for turbine installation are larger than for normal model engines, and therefore a loose fit on the standard 1/8" (3.2mm) diameter brass tubes supplied with most model fuel tanks. To make sure that the Tygon tubing cannot come off the brass tubes, or leak any air into the system, we recommended that all brass tubes are fitted with the Dubro fuel barbs (Dubro part# 512) which are soldered onto the brass tubes. These are available from most hobby shops, or we can supply them if required.

6.10 Fuelling up the model

Important: Before fuelling up the model, make sure that the ECU is switched 'off' to be sure that the solenoid fuel valve is closed and no fuel can be forced through the pump into the turbine, which would cause a 'wet-start'.

a) Connect the feed tube from the fuel pickup in the external fuel container to the tube that goes into the hopper tank, with the felt clunk on the end of it. This can be done easily via a Festo QH-QS-6 valve, as shown in figure 6.9. AMT highly recommend that you install a good quality fuel filter in the filling tube between your external fuel container and the model.

b) Connect a return tube from the model's fuel tank air vent tube (normally under the fuselage) back to the vent on the external fuel container.

c) Start pumping fuel into the model, and keep pumping until the hopper tank and main tank(s) are full, and no large air bubbles remain. The fuel will overflow through the return tube, back into the external fuel container.

d) Disconnect the filling tube from the tube that goes into the hopper tank, and then disconnect the return tube from the air vent under the model. Leave the vent tube open - do not block it.

6.11 Alternative method for fuelling up the model

If using this alternative fuelling system (below) the main fuel tank(s) in your model will remain full after you have started the turbine, until you taxy out for take-off, and this is very useful at some large model meetings where it is often necessary to wait before take-off is permitted.

- Fuel up as above following points (a) to (d) exactly.
- Reconnect the fuel feed tube from the external fuel container to the model's fuel tank air vent tube (under the fuselage). Leave the return hole in the external fuel container open/unblocked.
- Start the turbine in the normal way. The main and hopper tanks in model will remain full, automatically sucking the extra fuel needed from external container, until you are ready for taxy and take-off. At this time just disconnect the tube from the external fuel container to the vent under the model. In this way you will always have full fuel tanks at takeoff.

7.1. Fueling

7.1.1 Fueling kerosene

Fuel up the model as described in chapter 6.

Important note: If fuel enters the turbine by accident, empty the turbine by putting the model in a vertical position, with the exhaust nozzle and ducting downwards for at least 15 minutes to ensure that all fuel has drained out, and the remaining fuel in the motor and ducting has evaporated.

7.1.2 Fueling propane (optional gas container)

When you use the internal gas container we advise you to fill it before every flight, and to take extra care of safety precautions during this operation - for example no smoking or naked lights nearby !

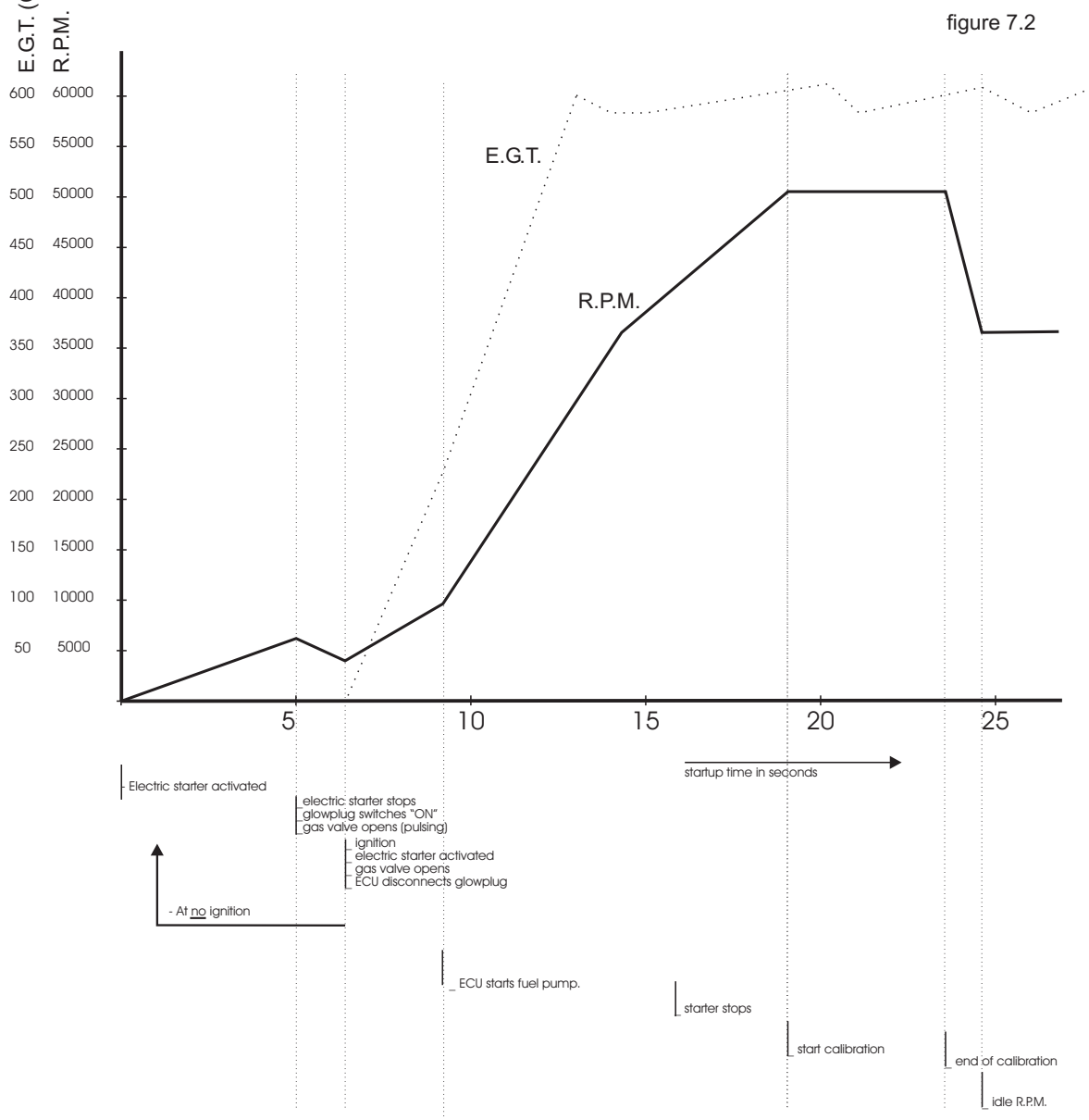
To fill the internal gas container follow these steps in order:

1. Connect your external propane storage container to the "**in**" Festo connection on the gas container in the model with a transparent Festo pp3 tube, so that you can easily see the liquid propane going into the gascontainer in the model.
2. Connect a length of transparent pp3 tube to the "**70%**" overflow Festo connection on the internal gas container and run it out of the bottom of the model. (This tube can be fitted in the model permanently if you wish).
3. Fully open the valve on your external storage container.
4. Fully open the screw on the "**70%**" valve on the gas container in the model.
5. Put the external storage container upside down to allow a flow of **liquid** propane into the gas container in the model. (observe the flow through the transparent tube)
6. The moment that **liquid** propane comes out of the "**70%**" overflow put the external storage container into the normal upright position and close its valve immediately.
7. Fully close the valve on top of the "**70%**" overflow output.
8. Disconnect the external storage container from the gas container in the model. Be careful of any surplus propane coming out of the transparent filling tube of your external storage container.

Note: In some countries or regions flying a model airplane with liquid propane on-board may be prohibited, and AMT staff personally prefer to use an external propane container for safety reasons anyway. For this it is only necessary to add a Festo quick-connect fitting in a convenient location (either inside or on the outside of your model), connected to the gas solenoid valve with pp3 tubing, and use this to connect your external propane container during starting. If using this method, please make sure that no dirt can get into the propane inlet fitting on the model, as this may be blown into the engine on future starts.

Important note: Wait at least 5 minutes to give the on-board gas container the time to warm up, because low temperature gives low gas pressure and therefore low gas flow. With low gasflow the startup sequence takes more time.

figure 7.2



Start up sequence Olympus HP ES

7.2 Powering up the system

It is necessary to calibrate the 2 input channels before you can operate the turbine because there are a variety of radio control systems with their own pulse widths.

For calibration see chapter **5.4.2.1** for dual channel operation, or **5.4.2.2** for single channel operation. Once this calibration sequence is done the pulse width is stored in the ECU and it does not need to be done again, unless the throttle or switch channel programming in your Transmitter is changed.

1 Be sure everything is properly connected to the ECU. Do not use dual rate, exponential or logarithmic servo control, servo limiting, idle trim or trim memory to either of the 2 input (throttle and switch) channels.

2 If you use a PCM transmitter switch on your transmitter before your receiver. After this switch on the ECU. You should hear the “OK beep”.
If you do not hear this beep please check your pump battery and its connections.
If you hear a “no start up beep” (high pitch tone with short intervals) the thermo-couple is disconnected or broken.
If you hear a “hardware error beep” (continuous low pitch tone) please contact AMT Netherlands or your AMT NL dealer.

3 If you are using dual channel operation you should get the 3 beeps (low, middle and high) from the 3 position switch and 3 beeps from the throttle.

4 If you are using single channel operation you should get the 3 beeps (low, middle and high) from the throttle trim, when throttle is on idle, and 3 beeps from the throttle when you move the stick from idle the max throttle.

You can also monitor these positions when using the optional **E**ngine **D**ata **T**erminal (see chapter 11.5)

5 It is a good idea to check throttle and switch (or throttle and trim) operation before every flight, by listening for the beeps as described above.

7.3 Starting the Olympus HP E-start (ECU software version 6.14 or higher)

Note: AMT recommends that you fully charge the ECU/pump nicad battery before every flight, to be sure that you have the maximum energy possible for powering the electric starter and glowplug to ensure reliable starting.

Power up the system as described in 7.2.

1 Put the throttle in the idle position (low pitched beep).

2 Put the 3-position switch (or throttle trim lever for single channel operation) on the transmitter in the 'off' position (low pitched beep).

3 When you use an external gas tank, instead of an internal gas container, connect this gas tank to the system and open the regulator valve fully.

4 To start the turbine put the switch (or throttle trim lever) on the transmitter in the 'start/run' position (high-pitched beep). Now you will hear 5 beeps from the ECU, and then it will begin the start sequence and the electric starter motor will turn the turbine. The glowplug will be switched off automatically as soon as the turbine has ignition.

Note: *If you try to start the turbine and you hear a continous high pitched tone with short intervals, the engine's exhaust temperature is to high for restarting. (Above 88°C). Leave the switch (or trim lever) in the middle position in order to cool the engine. When it has cooled down switch over to the starting position.*

5 The ECU will automatically start the fuel pump and open the fuel solenoid valve when the RPM reaches 9,000 RPM and the EGT exceeds 88 °C.
If using an external gas container, keep the starting gas regulator fully open until the ECU is passing idle RPM (36,000 RPM).

6 The ECU will automatically throttle up the turbine to its calibration point at approx. 50,000 RPM. (Now you can disconnect and remove the external gas container, if used). The ECU will keep the turbine at approx. 50,000 RPM for about 5 sec and then it will automatically throttle back down to idle RPM (36,000). Idle RPM is now calibrated.

7 You now have control over engine thrust with the throttle stick on your transmitter.

Note: When you throttle up for the first time after starting, the engine power is limited to about 90% for 3 - 4 seconds for internal calibration of the ECU. Therefore when you want maximum power for take-off you should make sure that you have first throttled up to full power one time, and held the throttle stick there for at least 4 seconds.
If you are using our optional ‘EDT’ then as soon as you see “Max RPM set” in the bottom row of text, this is confirmation that you will have maximum power the next time you throttle up.

7.4.1 Stopping the engine

For the normal stopping of the engine you should use the automatic “power-down” sequence which functions as follows:

- Put the nose of the model into the wind if possible.

- Put the switch (or trim lever) on your transmitter to the middle position to activate the automatic power-down sequence.

- The ECU now regulates the engine to 30% throttle (approx. 60,000 RPM) for about 5 seconds and waits until the exhaust temperature stabilizes. Be careful - there is still about 2 kg of thrust at this RPM.

- After this the ECU will stop the engine.

- Then the ECU will automatically switch the Electric-starter on and off several times, until the EGT is below 88 °C.

The ECU is now ready for a new start-up.

7.4.2 Switching off in case of an emergency

If, in case of an emergency, the turbine needs to be switched off quickly, you can immediately switch over to position 1 “off” (low pitch tone) using the 3 position switch, or throttle trim lever if using single channel operation.
The ECU will now stop the turbine immediately from any RPM or power setting. You should only use this method in emergency cases and if fail-safe programming is possible in your transmitter (PCM transmission mode).

The advantage of the programmed 'power-down' sequence is that the turbine is switched off with the coldest possible motor and at a relatively low RPM, which is best for the fatigue and the wear of the ball bearings.

7.5 Recommended fueling and charging sequence

From the experience of AMT staff we have found that the following sequence between flights works well. It allows the internal gas container the longest time to return to ambient temperature after filling, giving the most reliable starting because of the higher temperature and pressure in the container.

1. Fill the internal gas container in the model before every flight with liquid propane, using the “70%” overflow valve to make sure that it is full (see 7.1.2).

2. Connect fast nicad charger to the ECU/pump battery and start charging.

3. Fill fuel tanks while charging is taking place.

4. Recharge Receiver nicad (and transmitter) if necessary.

Note: AMT highly recommend recharging the ECU/pump nicad before every flight, and a complete slow discharge and recharge after each day of flying.

Note: AMT Netherlands recommends to cycle, discharge / charge, the new nicad battery at least 5 times before useing them, to get maximum capacity available

8.1 Preventative maintenance

These are maintenance checks and procedures that you can do yourself according to the time schedule shown.

8.1.1 Visual inspection of the turbine and gear

Check the following things after each 1 hour of running time of the turbine:

- Visually inspect the outer casing of the turbine, especially for colour changes which indicate extreme temperature rises.
- Inspect the mounting brackets for possible cracks.
- Look for damage to the inlet and compressor wheel.
- Is the fuel pump still sealed and not leaking ?
- Are the fuel tank(s) still sealed and not leaking ?
- Check that turbine and compressor wheel are not dragging.
- Check and clean the Festo fuel filter in the model and in your external fuel container at least every 30 litres of fuel. **AMT NL** recommends replacing the filters every 50 - 60 litres of fuel, or sooner if they are very dirty.

8.1.2 Checking of bearings

If you turn the engine shaft by hand, you can judge reasonably well the condition of both ball bearings. Watch for the following things:

If the turbine produces considerably more noise than before, the ball bearings are probably damaged by dirt in the fuel, or in the ingested air.
It is advisable to replace the fuel (and/or filter) and make a test run in a dust-free area.

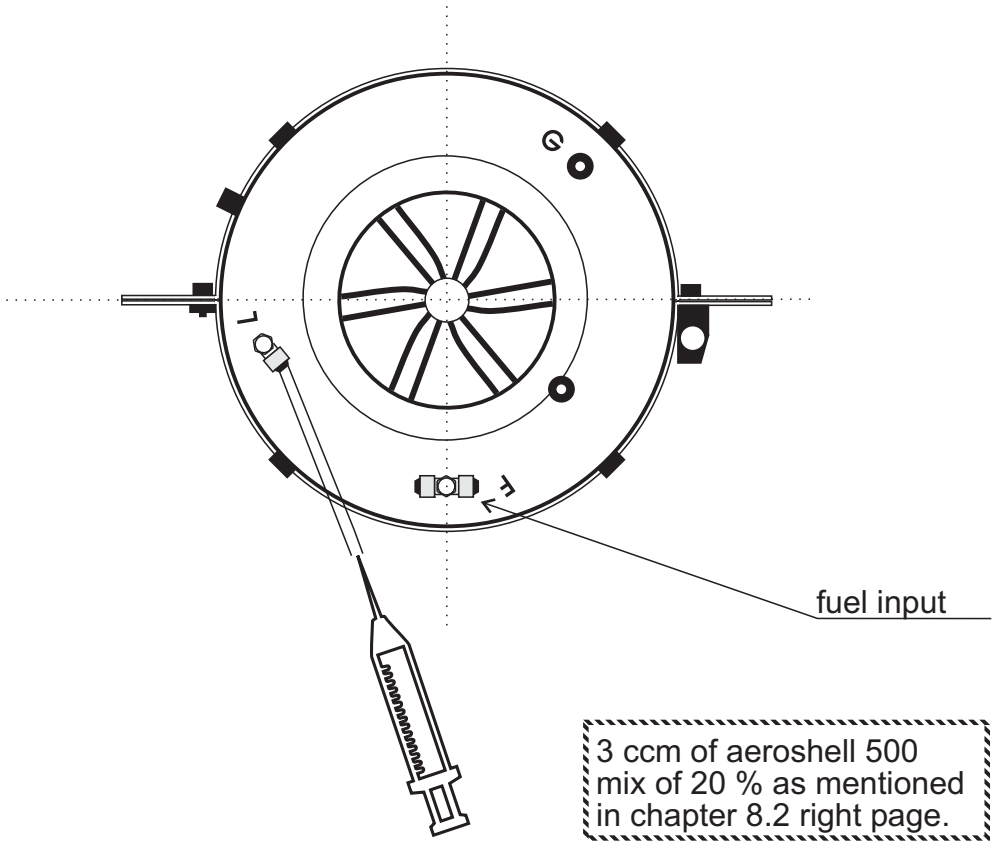
If the performance of the motor during test run is normal, it is not necessary to replace the bearings. It is advisable, however, to check the bearings more often now.

If one detects uneven, or rough, points when spinning the motor by hand, then one or both bearings are probably damaged. This could, for example, be caused by sand or grit particles that have been sucked in by the engine (approx. 1% of the ingested air passes through the bearings for cooling) or by dirt in the fuel (lubrication).

The bearings now need to be replaced by **AMT Netherlands** or, if present, the **AMT NL** service centre in your own country.

figure 8.1

front view Olympus HP Airstart, front cap not mounted



8.2 Storage and lubrication

If the engine will not be used for 3 months or longer we recommend that it has additional lubrication with a mixture of kerosene and 20% Aeroshell 500 oil, as in 8.1 left. This is to prevent any possible corrosion of the ball bearings, which can happen especially if the engine is stored in a humid environment.

If the turbine will not be used for longer periods (6 -12 months) it is recommended that it is placed in a vertical position (compressor upward), and the inlet and exhaust are covered to stop dust and other particles from entering the engine. After this storage period we recommend that you pre-lubricate the engine (as in 8.3) before starting it.

8.3 Removal of Front Cap and pre-lubrication procedure

a) Remove **only** the blue Gas and Air Festo quick-connectors using a 2.5mm hexagon wrench inserted inside the fitting, and turning anti-clockwise.
Note: It is **not** possible to remove the Festo quick-connector fitting for the Fuel supply, and if you insert a hexagon wrench into this fitting you may damage it and cause a fuel leak.

b) Loosen 7 of the 8 bolts that hold the hull to the motor by a 1/2 turn. Do not loosen the bolt that has the lead seal attached, as this may affect the warranty.

c) The Front Cap should now be loose, and can be removed by inserting 2 hexagon wrenches, or similar, in 2 of the holes used for securing it to the motor, and lifting upwards. Be careful not to damage the RPM sensor cable.

d) Remove the short pp3 tube from the Fuel elbow (marked 'F') by pushing the blue plastic ring part towards the fitting, and pulling the tube out of the Festo fitting. Using a hypodermic syringe and a short length of pp3 tubing, inject 5 or 6 cc of kerosene and 20% Aeroshell 500 turbine oil into the tube connected to the ‘Lube’ fitting.

e) Reconnect the pp3 tube between the Fuel and Lubrication fittings, being careful not to kink or bend it, and replace the Front Cap in the reverse order of removal.

Spin the turbine for about 10 seconds to distribute the oil all around the inside of the turbine. You can do this by connecting a 4.8 or 6 volt DC supply directly to the connector plug of the electric starter. An old 4 or 5 cell receiver battery can be used for this. **Do not** use more than 6 volts for this process!

Alternatively, if you have compressed air available (8 -12 bar), connect it to the ’Air’ Festo quick connector with pp3 tube and give the motor 2 or 3 short blasts of air to spin the shaft, which will distribute the oil all around the inside of the motor.

Finally place the turbine in a vertical position, compressor upwards, and let any excess oil drain out for 15 minutes before sealing the exhaust with the plastic cap supplied with the turbine.

8.4 Returning motor for service or repair

If you need to return your motor to AMT NL for service or repair please **only** send the following items, unless other accessories or parts need checking or repair. Please do not send any unnecessary items back to us with the motor, as this will only increase the size and weight of the parcel, which may increase costs.

When possible, please use the original packing when returning parts to us for service, to prevent possible damage during shipping.

1. Turbine. **Important**: Please make sure that the Festo Fuel and Gas input connections are properly sealed to prevent any dirt getting inside these systems. This can be done with short pieces of pp3 tubing with the ends heated with a cigarette lighter and then squashed flat with pliers. Please fit the supplied red plastic caps to the turbine to stop anything getting inside the turbine.

2. ECU.

3. Fuel pump.

4. Either a copy of the Engine Log, showing the problem, or a detailed report on the problem. Without a clear error description it may take more time to find and solve any problems with your motor.

Note: You may also send the ECU/pump battery back to us with your motor, and we will check that it is still serviceable and has sufficient capacity. If you are sending us an Electric-start version turbine for service, then it is recommended that you send us the battery, as this should be in good condition for proper turbine operation.

8.5 P2 Pressure fitting installation

All new motors manufactured since 2002 have ready tapped and threaded M5 in the front plate to allow the customer to fit a Festo nipple to provide pressure for a smoke system, topping up your pneumatic retract tank, or similar.

If you remove the Front cap, as described in 8.3 for Pre-lubrication, you will see a small s/s grub screw inserted in the Front plate approx. between the Fuel and Air inputs. This plug can be removed with a 2.5mm hexagon wrench, and replaced with a suitable Festo nipple such as the standard CK-M5-PK-3, or a quick-connect type such as the QSM-M5-4-I fitted onto a QM-M5-A/I hexagon extension piece. All new Front Caps manufactured from 2003 have a small 1mm diameter hole in them placed exactly vertically above this P2 position. Simply drill this out to 8.5mm diameter to allow access to the new P2 pressure nipple. For full details of the smoke system please look on the 'Download' page of our website at www.amtjets.com.

8.6 Looking after your gasturbine

These are a few tips from our staff which will help prolong the life of your turbine, and help to prevent some of the small problems that we often see when motors are returned to us for service or repair.

1. Please do *not* overtighten the 8 bolts that hold the outer casing onto the motor, or the 4 bolts that retain the Front Cap. It is not necessary to use Loctite, or similar, on any of these bolts.

2. You should occasionally check the RPM sensor to make sure that it is not touching the compressor wheel. On a Olympus HP the clearance should be about 0.25 - 0.30 mm.
   If you replace the RPM sensor because of damage, please follow the instructions we provide with the new sensor, and do *not* use any loctite or glue on the small M2 bolts that hold the sensor mounting block to the inlet.

3. Please make sure that all tubes and cables, especially the RPM sensor cable and glow-pug connector cables, are properly secured in front of the motor so that they cannot be sucked into the compressor which will mean that the motor has to be returned to us for repair. This is a common occurence with new operators, who often underestimate the suction of a miniature gasturbine.

4. When connecting pp3 tubing into the Festo quick-connect fittings for Fuel, Gas or Air on the front of your motor (or the internal gas tank), please make sure that the pp3 tube is cleanly cut at 90 degrees, and that there are no burrs or dirt on the end of the tube which can easily damage the sealing mechanism inside the Festo fitting. AMT Netherlands can supply customers with the proper Festo tube-cutter for doing this (an inexpensive item), which makes installation and maintenance very simple.

5. Please do *not* modify the cables, switch, or connectors on the ECU, fuel pump or battery pack in any way. The type and quality of items we supply have been very carefully selected to be suitable for our turbines, and to ensure the highest reliablity and longest life.

   Also, leaving everything in the ‘standard’ configuration as supplied by AMT NL makes replacement in the event of damage, or maintenance or repair by our staff a simple and more economical task.

   AMT Netherlands can supply any special extension cables that you need to complete the proper installation in your airplane. Please supply us with accurate lengths when ordering your gasturbine.

9.1 How to complete the log

Completing the log correctly is of great importance for the optimal use of the Olympus Hp and HP ES. It does not only give you information about your flight hours with the Olympus HP, but can later also be useful for maintenance, fault finding, guarantee, or sale to a third party, etc.

Make it a rule to put your manual & log in your transmitter case, so that it is kept with your turbine at all times.

The log is built up from a number of columns.

1st column	date	(dd-mm-yy)
2nd column	place	----------
3rd column	model	A,B,C,D, Test
4th column	time of the motor run	(minutes)
5th column	remarks	----------

Example:

Log Olympus HP ES				
Date	**Location**	**Model type**	**engine time**	**remarks**

All flights with the motor should be entered in the log, as well as all test-runs and start-ups, etc.

9.2 Log

From version 2.10 the manual the engine log is intergrated at the end of this owners manual.

10.1 Warranty conditions

If any shortcomings occur within a period of 24 months after the delivery date, due to material or fabrication defects, these will be compensated free of charge by Advanced Micro Turbines NL, or, if present, by the AMT service centre in your own country.
In case of replacement, Advanced Micro Turbines NL becomes the owner of the replaced components.

When AMT discovers that the Warranty seals have been broken, or that the ECU or pump or other accessories have been dissassembled or modified in any way, then every form of warranty expires and AMT is in no way responsible for any damage whatsoever.

The Warranty does not apply to insufficient maintenance, overloading, natural wastage in case of sale to third-parties and other causes beyond the control of AMT, this within the discretion of AMT Netherlands.

10.2 Completing the warranty card

The Warranty card should be completed by the buyer of the turbine, and should be sent by the buyer to AMT within two weeks of receipt.

In case of a possible Warranty claim a detailed description of the complaint needs to be sent to AMT, as well as the turbine, ECU, fuel pump and completed Engine Log. Please use the original packaging for this.

10.3 Warranty

The Warranty card is included with turbine set.

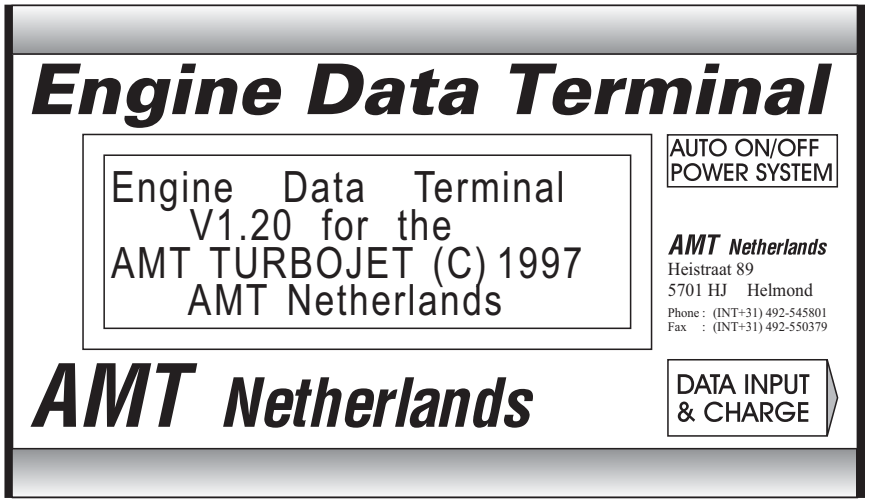


figure 11.1

(power up)

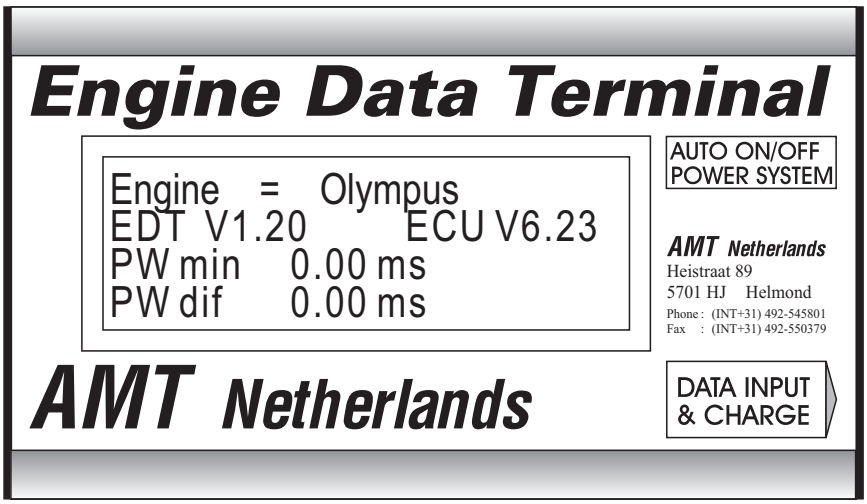


figure 11.2

(start up screen)

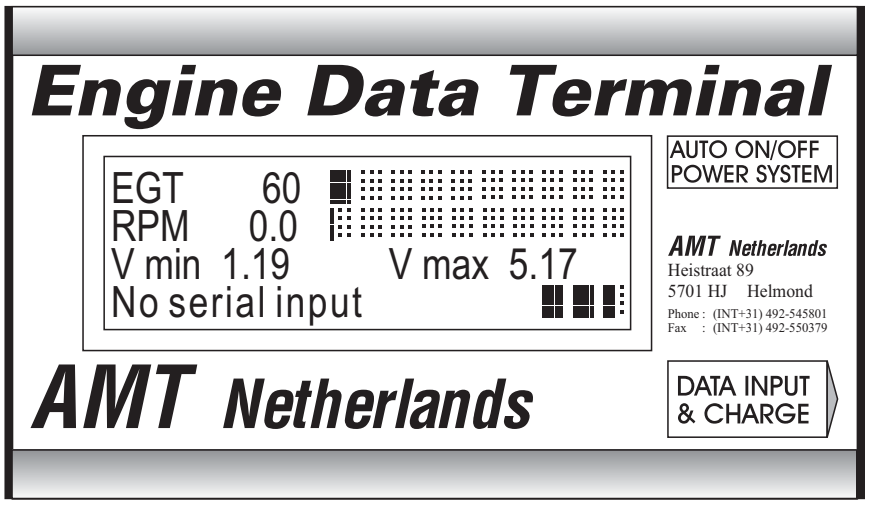


figure 11.3

(no data input)

11.1 Description Engine Data Terminal

The EDT is microprocessor controlled and displays all the engine data in real-time mode on a 4 row 20-character LCD display.
The EDT must be connected to the serial communication/Telemetry port of the ECU, which provides the data output. (all EDT will work with V1 and with V2 ECU)

11.2 On / Off switching

The EDT has a device in it, which automatically detects if there is any data input received. The EDT starts automatically when data is received.(figure 11.1)
If no data is received for more than 3 minutes this device automatically shuts down the EDT. You can see this by the time bar on figure 11.3

11.3 Charging the EDT

The EDT gives a warning when it has a low battery, and when this happens the EDT will work properly for only another 10-15 minutes.
The EDT should be charged with the special cable that is supplied with it.

Charging can be done from any 12 volt DC supply, and the internal charge circuit will regulate the current. Alternatively the EDT can be charged from any regular battery charger which has a 10 mA current output.
The time required to fully charge the internal EDT battery is 15 hours.

11.4 Startup Screen

This is the 2nd screen displayed after the EDT receives data. After this you can calibrate the ECU with the three-position switch. When the calibration is OK, you will hear the OK beep from the ECU (see Ch.5.4.1) At this time the pulse width of your RC system and the engine type are shown on the EDT display.

This screen will stay for about 5 seconds and will not be available again until you re-calibrate the ECU again. (seen fig 11.2).

From this stage 3 screens are available, chosen by the 3-position switch on your transmitter.

(See chapter 7 page 2. and figure 5.2 in chapter 5.)

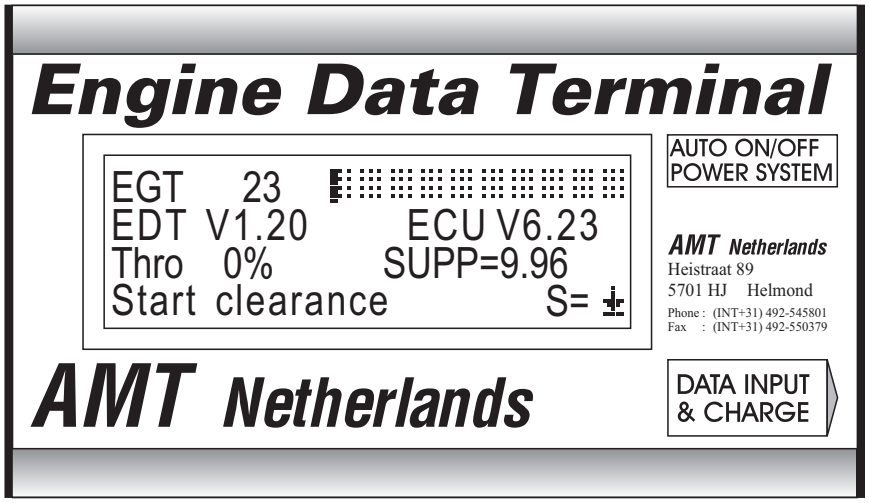


figure 11.4

(system off)

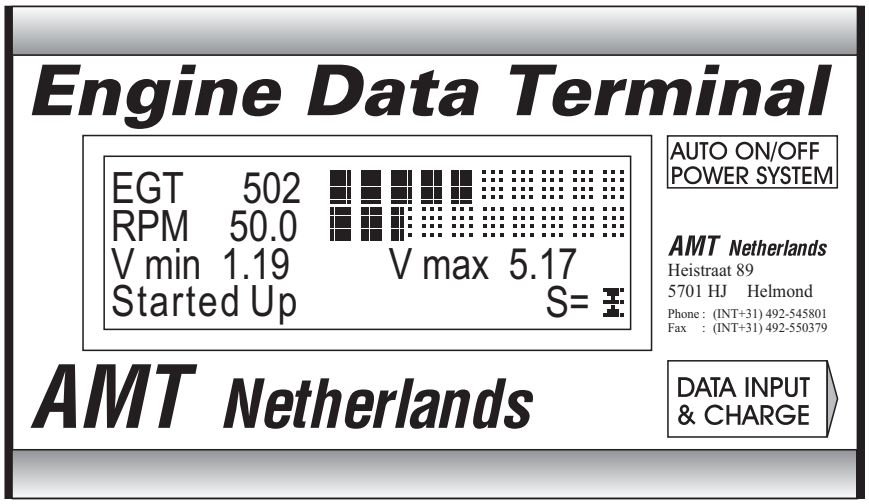


figure 11.5

(power down seq.)

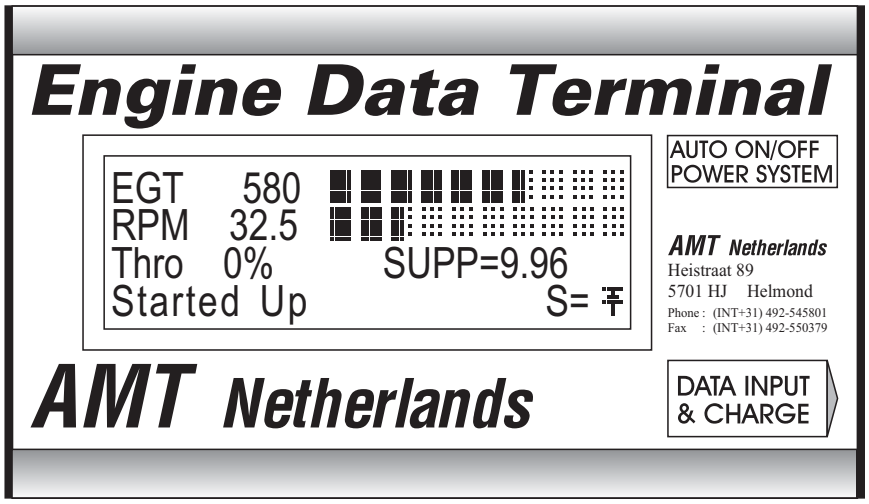


figure 11.6

(starting)
(and running)

11.5 **Screen 1** : "Off"

This screen is displayed when the three position switch is in position 1, for "off", indicated by the low beep tone. (figure 11.4)

1st line: Exhaust Gas Temperature in °C (EGT)
2nd line: software version of ECU and software version of EDT
3rd line: throttle position and ECU supply voltage
4th line: additional text and position of the switch channel

11.6 **Screen 2** : "Power Down" sequence

This screen is displayed when the three-position switch is in position 2, for the "powerdown" sequence, indicated by the middle beep tone. (figure 11.5)

1st line: Exhaust Gas Temperature in °C (EGT)
2nd line: Revolutions of the shaft (RPM)
3rd line: pump voltage at idle and pump voltage at max RPM
4th line: additional text and position of the switch channel

11.7 **Screen 3** : "Starting and Running"

This screen is displayed when the three-position switch is in position 3, for "starting and running" the engine, indicated by the high beep tone. (figure 11.6)

1st line: Exhaust Gas Temperature in °C (EGT)
2nd line: Revolutions of shaft (RPM) and actual pump voltage (V out)
3rd line: throttle position and ECU supply voltage or additional text
4th line: additional text and position of the switch channel

11.8 **Additional Information**

Line four of every screen gives you additional text when it is required. For example all the error messages are displayed in this line, and also additional information during engine starting. These include messages like "close air" and "close gas ".

The text "starting" in line three is a very important message. The message occurs when you are starting up the engine and means that EGT is over 88 °C and RPM has reached 9.000 RPM. Then the fuelpump starts to supply fuel to the engine.

When this happens line four gives you information about disconnecting the glowplug, closing the air-valve and gas-bottle. When you use the **Version 2 ECU** which has the fully automatic electric-start, all these things are done automatically.

Start clearance
-> Engine is ready to start up.

Starting
-> EGT is over 88 °C and RPM exceeds 9,000 RPM. The fuel pump starts pumping.

Started Up
-> ECU has successfully started up the engine.

Idle RPM set
-> Engine has reached idle RPM.

Max RPM set
-> Engine has reached maximum RPM.

Close GAS
-> Engine is starting up, and the engine is running on liquid fuel. If using manual starting, you must now close the valve on the gas bottle.

Close AIR
-> Engine is starting up, the engine is above minimum RPM. If using manual starting, you must now close the air valve.

No start clearance
-> Engine is too hot to start (over 88°C). You must cool down the engine before starting. (auto cool function, switch middle position)
-> When you are using the the **V2** fully automatic E-start ECU, this message occurs, there is no proper working glowplug connected.
-> When you are using the Automatic Startup Unit and this message occurs, there is no proper working glowplug connected.

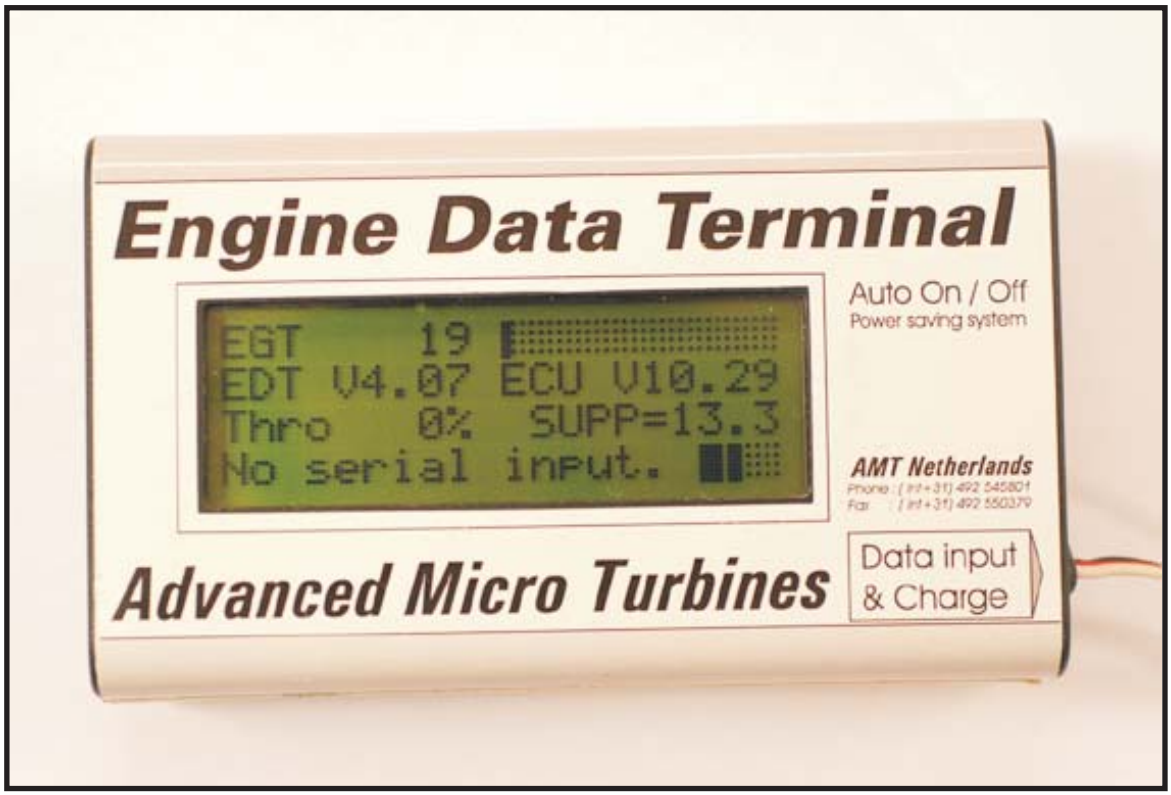
11.9 Error messages

As mentioned in 11.8, line four of the EDT gives also possible error messages. These messages are very important for trouble shooting.

EDT errors

- EDT low battery
  = EDT battery voltage is below 6.3 volt.
  -> charge EDT.

- no serial input.
  = ECU is sending no data to EDT.
  -> switch on ECU.


Engine Data Terminal
EGT 19
EDT V4.07 ECU V10.29
Thro 0% SUPP=13.3
No serial input.
Auto On / Off
Power saving system
AMT Netherlands
Advanced Micro Turbines
Data input
& Charge

ECU errors

- **Supply low error**
  = ECU battery voltage became below 9.0 volt during running.
  = ECU battery voltage is below 12.5 volt at startup.

  -> charge ECU battery. (AMT advises to charge batteries before every flight.)

- **Switch fail**
  = no switch channel connected.
  -> Check that receiver is switched on ?
  -> Check that switch channel is connected ?

- **Throttle fail**
  = no throttle channel connected.
  -> Check that receiver is switched on ?
  -> Check that throttle channel is connected ?

Engine errors

- **RPM low error**
  = engine RPM below 29,000 RPM.
  -> check fuel system, possible air in the system.

- **RPM high error**
  = engine RPM over 112,000 RPM.
  -> check fuel system, possible dirt in the system.
  -> possible bent fuel line.
  -> possible fuel pump problem.

- **EGT error**
  = EGT over 850 °C at startup.
  > check position of thermo sensor in nozzle (maybe too far in?). (fig 6.7)
  > possible inlet duct problem. (not enough air to motor)
  > possible fuel system problem. (dirt)

***** Important *****

When you have an engine shut off because of an error, connect the EDT to the ECU. Then the EDT gives you the error type. After you have switched off the ECU the error message is no longer available.

Engine log

model : A	model : B	model : C	model : D	motor test = T

date	location	model	engine time	remarks
- -			min.	
- -			min.	
- -			min.	
- -			min.	
- -			min.	
- -			min.	
- -			min.	
- -			min.	
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- -			min.	
- -			min.	
- -			min.	

model : A	model : B	model : C	model : D	motor test = T

date	location	model	engine time	remarks
- -			min.	
- -			min.	
- -			min.	
- -			min.	
- -			min.	
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- -			min.	
- -			min.	

Advanced Micro Turbines

model : A	model : B	model : C	model : D	motor test = T

date	location	model	engine time	remarks
- -			min.	
- -			min.	
- -			min.	
- -			min.	
- -			min.	
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- -			min.	
- -			min.	
- -			min.	

model : A	model : B	model : C	model : D	motor test = T

date	location	model	engine time	remarks
- -			min.	
- -			min.	
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Advanced Micro Turbines

model : A	model : B	model : C	model : D	motor test = T

date	location	model	engine time	remarks
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model : A	model : B	model : C	model : D	motor test = T

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Advanced Micro Turbines

model : A	model : B	model : C	model : D	motor test = T

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model : A	model : B	model : C	model : D	motor test = T

date	location	model	engine time	remarks
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Advanced Micro Turbines