

# Manual & ENGINE LOG (V31A)

**Nike** *gas turbine* ©

Kerosene start version, internal igniter.

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.

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## **1.1 Profile of Advanced Micro Turbines**

Advanced Micro Turbines develops small gas turbines for the propulsion of radio-controlled flying airplanes, UAV's, 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. Over the years several engines have been designed with great success. In 2011 the Nike turbojet was developed by a team of engineers with a thrust of 784 Newton at 61,500 RPM.

The production version of the Nike turbojet has been developed from knowledge gained during design and operation of the Titan engines. The Nike has specifications and performance which have never been achieved before in a motor of this size.

In 2011 the Nike was developed together with a new version of ECU capable of fully automatic start with our own newly developed electric starter unit. The Nike engine is only available as a electric direct kerosene start version. In January 2014 an internal igniter is introduced for the Nike engine.

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

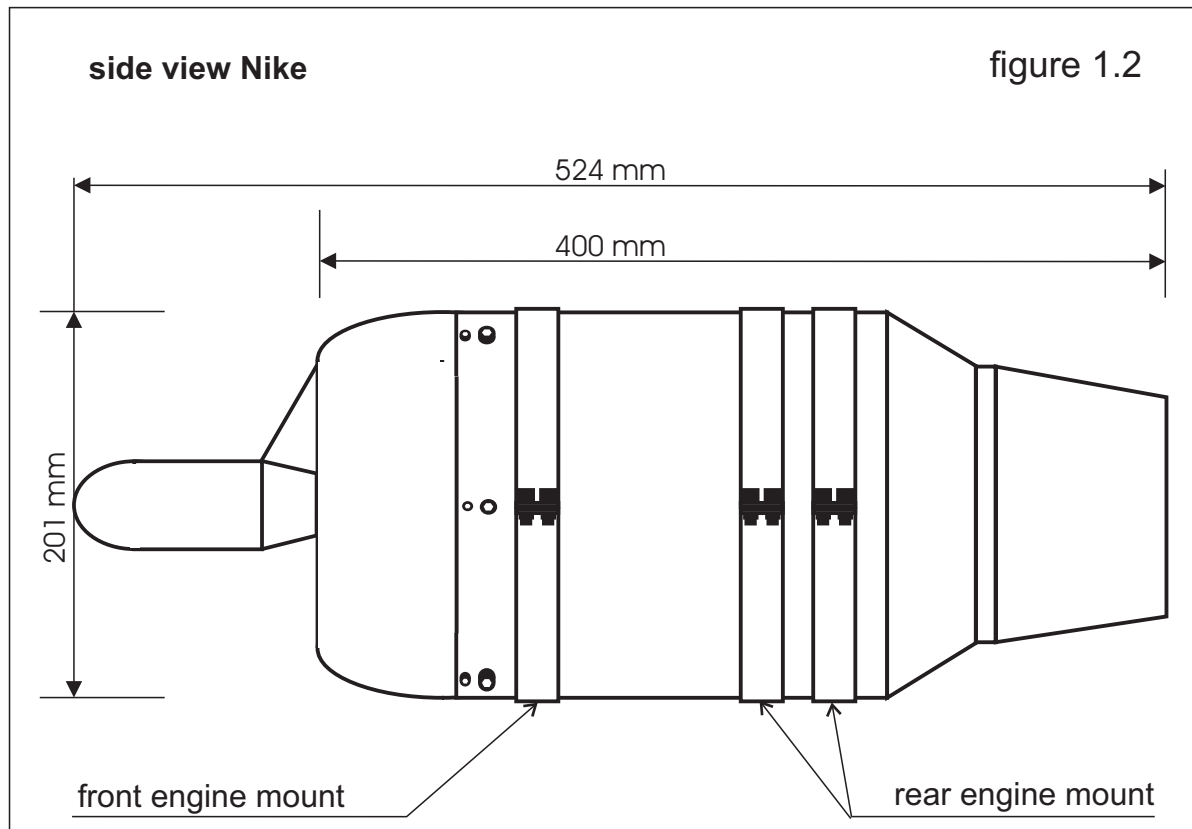
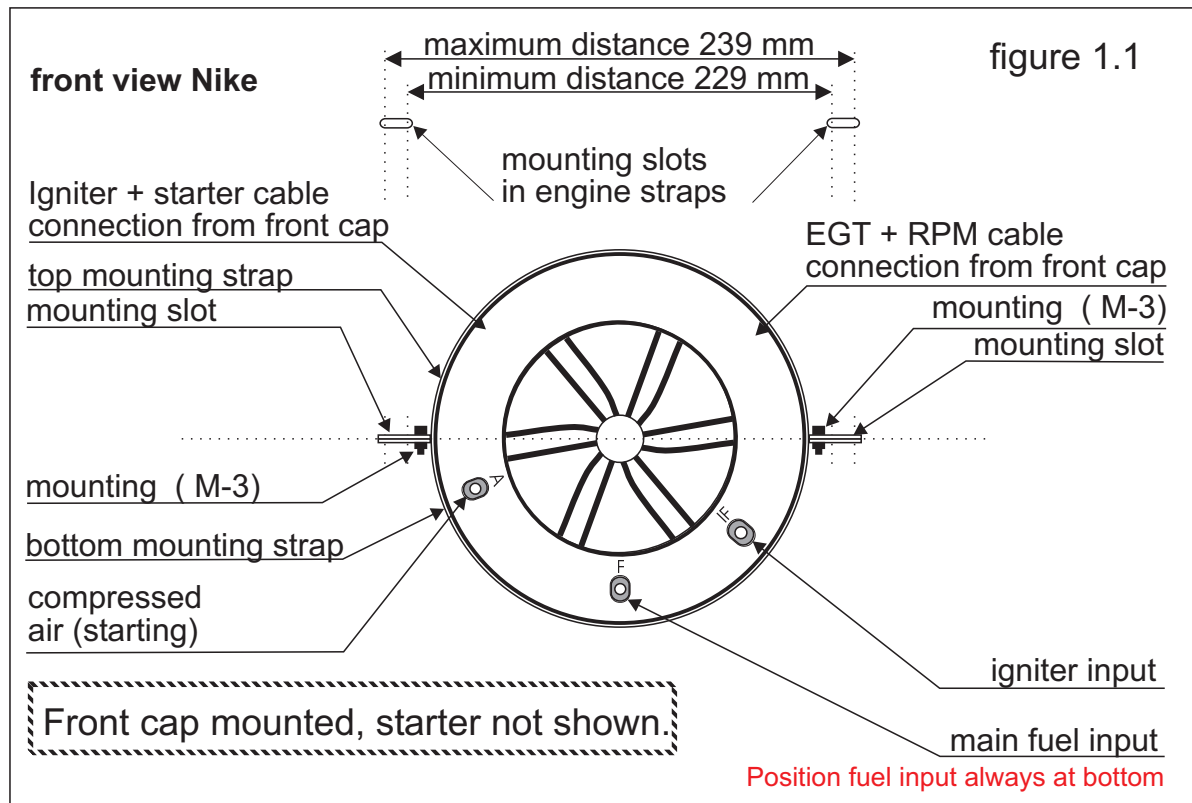
## **1.2 Description of Nike engine**

The Nike has been constructed from a single radial compressor and an axial flow turbine. The Nike owes much of its excellent performance and superb power/weight ratio to this turbine wheel which was designed by skilled engineers especially for our motors. The engine is capable to spool up and down within 5 seconds which is extremely fast for this size of engine. However the ECU,s software limits the spool up and downtime to aprox 10 seconds. The 10 seconds spool up and down time makes the engine extremely reliable for operation in high altitudes.

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 pre-programmed software limits. The ECU is fully automatic and needs no adjustment by the operator.

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1. Introduction

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**1.3 Technical data for Nike E- start** (internal kerosene start system)

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

All data below +/- 2%.

Diameter	201 mm	7.9 inch
Length	524 mm	20.6 inch
Engine only weight	8770 gr	19.3 Lbs
System airborne weight *	10580 gr	23.3 Lbs
Maximum RPM	63,000	63,000
Thrust @ 61.500 RPM	784 N	176.3 Lbf
Mass flow @ max. RPM	1100 gr/sec	2.43 Lb/sec
Idle RPM	20,000	20,000
Thrust @ idle RPM	40 N	9.0 Lbf
Pressure ratio @ max. RPM	4:1	4:1
Exhaust temperature	800 °C	1472 °F
Maximum exhaust temperature	875 °C	1607 °F
Fuel usage @ max. RPM	1900 gr/min	67 oz/min
Fuel type	kerosene/paraffin/A-1/white spirit	

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

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



**\*\*\* DELIVERY FORM \*\*\***

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

Date of transport : ..... - ..... - .....  
Transport by : ☐ UPS ☐ DHL ☐ FEDEX  
Set complete : ☐ .....

number	article description	items
90035306	Engine Nike (engine->	) 1
05890099	ECU Nike	1
05030488	Lithium polymer battery 14.8V/5200Mah.	1
05030510	Battery pack charge cable	1
89500310	High flow Kerosene Solenoid valve KV70+	1
89500304	Ignitor valve Kerosene KV70-3	1
87310101	Fuel pump (pump ->	) 1
98390105	Front engine mount	1
98390104	Rear engine mount	2
05030513	Safety clip	1
24890503	Warrenty card	1
08470521	Festo PAN 4 Tube (To ignitor)	1
08470522	Festo PAN 6 Tube (pump to engine)	1
08470523	Festo PAN 8 Tube (fuel tank to pump)	1
90001070	Festo T-piece	1
08470518	Fuel filter K&N (between tank and pump)	1
05300151	ECU telemetry software V2.____ + USB cable	1
84890502	Manual Nike	1
05890111	Engine data terminal	1
05030515	Engine data terminal charge cable	1

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2. Contents

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## 2.1 Turbine

The kit consists a gas turbine, manufactured with the utmost precision and care, and it is important that a user treats the engine as a precision instrument.

Each new motor has undergone 3 test runs before delivery together with its own ECU and fuel pump. At each test run capacities and performance have been checked and are stored in our database.

## 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. **Note:** At 100% throttle the temperature of the ECU can go up to 60 Deg C, a place in the vehicle with cooling air would be preferable.

## 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 irreparable damage. **Note:** At 100% throttle the temperature of the fuel pump can go up to 70 Deg C, a place in the vehicle with cooling air would be preferable.

## 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 Nike and its systems properly.

Check for updates of this Nike manual the AMT Netherlands website. (download area)

## 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 connectors, as this guarantees that everything fits properly. If the availability of FESTO components is a problem for you, then please contact AMT Netherlands or your AMT dealer for supplies.

The total quantity of the delivered goods is to be found in the packing list, the packing list at the left facing page is a "example". The actual packing list shipped with the engine can be different due to agreements made with the customer.

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3. Extra requirements

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### 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: Jet A-1       | This fuel type is used in commercial aviation.   |
| 2: JP-4/Kerosene | This fuel type is used in the military aviation. |
| 3: Paraffin      | This fuel type is mostly used in oil stoves.     |
| 4: Diesel        | Contact AMT Netherlands for details              |

The Nike also uses the fuel for lubrication, so the fuel must be pre-mixed with 4,5% Areoshell 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 vaporize 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.

\* Check for other suitable oils our website. (<http://www.amtjets.com/specs.php>)

**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 Ignition system

The ignition system is developed around a "Webasto" 12 volt ceramic igniter with the Webasto part # 84906B. The ceramic igniter must be replaced by AMT Netherlands in case of a failure, special tooling is needed for replacement.

Under normal conditions the ceramic igniter will last more than 1000 starts.

**Note:** From ECU software version V23 and higher you will get "no start clearance" on the EDT display when the igniter is faulty, also high intermitted beeps from the ECU when going into the start sequence indicate a faulty igniter. At a faulty igniter the startup sequence will be aborted and no start is possible.

### 3.3 Fire extinguisher

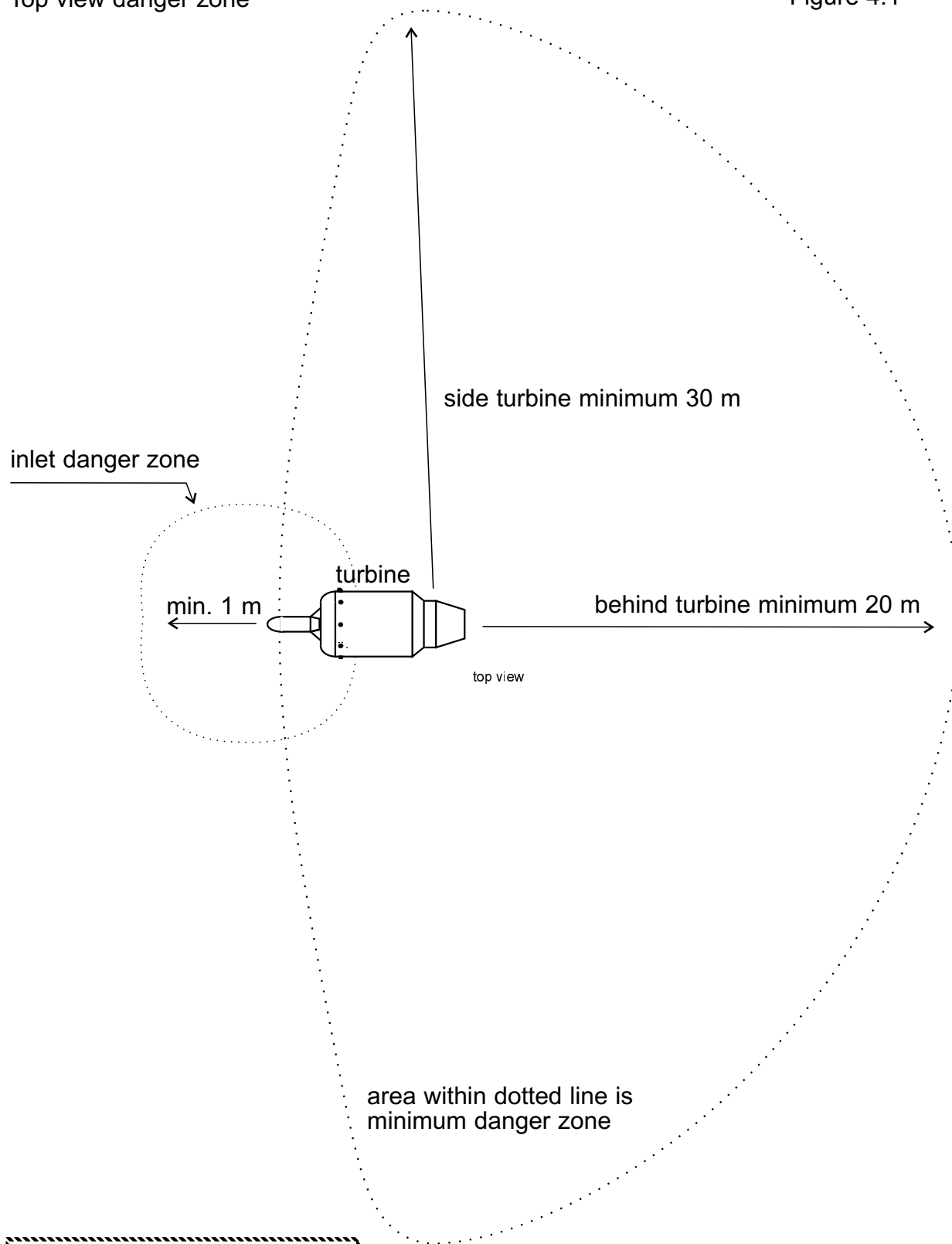
Safety is of the utmost importance, so please make sure that you have a properly functioning fire extinguisher within reach, and take care that at least one of your assistants is able to handle it.

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. Safety

### 4.1 General

A turbine of this size is a type of motor that needs more safety precautions than the smaller version AMT Netherlands does manufacture.

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 vehicle. 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

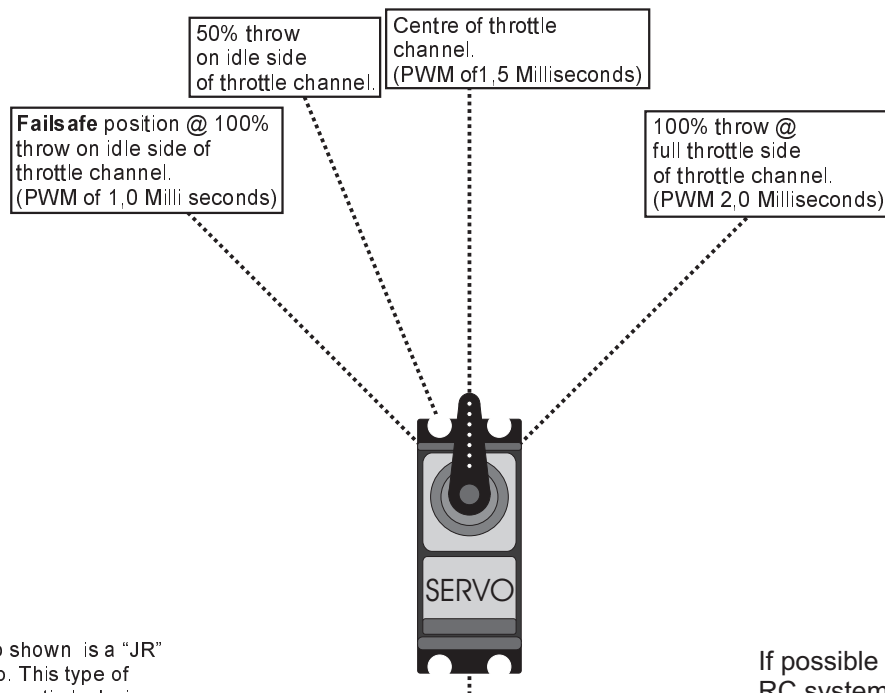
A turbine mainly produces noise in the high frequencies. Often these noises are not experienced as annoying, but prolonged exposure may still harm your hearing, and especially as an operator you are intensively exposed to this noise. Therefore please wear sufficient hearing protection when running the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

### 4.6 Liability

**AMT Netherlands** is not liable in any way for whatever damage or injury, resulting from the use of the Nike gas turbine.

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figure 5.1

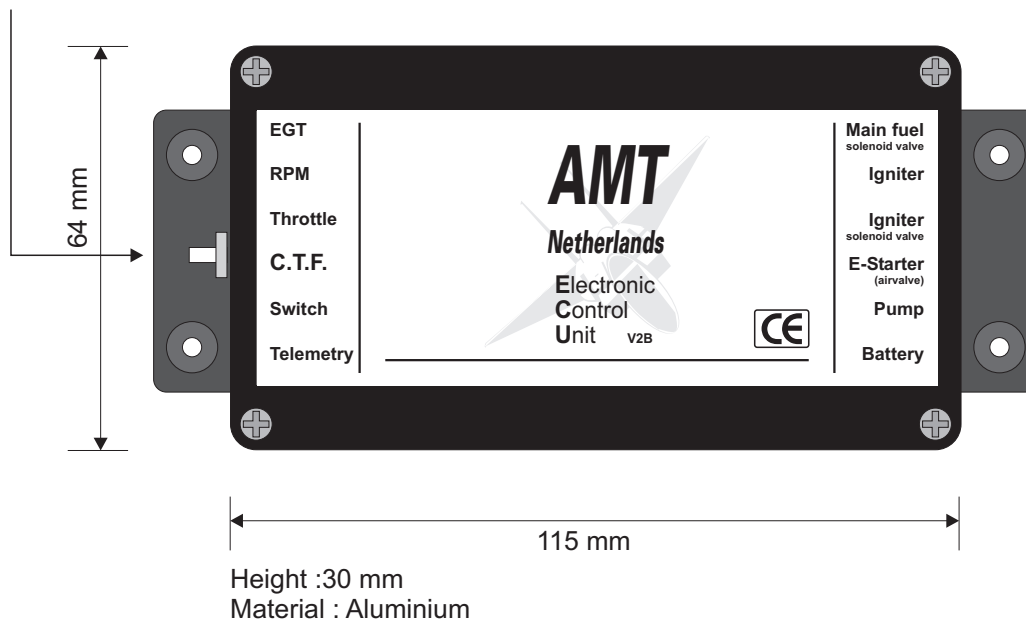
**Note:**

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 2b ECU.

figure 5.2

**" F " button**

## 5.1 Description of ECU

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

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

Most likely before using the gas turbine into a vehicle the gas turbine will be tested, to control the ECU you could use your Flight Management System (FMS) or a RC set used in model aeroplane. In general there are 2 RC 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. When, for testing purpose, a FMS will be used to control the ECU the inputs "throttle and switch" have to be calibrated similar to a RC system

### 5.2.1 Adjustment of Failsafe 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.

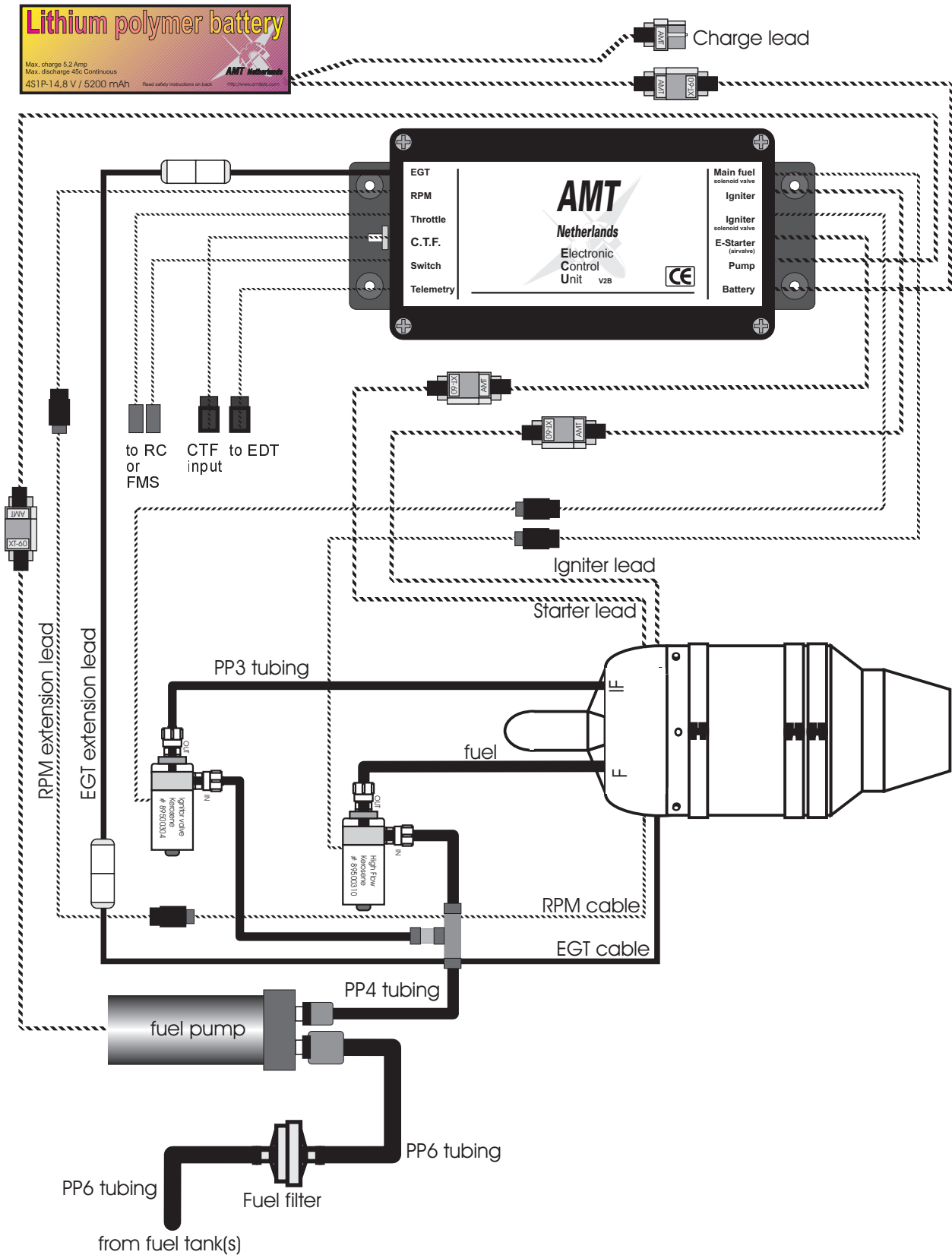
Now go to the failsafe menu of your transmitter and set the failsafe function for your throttle and program the channel to go to "idle" in case of a failsafe condition. Check with a servo connected to the receivers throttle channel if the servo moves to the idle position in case of a failsafe condition. 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.

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Power supply  
4S Lipo Battery

Figure 5.3



5. Electronic Control Unit V2

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Please check the throttle channel with a servo connected to the receiver and check if the failsafe indeed goes 10-20 deg further than 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 2-second delay.

### 5.3 Definition of input channels

The ECU uses as inputs:

- A: Exhaust gas temperature (EGT).
- B: Rotation speed (RPM).
- C: Throttle channel (RC receiver / FMS\*).
- D: CTF input.
- E: Switch channel (RC receiver / FMS).
- F: Power supply. (4 cell LiPo 5200-6000 Ma/hour)
- G: Function button
- H: Telemetry (to control the ECU via RS232)

The outputs present are:

- A: High flow kerosene solenoid valve connection.
- B: Igniter connection.
- C: Kerosene starter fuel solenoid valve connection.
- D: Electric starter connection.
- E: Fuel pump connection.
- F: Telemetry, also for EDT connection.

\*FMS = **F**light **M**anagement **S**ystem.

#### 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 (EGT sensor) is mounted in the appropriate place in the exhaust nozzle of the turbine. (7-8 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.

**Note:** When the EGT sensor is not mounted correctly this can result in not successful starts.

#### 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, a 50 cm extension cable is included when needed.

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figure 5.4 Dual channel operation

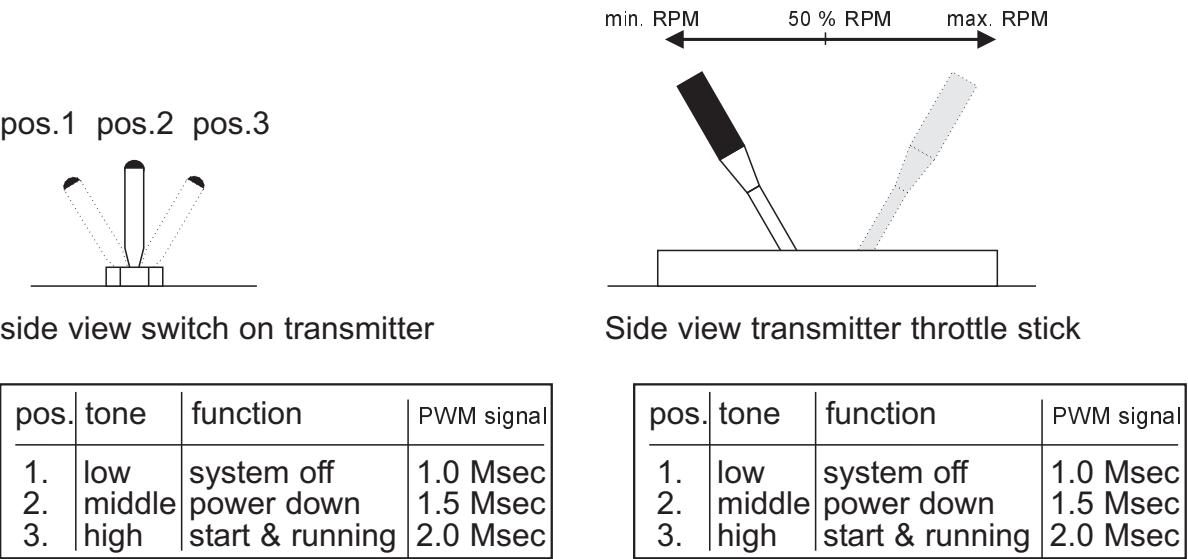
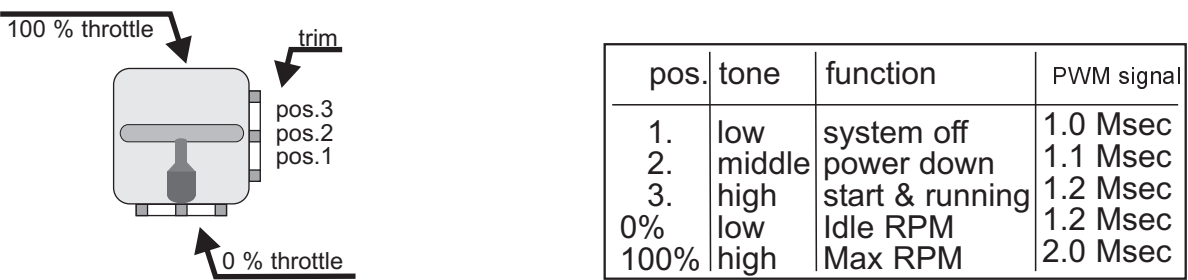


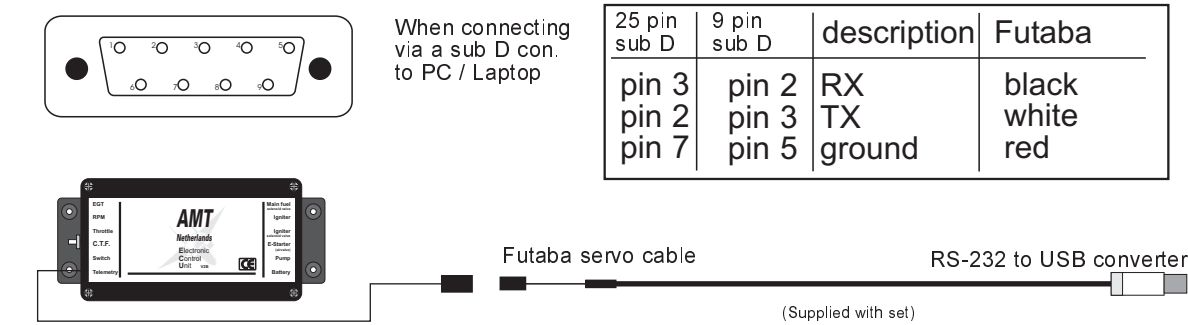
figure 5.5 Single channel operation



Throttle to thrust relation

Stick	RPM	Thrust
min.	20.000	< 40 Newton
50 %	40.000	~270 Newton
max.	61.500	>784 Newton

figure 5.6 Rear view 9 pol. connector to P.C. (Not supplied with set)



5. Electronic Control Unit V2

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**Important note:** Keep the complete RPM cable away from any high current cables like; Battery, Igniter, E-starter, Fuel pump or other “high current” cables.

### 5.3.3 Regulator channel input C

This input channel must be connected to a PWM signal between 1,0 and 2,0 millisecond which repeats every 20-25 milliseconds 1,0 millisecond PWM equals 0% throttle, 2,0 millisecond equals 100% throttle.

### 5.3.4 Switch channel input E

This input channel must be connected to a PWM signal between 1,0 and 2,0 millisecond which repeats every 20-25 milliseconds . 1,0 millisecond PWM equals emergency stop position. 1,5 millisecond equals auto power down and 2,0 millisecond equals the start and running position.

### 5.3.5 Power supply input F

The power supply input is designed for a **4 cell Lithium Polymer** (Lipo) battery, the advised capacity of the battery pack to be used is 5200-6000 Ma/hour. The supplied pack has a rating of 5200 Ma/hour or higher. The current at full throttle running will be between 10 and 12 amps depending on ambient conditions fuel system etc, at starting the “peak” current can go up to 20-30 Amp.

**Note:** To have LiPo batteries working properly, they need to be “balanced” on a regular base. LiPo chargers and balancing equipment are also separate available from AMT Netherlands.

#### **Low battery error at a running engine.**

The error message “low battery” at a running engine will be generated at 10,0 volt. (2,5 volt for each Lithium Polymer cell) With this error message the engine will go to full stop.

#### **Low battery error at a the starting sequence.**

At the starting sequence the supplied voltage should at least be 14,0 volt or a low battery error will be generated, and the start-up will be aborted.

#### Information for the TMC (Turbine Management Centre) program:

Address 201 for a low battery error at start-up. (error is set at 14.0 volt for Lipo use)

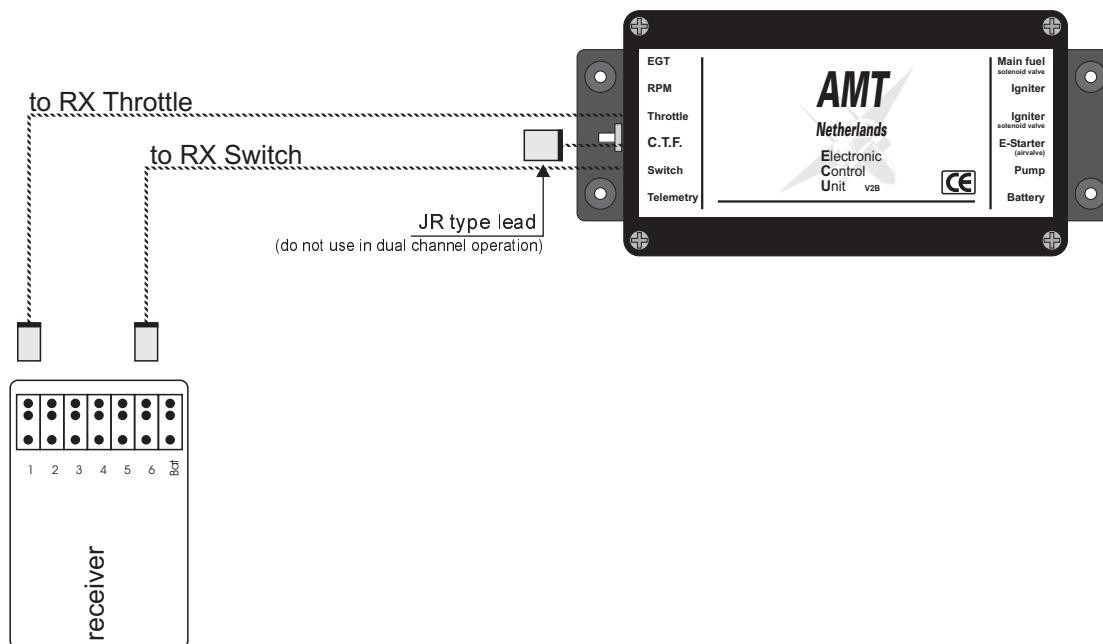
Address 200 for low battery error at a running engine. (set at 10,0 Volt for Lipo use)

When a different power supply is use used as mentioned above the battery error levels have to be changed in the appropriate way with the supplied TMC program.

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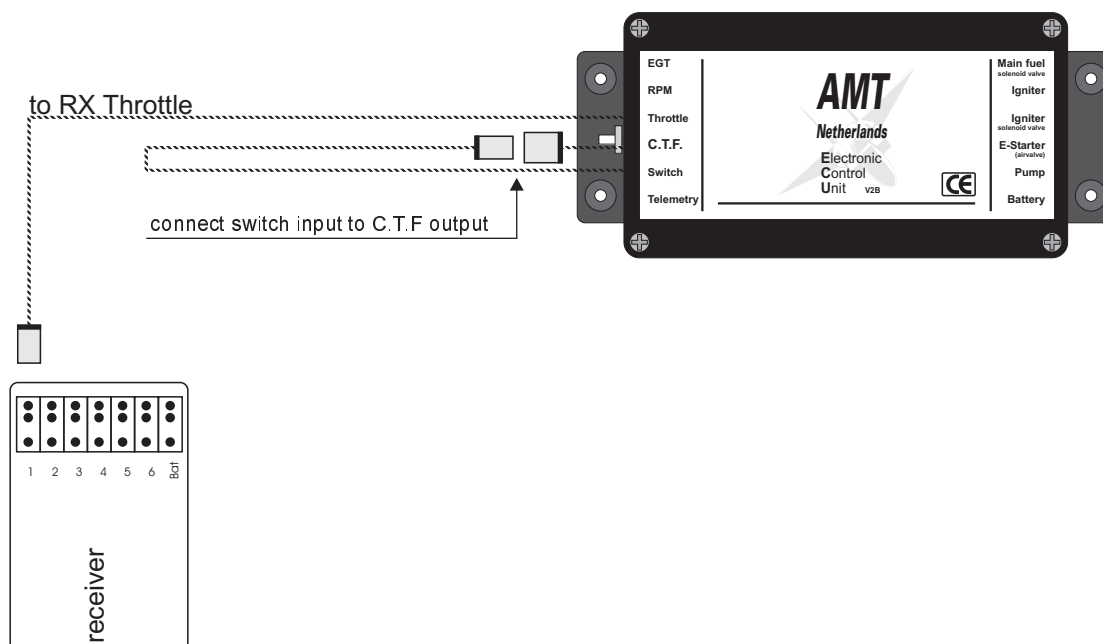
Wiring diagram of CTF button for dual channel operation.

figure 5.7



Wiring diagram of CTF button for single channel operation.

figure 5.8



5. Electronic Control Unit V2

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**5.4.1 Dual channel operation**

In this mode both input channels (input C & E) are used to control the ECU and therefore the engine.

The function button is used to “teach” the ECU the pulse width of your radio system or FMS. To program two channel operation follow this sequence:

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

When you are using a RC 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 have only one channel 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.

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### 5.4.2 Single channel operation

**Note:** The moment you connect the switch channel input E of the ECU into the CTF lead, the ECU operates in single channel mode. (Combined Throttle Function)

To program the single channel operation follow this sequence:

- 1 Connect the throttle lead to the correct channel on your RC receiver or FMS.
- 2 Connect the switch lead of the ECU to the CTF lead.
- 3 Switch "on" Transmitter and RC receiver or FMS.
- 4 Push down the function button, and hold it pushed down.
- 5 Switch "on" the ECU after a few seconds you will hear a beep.
- 6 Release the function button.
- 7 Put the throttle in the "Idle" position and put the trim of your throttle channel on your RC 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 function button. ECU will give a beep for confirmation.
- 8 Put the trim of the throttle on your RC transmitter in the "Middle" position and push and release the function button. ECU will give a beep for confirmation.
- 9 Put the trim of your throttle on your RC 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 function button. ECU will give a beep for confirmation.
- 10 Leave the throttle in the "Idle" position and push and release the function button. ECU will giving a beep for confirmation.
- 11 Put the throttle in the "Max throttle" position and push and release the function 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 switch channel connected the CTF lead of the ECU.

**Note:**

When using a RC system 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.

When you are using a RC 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

---



## 5.5 Definition of output channels

### 5.5.1 Output A, High flow kerosene solenoid valve connection

This output must be connected to the high flow fuel solenoid valve. When you connect the pp4 tubes to the valve be careful of the correct flow direction, which is clearly marked on the valve with an arrow.

### 5.5.2 Output B, Igniter connection

This output must be connected to the Webasto ceramic kerosene igniter of the engine.

### 5.5.3 Output C, Igniter solenoid valve connection

This output must be connected to the kerosene starter 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.

### 5.5.4 Output D, Electric starter connection

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

### 5.5.5 Output E, Fuel pump connection

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

### 5.5.6 Output F, Telemetry - EDT connection

This output can be connected to the **Engine Data Terminal** 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 the AMT Netherlands website.

**Note:** From software version V34 and up the ECU also can be fully controlled by the serial port of a PC. The serial protocol for own applications is available from our website but also available from the supplied CD.

---



## 5.6 Buzzer

### 5.6.1 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 <i>series</i> 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.<br>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.<br>It occurs when you attempt to start up your engine and the exhaust temperature is too high or the igniter is faulty.  |
| 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.<br>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!

- 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: low supply error.

When an error occurs the type of error will be displayed on the bottom line of text on the EDT when going to the full stop position of the 3 position switch.

When resetting the ECU error (5.6.2) also the error message in the EDT will be removed from the bottom line.

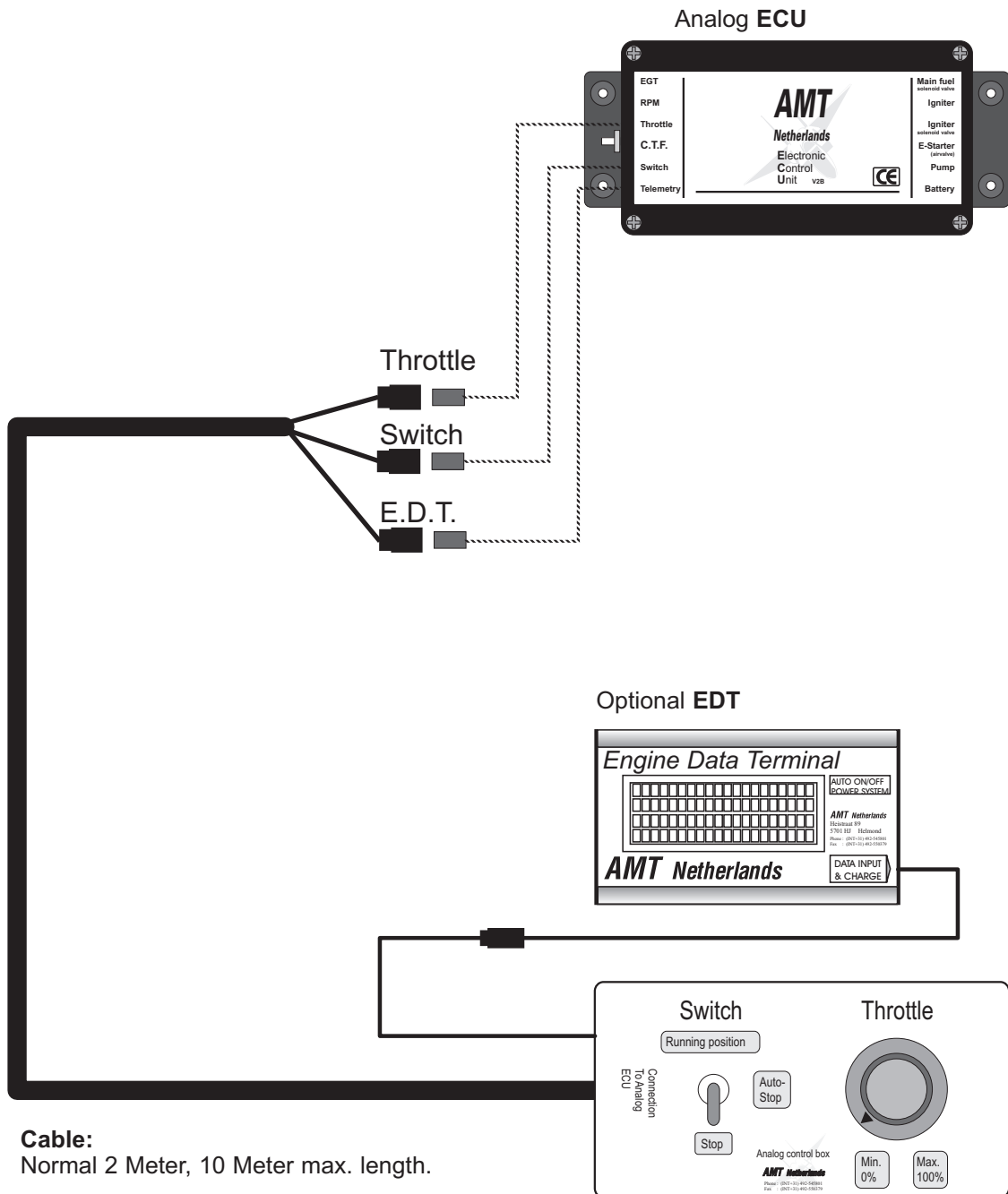
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figure 5.9

**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.

Now 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.



5. Electronic Control Unit V2

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**5.6.2 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 button 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.

**5.7 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.

**5.8 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](mailto: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%	<b>Igniter switches on.</b>	(will switch on igniter)
40%	Not in use at this moment.	
50%	<b>Priming function.</b>	(opens main fuel valve (output A) and activates fuel pump)
60%	<b>Priming function.</b>	(opens starter valve (output C) and activates fuel pump)
70%	Not in use at this moment.	
80%	<b>Activation of starter motor .</b>	(will activate electric starter)
90%	<b>Clutch check.</b>	(will activate clutch check with on/off interval)
100%	<b>Quick cooling function.</b>	(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.

### **5.8.1 Activating of extra features in dual channel operation**

To activate extra features dual channel mode, please handle as follows:

- Switch on the TX, RX or FMS and the ECU.
- Calibrate the ECU as described in chapter **5.4.1** 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 the desired position. (e.g. 50% for the priming function of the main fuel line).
- Now push the CTF button, after 2 seconds the selected feature will be activated.
- Releasing the CTF button will deactivate the function.

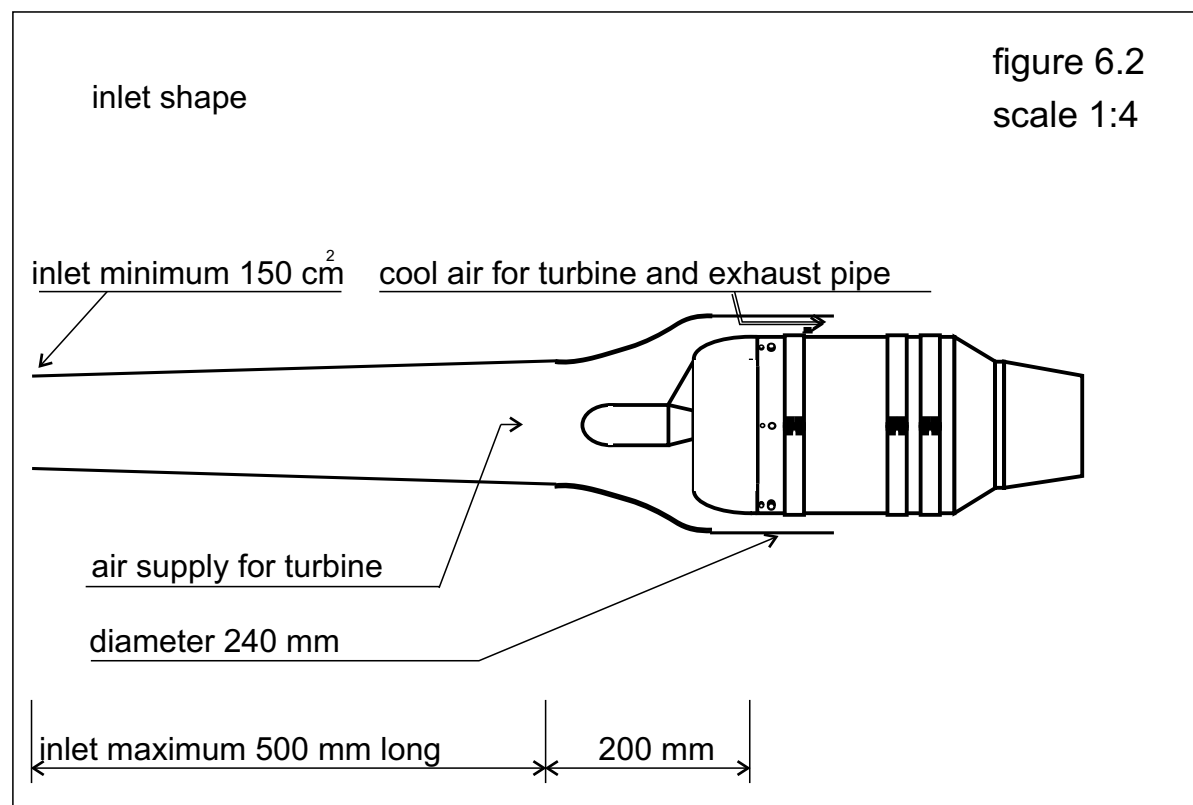
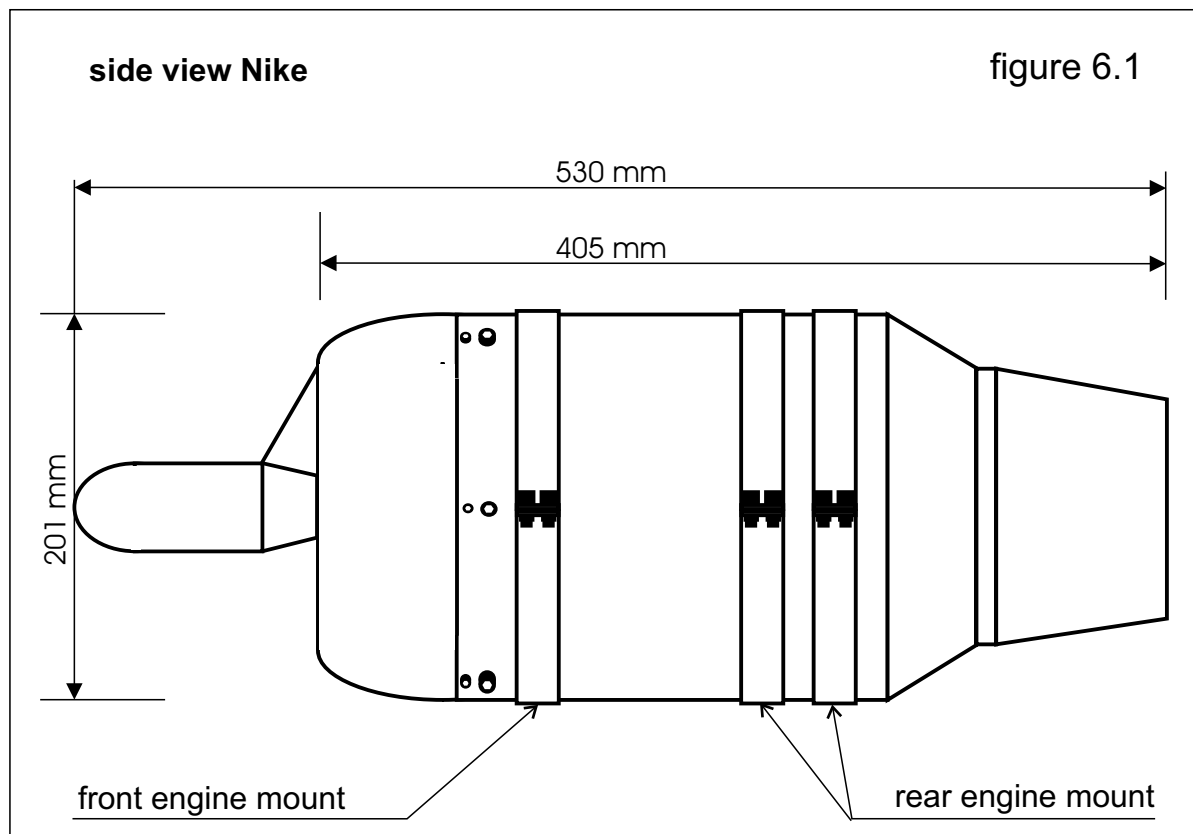
### **5.8.2 Activating of extra features in single channel operation**

To activate extra features single channel mode, please handle as follows:

- Switch on the TX, RX or FMS and the ECU.
- Calibrate the ECU as described in chapter **5.4.2** for single channel operation, when ECU was already in single channel operation you do not have to do this again.
- Push down the CTF button for 5 seconds until you hear a confirmation beep
- Put your throttle the desired position. (e.g. 50% for the priming function of the main fuel line).
- Now push the CTF button, for 3 seconds after releasing the selected feature will be activated.
- Power down of the ECU 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.

---



## **6.1 Dimensions of Nike E-start.**

Figure 6.1 shows in scale 1:2 the dimensions of the Nike gas turbine. Note that the 201 mm dimension is the max. diameter of the casing, and does not include the mounting brackets and external connections like the igniter.

## **6.2 Position of Turbine.**

The Nike 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 15mm 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.**

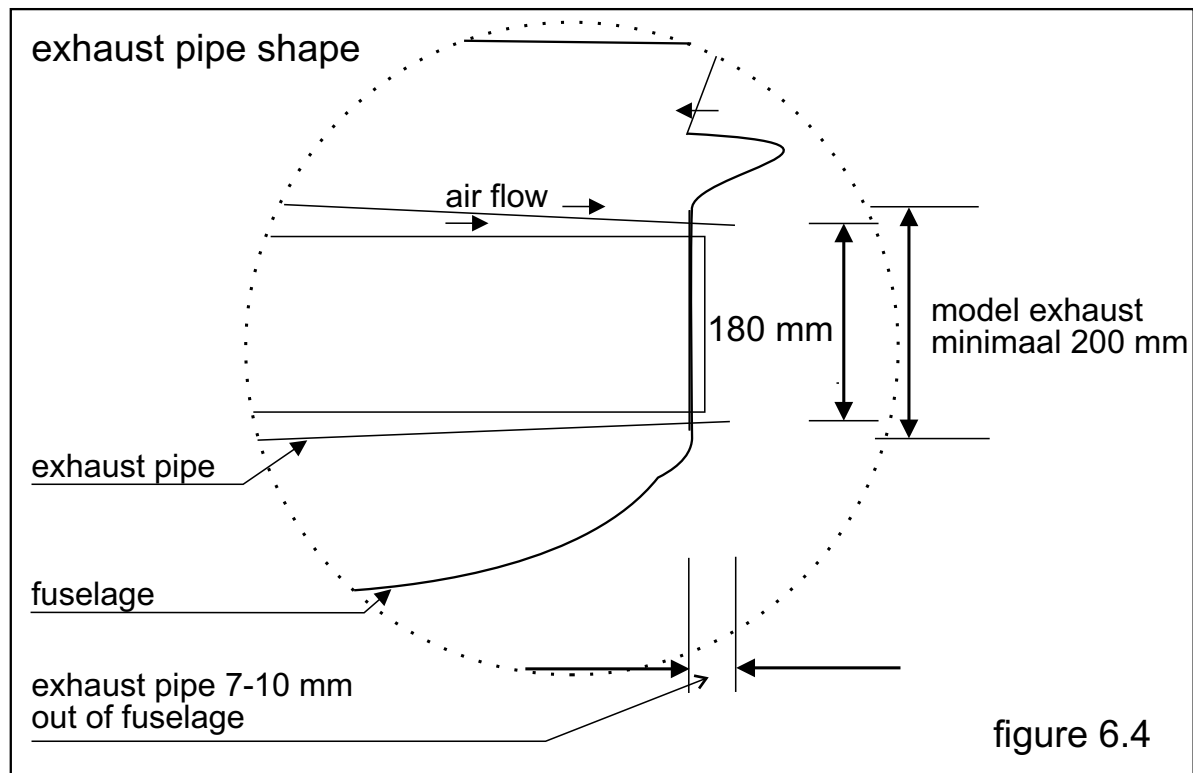
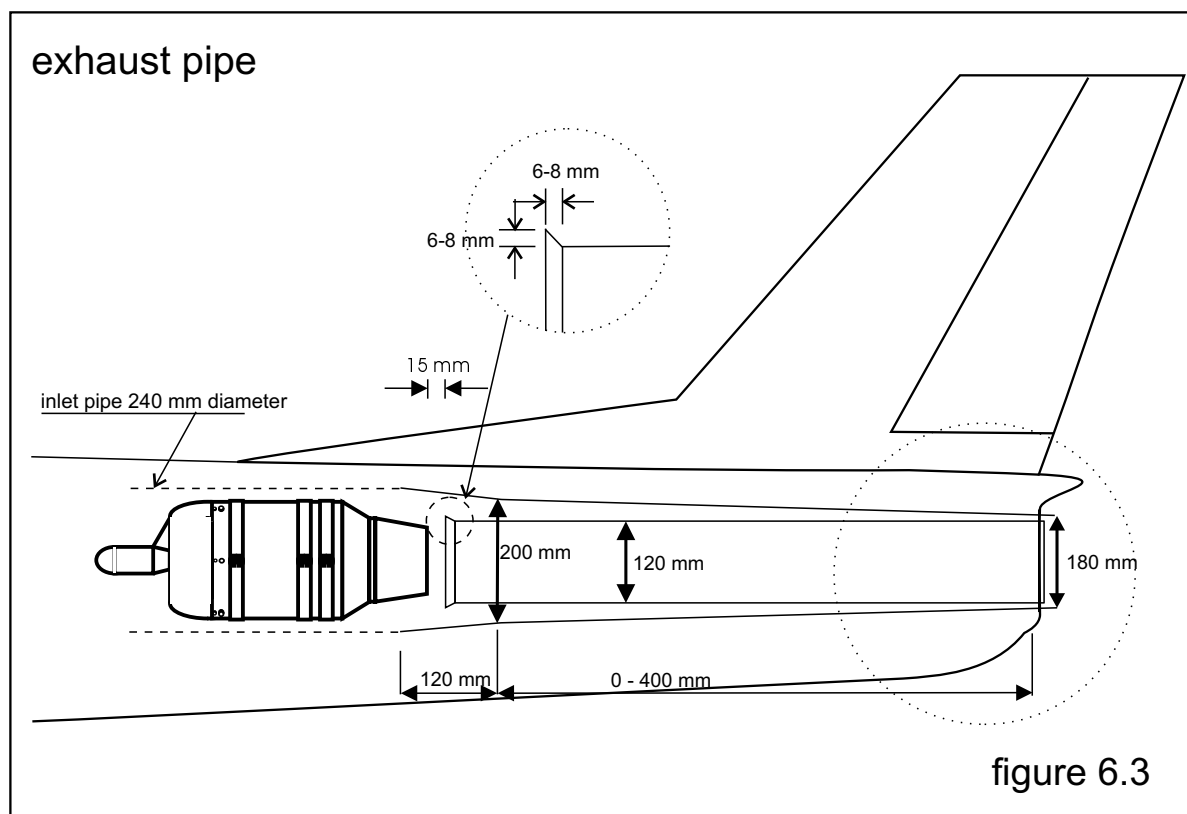
The Nike engine has an inlet of 112mm in diameter. This is equal to a surface area of 98,5 cm<sup>2</sup>. Therefore the air inlet duct of your vehicle needs to have a minimum area of 98.5 cm<sup>2</sup> for the engine air plus extra 50 cm<sup>2</sup> area for the "bypass air" when a bypass system is used as in figure 6.2. This all for a vehicle air speed of aprox. 100 Meter / second, different airspeeds will have different "ideal" intakes.

### **6.3.2 Air inlet duct.**

The air inlet duct to the Nike engine 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 turbine, 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 230-240 mm) is being cooled properly.

---



#### 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 400 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 0.25 to 0.40mm. 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 0.2 to 0.30mm thick (to save weight) because it does not have to withstand such high temperatures. Some customers have also successfully used 0.2mm thick aluminum for the outer tube.

#### 6.4.2 Exhaust duct cooling.

Because the Nike 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 - 400°C (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 60-90°C (see figure 6.4).

Note that the outer tube should be mounted approx. 7 -10mm outside 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 Nike . Any deviation will result in a duct that does not function properly, and can affect the performance of the engine.

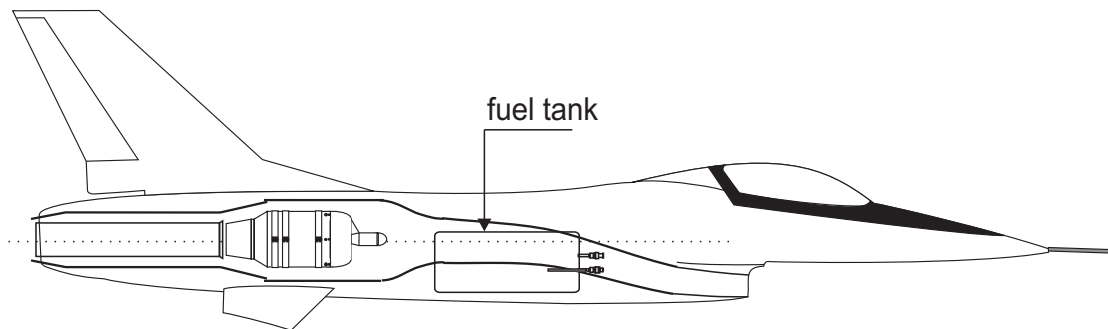
#### 6.5 On-board fuel pump.

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.

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Engine &amp; Fuel tank position

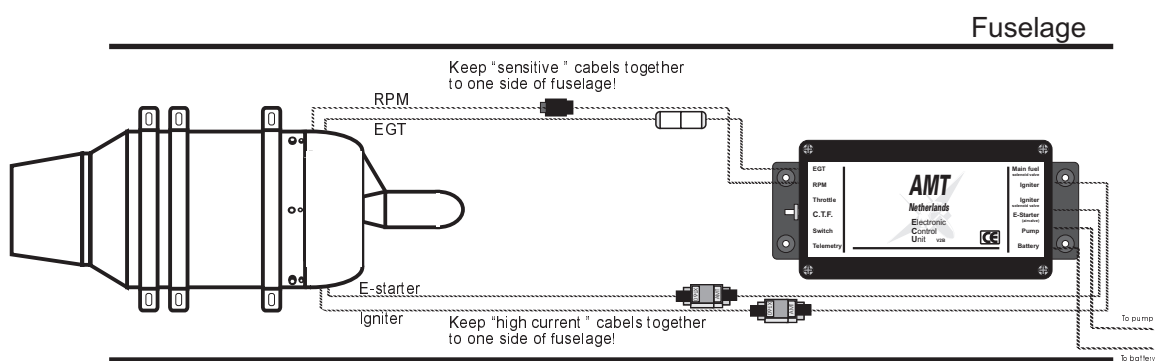
figure 6.6



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

ECU to engine wiring

figure 6.7



Note: items are not to scale !

## 6.6 Tubing size.

The total length of tubing between fuel pump and fuel tank may be a maximum of 100cm with an internal tube diameter of 6mm (PP6), the fuel filter may be placed on every position in this fuel line.

For the main fuel line from fuel pump to turbine a fuel line with an internal tube diameter of 4mm (PP4) with a maximum length of 150 cm.

From the igniter solenoid valve to the igniter a fuel line with an internal tube diameter of 3mm (PP3) with a maximum length of 150 cm.

## 6.7 The thermo-couple.

The K-type thermo-couple, with 1,0 mm thickness and isolated type, is mounted in the EGT mounting under the front cap. The tip of the thermo sensor is 7-8 mm deep mounted in the exhaust gas flow, seen from the inside of the exhaust nozzle, a 1,4 mm diameter hole is drilled in the turbine nozzle for this purpose. If the existing thermo sensor needs to be replaced undo the locking screw in the EGT mount and pull out the old EGT sensor.

A new EGT sensor must be mounted from the front of the engine, be sure that the thermo-couple sticks approx than 7-8 mm inside the exhaust nozzle seen from the rear, a improperly mounted EGT sensor might give incorrect temperature readings and faulty start-ups.

The sensor has a lead of 45 cm, but it may be shortened or extended with the correct K-type thermo sensor cable. (watch the polarity).

## 6.8 On-board ECU.

The ECU is made of valuable and sensitive electronic components, and therefore it should be installed using the attached mounting brackets with rubber grommets, do not over tighten the bolts which going through the centre of the rubber grommet

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.

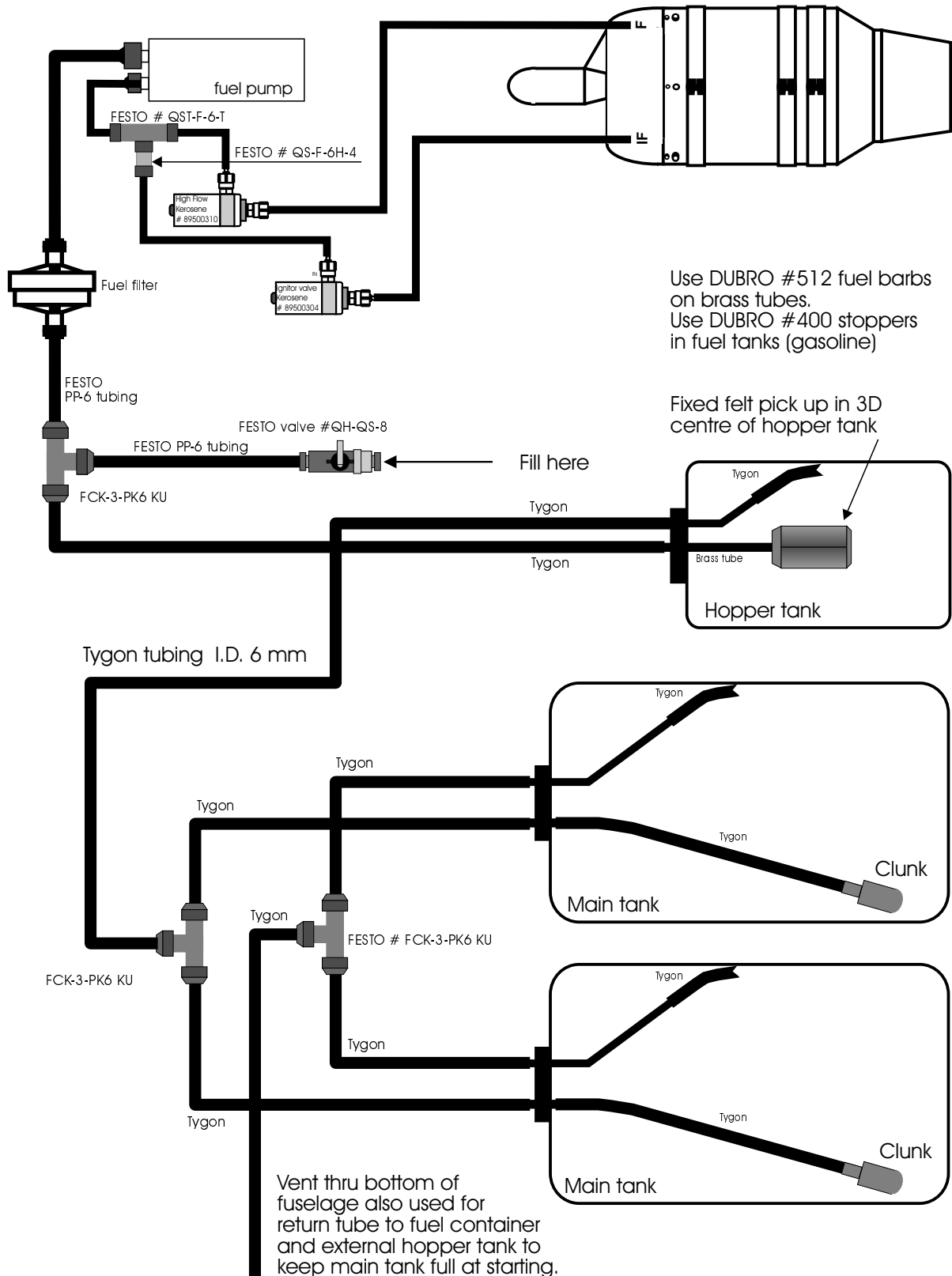
**Important;** Keep the “sensitive inputs” (RPM & EGT) to one side of the fuselage and the “high current” cables to the other side of the fuselage. (see fig 6.7 on the left page)

If possible 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.

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## Hard Tank fuel system

Figure 6.8

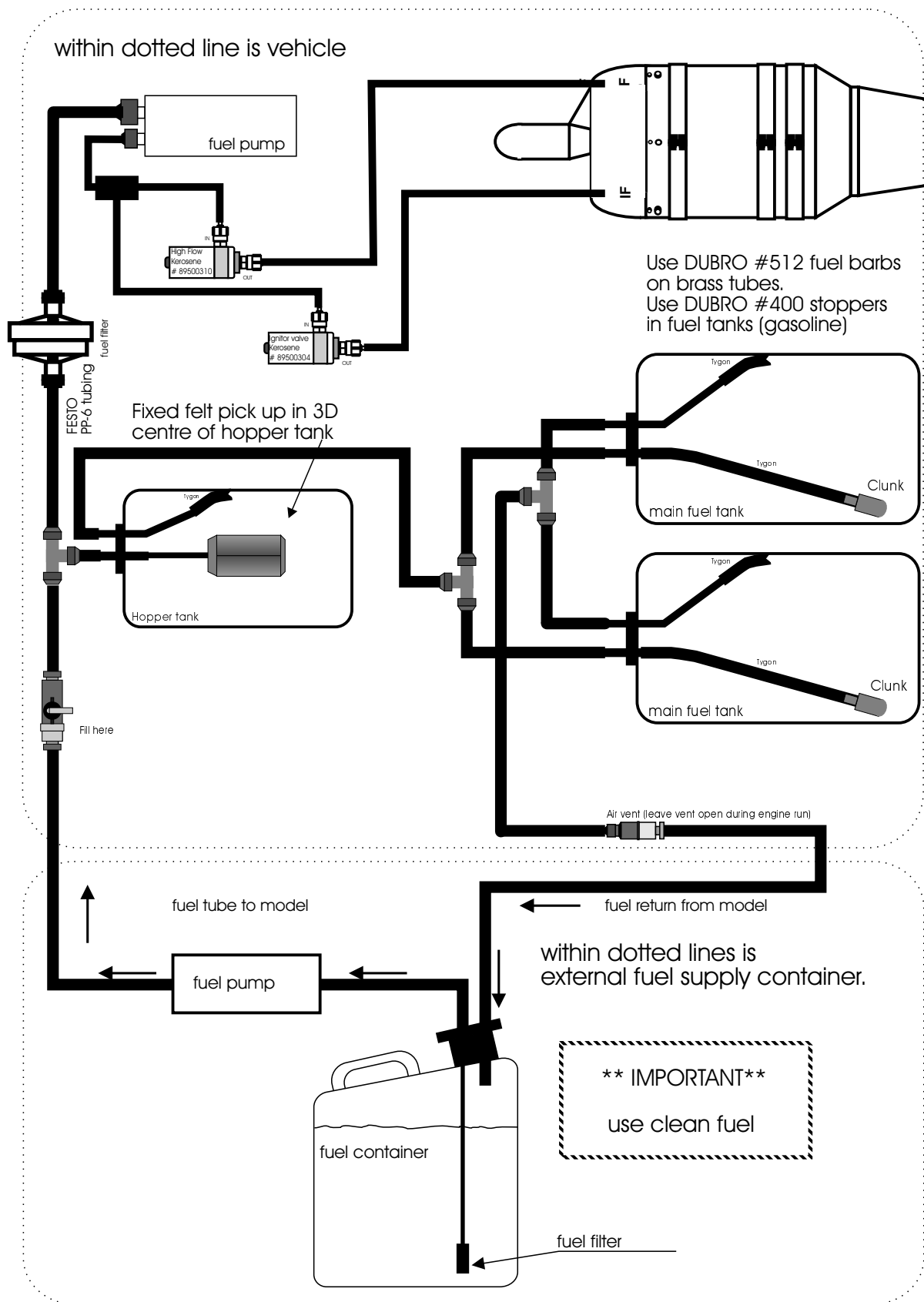


## 6.9 Hard fuel tank installation

If possible 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, PP4 and PP6 tubes supplied with your AMT turbine are all suitable for use with kerosene based fuels.
  - It is very important that no 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 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. We recommend a minimum hopper tank capacity of 1000 ml (28 fl.oz) for the Nike engine.
  - 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 high flow kerosene valve which only opens when the fuel pump is running.
  - If you are using 2 main tanks you will require Tee pieces to connect the fuel tanks, be sure to use sufficient inner diameter for the Tee pieces, the ID of the Tee piece may not be smaller than the ID of the tubing itself. Make sure that the length of tubing from each tank to the Tee piece is equal. At a proper designed fuel system each main tank is during operation emptied 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.
-

Figure 6.9



### 6.10 Fuelling up

**Important:** Before fuelling up the vehicle, 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 vehicle will remain full after you have started the turbine, until the vehicle takes off.

- 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 (**air vent tube must be pointed in flying direction**). Leave the return hole in the external fuel container open/unblocked.
  - Start the engine 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 take-off. At this time disconnect the extra fuel container from the air vent. This method will keep the fuel tank 100% full until takeoff.
-



## 7. Operation

## 7.1. Fuelling kerosene

### 7.1.1 Fuelling

Fuel up the vehicle as described in chapter 6.

**Important note:** If fuel enters the turbine by accident, empty the turbine by putting the vehicle 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 Priming the fuel system

For a **first** successful start it is **very important** that all the fuel lines are filled (primed) with kerosene. For this “priming” are special software functions available, the 2 special functions needed are the “50%” and the “60%” priming functions as described in chapter 5.8 Extra features of this instruction manual.

First prime the igniter system (60% function), be sure that you do not prime into the igniter but disconnect the PP3 fuel line from the engine (G connection) before you prime and prime into a small fuel container.

Second prime the main fuel system (50% function), be sure that you do not prime into the engine but disconnect the PP4 fuel line from the engine (F connection) before you prime and prime into a small fuel container.

Be sure that there are no “air bubbles” visible, check all fuel lines.

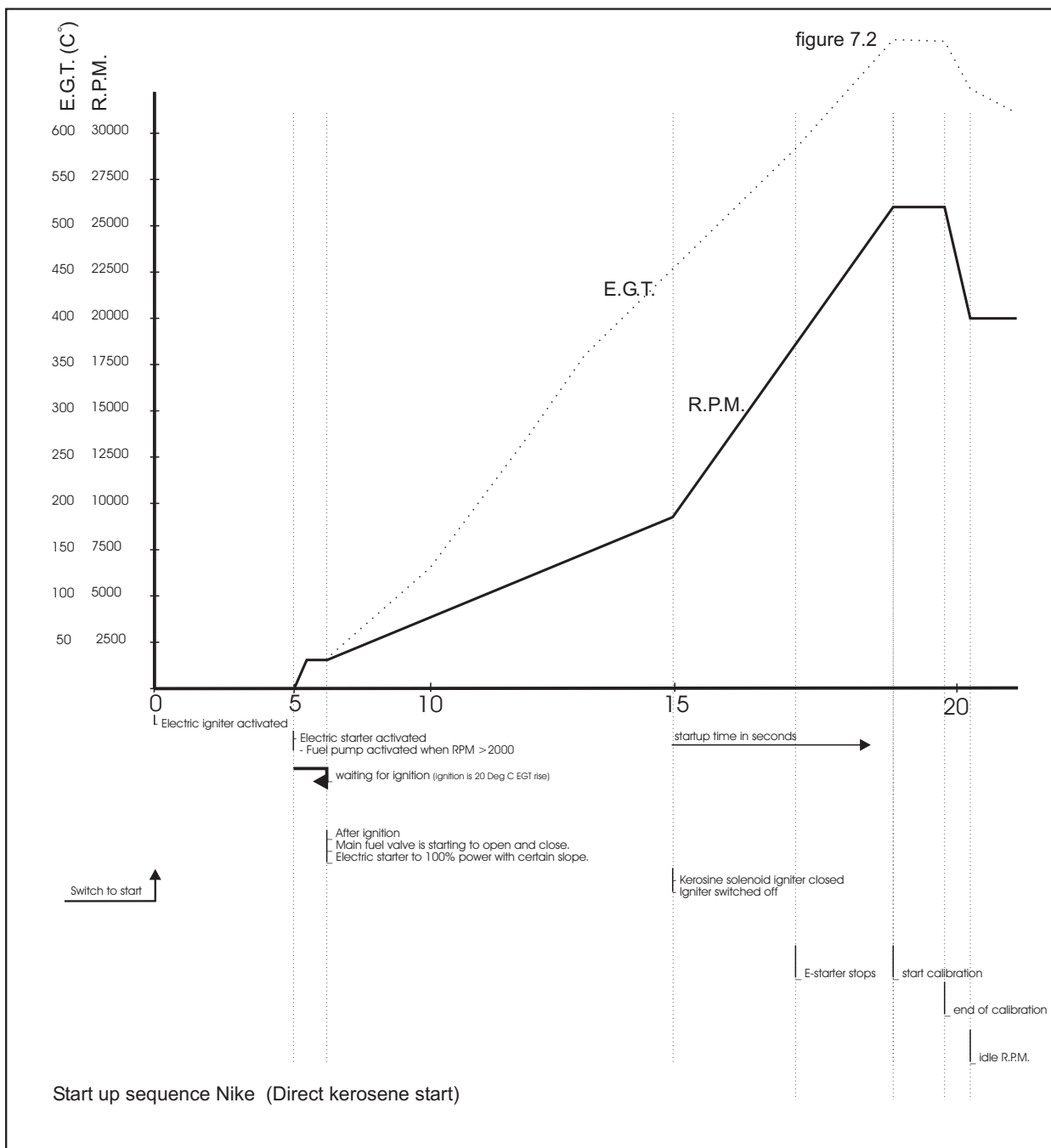
**Note:** After an normal engine run the fuel lines will be free of air bubbles and OK for a next startup, but it will be good practice to check fuel lines for air bubbles before every run.

## 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 control systems with their own pulse widths.

For calibration see chapter 5.4.1 for dual channel operation, or 5.4.2 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 pulse signals in your RC transmitter or FMS are 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 of the RC system.
-



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7. Operation

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- 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 the “no start up beep” (high pitch tone with short intervals) the thermo-couple reading is above 88 Deg Celsius and the engine should be cooled down. When the temperature reads below the 88 Deg Celsius during this error the kerosene igniter is broken and should be replaced.  
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 ECU beeps (low, middle and high beep tone) from the 3 position switch and 3 beeps from the throttle.
- 4 If you are using single channel operation you should get the 3 ECU 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 **Engine Data Terminal** (see chapter 11.5)
- 5 It is good practice to check throttle and switch (or throttle and trim) operation before every flight, by listening for the beeps as described above, or checking at you FMS (Flight Management System) or at your EDT screen.

### 7.3 Starting the Nike E-start (ECU software version 6.14 or higher)

**Note:** AMT recommends that you fully charge the ECU/pump Lipo battery before every flight, to be sure that you have the maximum energy possible for powering the electric starter and igniter 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 To start the turbine put the switch (or throttle trim lever) on the RC transmitter or FMS in the 'start/run' position (high-pitched beep). Now you will hear 5 “count down” beeps from the ECU, after the count down beeps the ECU will begin the start sequence and the electric starter motor will turn the turbine.

The preheat of the igniter will be switched on automatically as soon as you “go” into the start sequence.

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7. Operation

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**Note:** *If you try to start the turbine and you hear a continuous high pitched tone with short intervals, the engine's exhaust temperature is too high for restarting or the igniter is faulty, the start sequence will be aborted in this case.*

- 4 After the 5 “count down beeps” the ECU will engage the starter motor up to 3000 RPM, start the fuel pump and open the starter solenoid valve.
- 5 At a an EGT rise of 40 °C from the moment of “going into start” the main fuel valve will start opening and the electric starter motor will slowly increase RPM.  
**Note:** for this EGT rise of 40 °C the position of the EGT sensor is very important. See chapter 6.7 for details.
- 6 At a RPM between 10-15000 depending on a software setting the starter fuel valve will be closed and the igniter will be switched off.
- 7 The ECU will automatically throttle up the turbine to its calibration point at approx. 25,000 RPM. The ECU will keep the turbine at approx. 25,000 RPM for about 2 sec and then it will automatically throttle back down to idle RPM (20,000). Idle RPM is now calibrated.
- 6 You now have control over engine thrust with the throttle stick on your transmitter or FMS.

**Note:** When you throttle up for the first time after starting, the engine power is limited to about 95% for 1 - 2 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 keep the throttle to 100% for at least 2-4 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 RC transmitter or FMS to the middle position to activate the automatic power-down sequence.
  - The ECU now regulates the engine to 5 % throttle (approx. 25,000 RPM) for about 4 seconds and waits until the exhaust temperature stabilizes. Be careful - there is still about 4-5 kg of thrust at this RPM.
  - After this the ECU will stop the engine.
-



## 7. Operation

- 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 RC 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 fuelling and charging sequence

From the experience of AMT staff we have found that the following sequence between flights works well.

1. Connect fast Lipo charger to the ECU/pump battery and start charging, use a Lipo balancer on a regular base.  
  
(Be sure the ECU is **switched off** during charging)
2. Fill fuel tanks while charging is taking place, check for air bubbles when ready
3. Recharge all other batteries if necessary.
4. Check if all fuel lines are filled up to the engine quick connects, if not use the priming function 50% and 60%, be careful not to “prime” fuel into the engine this can cause “wet starts”, use a separate container for the excessive fuel.

**Note:** When you are using the supplied Lipo batteries AMT Netherlands recommends to balance the battery at least every fifth charge with the supplied balancer.

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## 8.1 Preventative maintenance

These are maintenance checks and procedures that the end-user can do 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 if needed change the fuel filter in the vehicle and in your external fuel container at least every 200 litres of fuel. **AMT NL** recommends replacing the filters every 100 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.

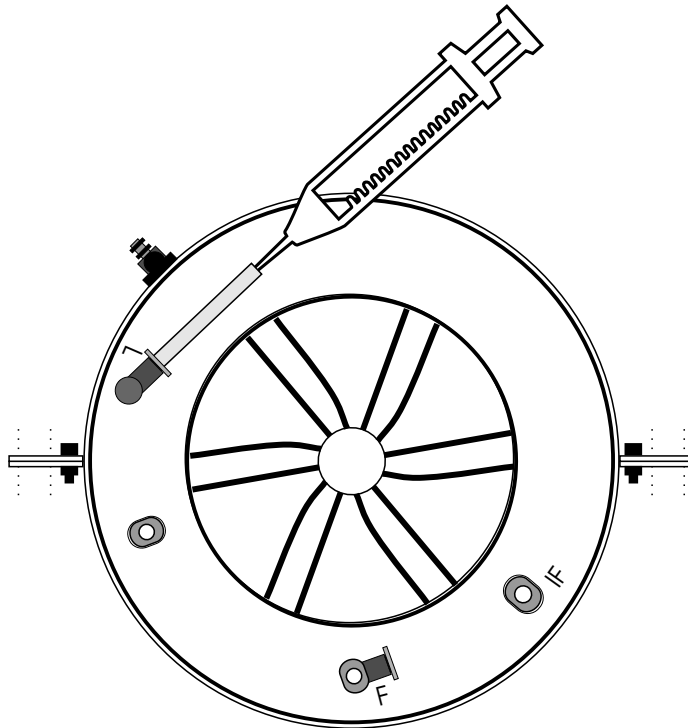
If one detects uneven, or rough, points when spinning the motor by hand, then one or both bearings are probably damaged. This could, for example, be caused by sand or grit particles that have been sucked in by the engine (approx. 1% of the ingested air passes through the bearings for cooling) or by dirt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

---

front view Nike, frontcap &amp; E-starter not mounted.

figure 8.1



3 ccm of aeroshell 500  
mix of 20 % as mentioned  
in chapter 8.2 right page.

## 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), fuel & gas input and the inlet & 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 the blue Festo Gas input quick-connector using a 2.5mm hexagon wrench inserted inside the fitting, the Air start connector uses a 3 mm wrench. 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 4 of the 5 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.

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Please fill out the "gray" boxes of this inspection form according the shipped parts and send this form together with the parts to **AMT Netherlands**

**AMT Netherlands**  
Spaarpot 34  
5667 KX Geldrop  
The Netherlands

\*\*\* INSPECTION FORM \*\*\*

Shipper information:

AMT Database sticker of customer.

h/ten of Inspect form 1

Date of shipping to AMT : \_\_\_\_\_  
Transport by : 0 UPS    0 DHL    0 \_\_\_\_\_  
Required turn around time: \_\_\_\_\_

Received @ AMT NL: \_\_\_\_\_  
Date of return shipping : \_\_\_\_\_  
Transport by : 0 UPS    0 DHL    0 \_\_\_\_\_

Description of work:  
0 Repair    0 Maintenance    0 Update

AMT Notes :

- ☐ Engine : NL \_\_\_\_\_
- ☐ Fuel pump : NL \_\_\_\_\_
- ☐ ECU V1      ☐ ECU V2
- ☐ E-Start      ☐ Air-start
- ☐ Front engine strap
- ☐ Rear engine strap
- ☐ Front cap
- ☐ Nicad battery    ☐ Lipo battery
- ☐ Solenoid fuel
- ☐ Solenoid gas
- ☐ C.T.F. switch
- ☐ Thermo sensor
- ☐ EDT
- ☐ Glow plug lead
- ☐ Fuel filter
- ☐ Kerosene igniter
- ☐ \_\_\_\_\_

- ☐ Engine : NL \_\_\_\_\_
- ☐ Fuel pump : NL \_\_\_\_\_
- ☐ ECU V1      ☐ ECU V2
- ☐ E-Start      ☐ Air-start
- ☐ Front engine strap
- ☐ Rear engine strap
- ☐ Front cap
- ☐ Nicad battery    ☐ Lipo battery
- ☐ Solenoid fuel
- ☐ Solenoid gas
- ☐ C.T.F. switch
- ☐ Thermo sensor
- ☐ EDT
- ☐ Glow plug lead
- ☐ Fuel filter
- ☐ Kerosene igniter
- ☐ \_\_\_\_\_

Incomming checked by:

Outgoing checked by:

#### 8.4 Returning motor for service or repair

If you need to return the 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 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 the motor.

**Note:** If possible use at return shipments the “inspection form”, this form can be downloaded from our webpage at <http://www.amtjets.com/download.php>, the left page is an example of “inspection form”, of course you can also copy this one and use it with a return shipment.

#### 8.5 P3 Pressure fitting installation

All AMT gas turbines 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 or other.

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 with a “P3” marking. This grub screw 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. For full details of a possible smoke on you vehicle please look on the ‘Download’ page of our website at [www.amtjets.com](http://www.amtjets.com). For more details.

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### 8.6 Looking after the gas turbine

These are a few tips from our staff which will help prolong the life of the 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* over tighten the 5 bolts that hold the outer casing onto the motor, or the 5 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 Nike the clearance should be 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 M3 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 igniter 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 type of FOD often happens with new operators, who underestimate the suction of a miniature gas turbine.
4. When connecting pp3 and pp4 tubing into the Festo quick-connect fittings for Fuel and igniter at the front of the engine, please make sure that the 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 of 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 reliability 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 may need to complete the proper installation in your vehicle. Please supply us with accurate lengths when at ordering.

**Note:** A (Salt) water contamination procedure for the engine is available at AMT Netherlands, if needed send a request by email to AMT Netherlands.

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## 9. Engine Log

**9.1 How to complete the log**

Completing the log correctly is of great importance for the optimal use of the Nike engine. It does not only give you information about the running with the Nike, but can later also be useful for maintenance, fault finding, guarantee, or sale to a third party, etc.

.

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 Nike gas turbine				
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 disassembled 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.

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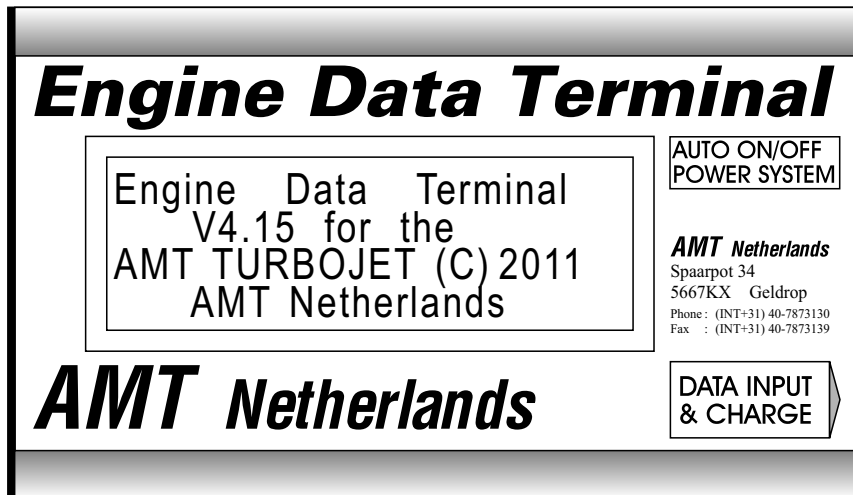


figure 11.1

(power up)

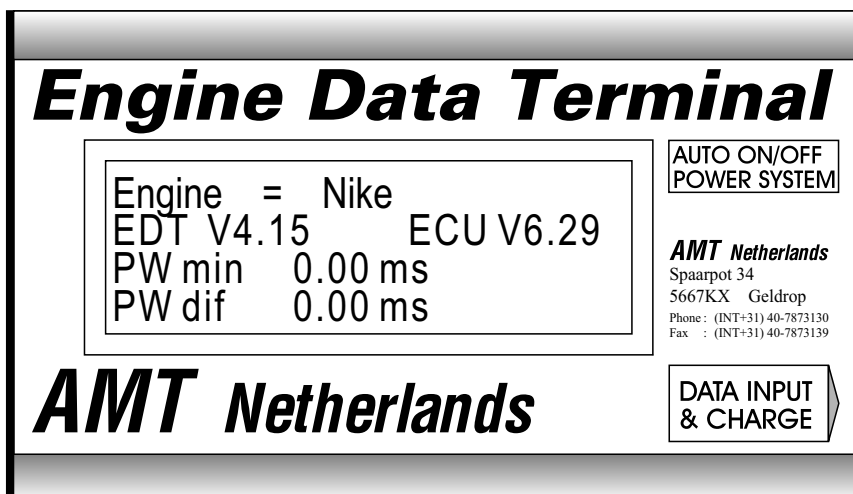


figure 11.2

(start up screen)

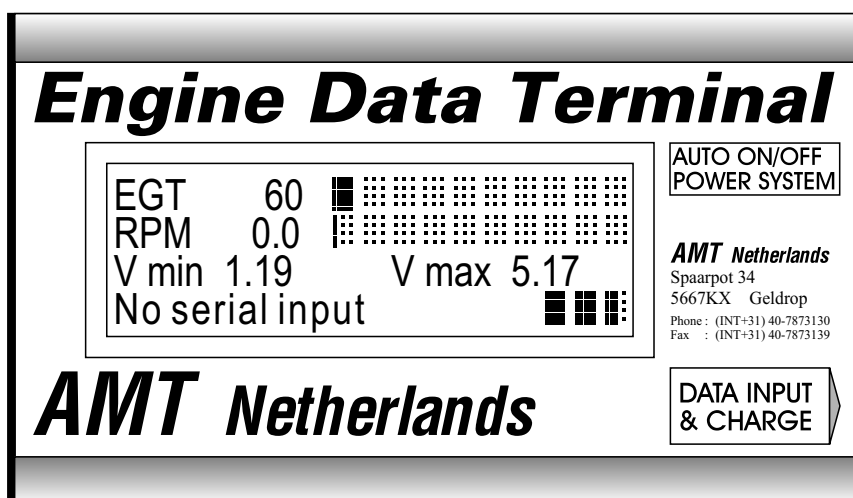


figure 11.3

(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 the older V1 and with new 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 50-60 mA current output.

The time required to fully charge the internal EDT battery is 14-16 hours.

### 11.4 Startup Screen

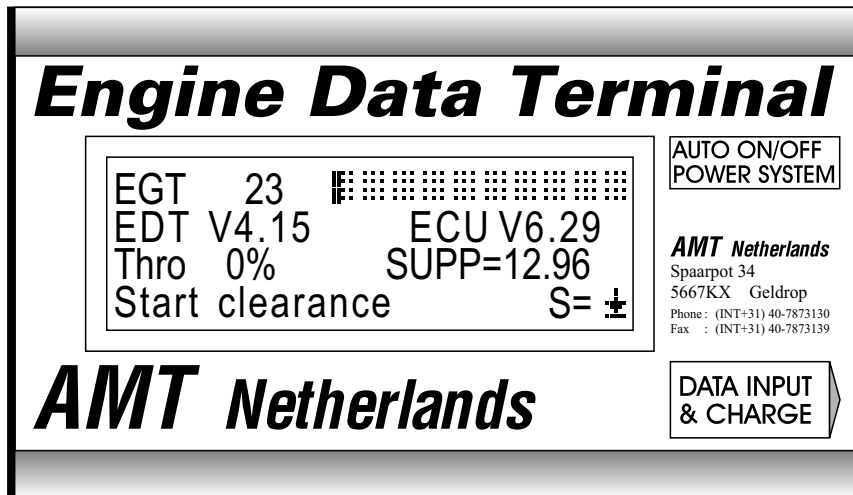
This is the 2nd screen displayed after the EDT receives data. After this you can calibrate the ECU with the three-position switch. When the calibration is OK, you will hear the OK beep from the ECU (see Ch.5.4.1) At this time the pulse width of your RC system and the engine type are shown on the EDT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

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**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)

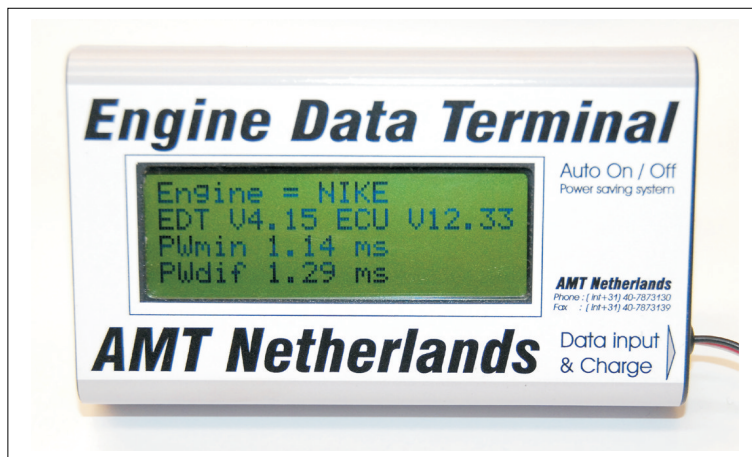
1st line: Exhaust Gas Temperature in °C (EGT)  
2nd line: Revolutions of shaft (RPM) and actual pump voltage (V out)  
3rd line: throttle position and ECU supply voltage or additional text  
4th line: additional text and position of the switch channel

**11.8 Additional Information**

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

The text "starting" in line three is a very important message. The message occurs when you are starting up the engine and the fuel pump is started.

---



11. Engine Data Terminal

---

**Start clearance**

-> Engine is ready to start up.

**Ignition**

-> EGT is detecting a rise in temperature of 40 °C at the startfase  
The main fuel solenoid start opening and the startermotor increases RPM.

**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.

**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 also occurs when there is no ignitor or a faulty one is connected.

**Note:** at “no start clearance” the system will not go into the startfase.

## 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.
-



**ECU errors**

- **Supply low error**  
= ECU battery voltage became below 10.0 volt during running.  
= ECU battery voltage is below 14.0 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 ?  
-> Check wiring.
- **Throttle fail**  
= no throttle channel connected.  
-> Check that receiver is switched on ?  
-> Check that throttle channel is connected ?  
-> Check wiring.

**Engine errors**

- **RPM low error**  
= engine RPM below 15,000 RPM for more than 4 seconds.  
-> check fuel system, possible air in the system.
- **RPM high error**  
= engine RPM over 65,000 RPM\* . (\* at normal MAX RPM settings)  
-> check fuel system, possible dirt in the system.  
-> possible bent fuel line.  
-> possible fuel pump problem.
- **EGT error**  
= EGT over 1100 °C at startup.  
> check position of thermo sensor in nozzle. (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 at the EDT but only at the download of the ECU.

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# Engine log















