Manual & ENGINE LOG (V32C)

Nike gas turbine©

EPV version.

Serial number N L

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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.


AMT

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 62,000 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. The EPV was introduced middle of 2014.

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

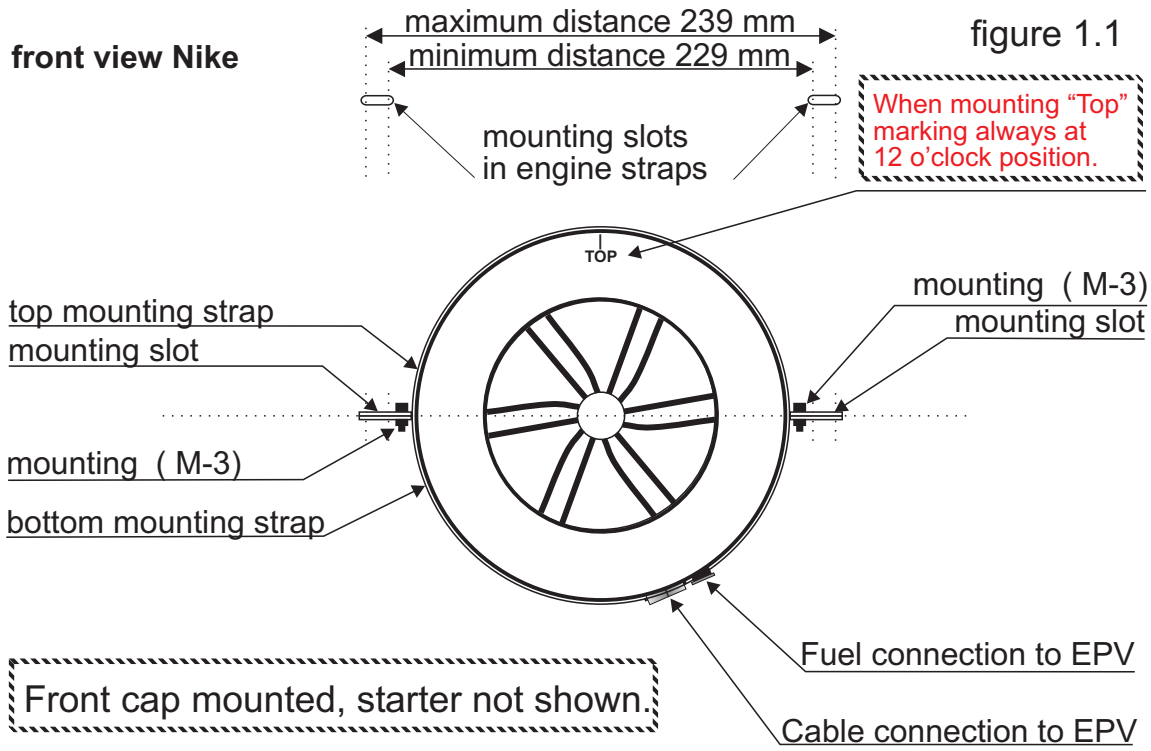
The Nike has been constructed from a single radial compressor and an axial flow turbine. The Nike owes much of its excellent performance and superb power/weight ratio to this turbine wheel which was designed by skilled engineers especially for our motors. The engine is capable to spool up and down within 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. The10 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 which regulates the maximum performance within pre-programmed software limits. The ECU is fully automatic and needs no adjustment by the operator and is integrated in the EPV.

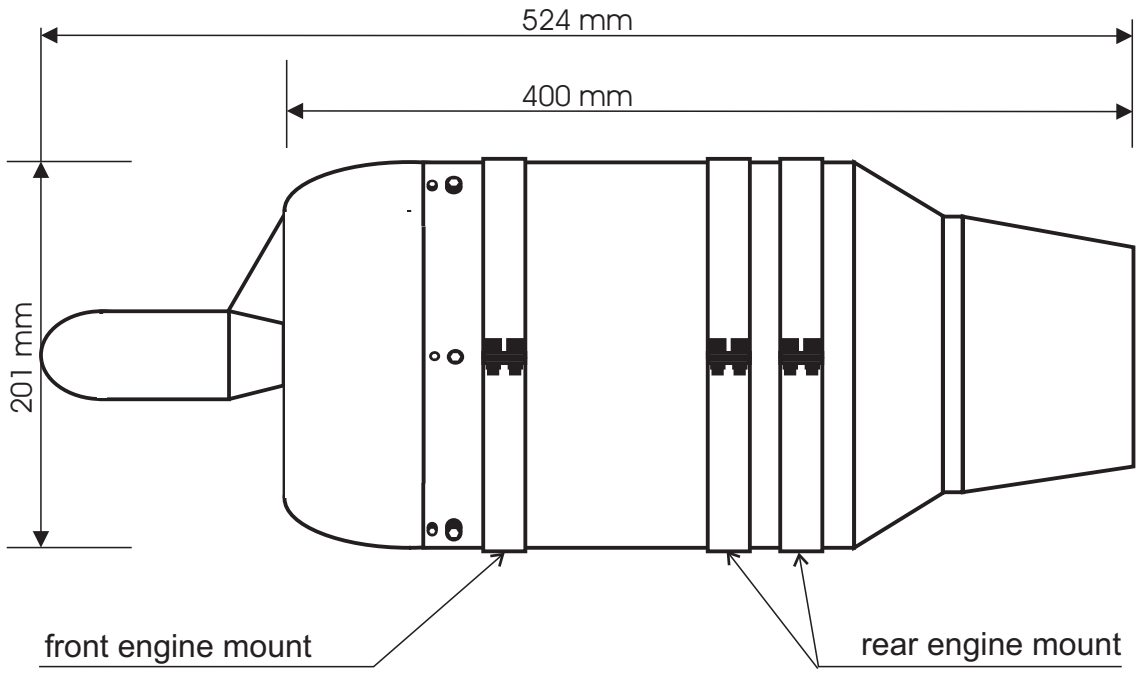
front view Nike

figure 1.1



side view Nike

figure 1.2



1.3 Technical data for Nike E- start (EPV 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	9150	gr	20.2	Lbs
System airborne weight *	11300	gr	24.9	Lbs
Maximum allowed RPM	63,000		63,000	
Thrust @ 62.000 RPM	784	N	176.3	Lbf
Mass flow @ design RPM	1100	gr/sec	2.43	Lb/sec
Idle RPM	20,000		20,000	
Thrust @ idle RPM	40	N	9.0	Lbf
Pressure ratio @ design RPM	4:1		4:1	
Exhaust temperature	800	°C	1472	°F
Maximum exhaust temperature	875	°C	1607	°F
Fuel usage @ design RPM	1900	gr/min	67	oz/min
Fuel type	kerosene/paraffin/A-1/white spirit			

(* System airborne weight: Engine, EPV, mounting straps, fuel filter, 4S LiPo 5200 Mah battery)

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

(Picture can be slightly different from real product)

*** DELIVERY FORM ***

Spaarpot 34
5667KX Geldrop
Phone : (INT+31) 40-7873130
Fax : (INT+31) 40-7873139

000000

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

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

number	article description	items
90035306	Nike engine (engine->)	1
05401103	RPM sensor (mounted on engine)	1
05400110	Thermo sensor (mounted on engine)	1
05890309	EPV box	1
05890313	EPV control cable FMS connector	1
05890314	EPV to engine cable (length 50cm.)	1
05030497	Lit.battery 14.8V/5200Mah.+Amphanol C. (read instructions)	1
05030510	Battery pack charge cable XT60	1
98390104	Front engine mount	1
98390105	Rear engine mount	2
08470521	Festo PAN 4 Tube / engine to EPV (igniter output)	1
08470522	Festo PAN 6 Tube / engine to EPV (main fuel output)	1
08470620	Legris tube 10 / EPV to fuel tank	1
08470515	Fuel filter (between tank and EPV)	1
05300151	TMC software V_._. + USB cable VX_._ ARS file	1
84890502	Manual V_.	1
05890111	Engine Data Terminal + charge cable	1
84890503	Test data	1
24890503	Warrenty card	1

2.1 Turbine

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

Each new motor has undergone 3 test runs with its own EPV before shipping.

At each test run capacities and performance have been checked and are stored in our database.

Data of the final test run will be shipped together with the engine.

2.2 EPV

The aluminium EPV box contains 3 basic components:

- The ECU; this unit is controlled by a microprocessor, which is powered from the EPV battery. The control unit has two PWM control inputs, throttle and switch which are available at the flight management connector.

  Besides PWM signals the EPV throttle and switch channel can also be controlled by a separate RS-232 serial protocol this port is available on the flight management connector.

  However, standard the EPV works with PWM signals, this can be changed by the customer using telemetry software supplied on CD.

- The fuel pump; this built from two gear-wheels running in a high-precision chamber. Therefore it is very important that the used a fuel is absolutely clean and pure, in order to prevent blockages in the fuel system.

  Taking the pump apart can lead to irreparable damage.

- The EPV also contains 2 solenoid valves, one valve is used in the main fuel line and one solenoid valve is used in the igniter line.

Note 1 : EPV stands for **E**CU, **P**ump, **V**alves.

Note 2 : At 100% throttle the temperature of the EPV can go up to 70 Deg C, a place in the vehicle with cooling air would be preferable.

2.3 Owner's Manual

It is very important that the operator does 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)

2.4 Sundries

The kit also contains a number of additional items such as tubes, connectors, battery and battery charging cables etc.

We recommend only use PAN tubing as comes with the set, The PAN is a tubing available from "FESTO" and will fit onto the motor and EPV connectors, using PAN guarantees that everything fits properly without leaks.

Note:
If the availability of FESTO components is a problem, 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 2.1 is a "example". The actual packing list shipped with the engine can be different due to agreements made with the customer.

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 mix	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: At fueling be sure that clean fuel and a fuel filter is used in the tube between the external fuel supply container and the fuel tanks for the vehicle.

3.2 Ignition system

The ignition system is developed around a ceramic igniter with the Webasto part # 84906B. The internal 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 EPV 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.

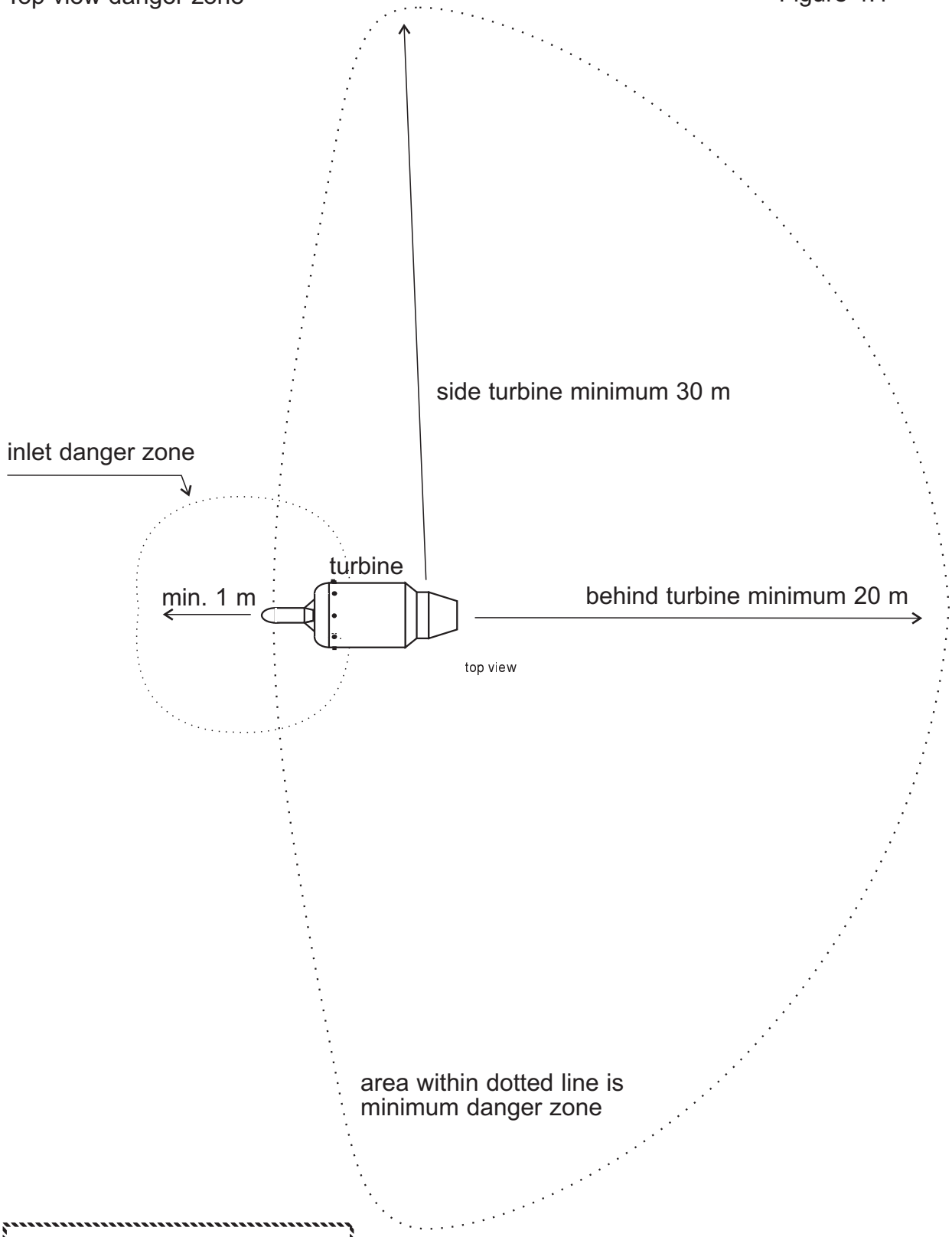
3.3 Fire extinguisher

Safety is of the utmost importance, so please make sure that there is a properly functioning fire extinguisher within reach, and take care that at least one of the operators is be able to handle this equipment.

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 of this size is a type of motor that needs more safety precautions than the smaller versions 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 there is at least one assistant when starting up the turbine. This assistant has to get acquainted with the turbine, just like the operator.

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. The operator should make enough test starts in a "clean" space, until the operator can handle the turbine properly and with confidence.

4.4 Danger zones

Figure 4.1 indicates which areas the operators, 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

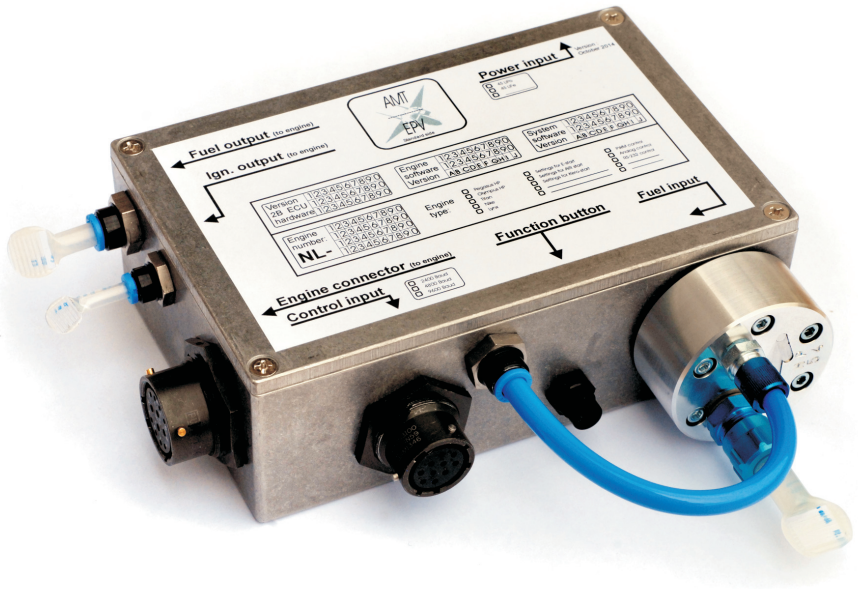
A turbine mainly produces noise in the high frequencies. Often these noises are not experienced as annoying, but prolonged exposure may still harm your hearing, and especially as an operator you are intensively exposed to this noise.

Therefore wear sufficient hearing protection when running the turbine.

4.6 Liability

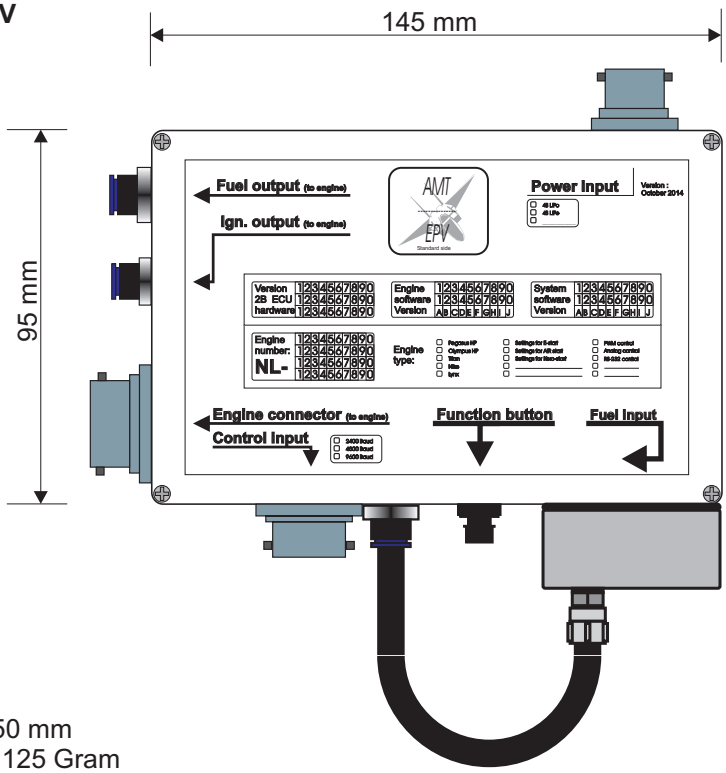
AMT Netherlands is not liable in any way for whatever damage or injury, resulting from the use of the Nike gas turbine.

figure 5.1



Version 2.0 EPV

figure 5.2



Height : 50 mm
Weight : 1125 Gram
Box material : Aluminium

5.1 Description of EPV

The aluminium EPV box contains 3 basic components:

- The EPV; this unit is controlled by a microprocessor, which is powered from the EPV battery. The control unit has two PWM control inputs, throttle and switch which are available at the flight management connector.

  Besides PWM signals the EPV throttle and switch channel can also be controlled by a separate RS-232 serial protocol this port is available on the flight management connector. (protocol available on the supplied CD)

  However, standard the EPV works with PWM signals, this can be changed by the customer using the supplied telemetry software.

- The internal fuel pump; this built from two gear-wheels running in a high-precision chamber. Therefore it is very important that fuel is used which is absolutely clean and pure, in order to prevent blockages in the fuel system.

  Taking the pump apart can lead to irreparable damage.

- The EPV also contains 2 solenoid valves, one valve is used in the main fuel line and one solenoid valve is used in the igniter line.

Note 1 : EPV stands for **E**CU, **P**ump, **V**alves.
Note 2 : At 100% throttle the temperature of the EPV can go up to 70 Deg C, a place in the vehicle with cooling air would be preferable.

5.2 Which radio control system, PPM or PCM is going to be used.

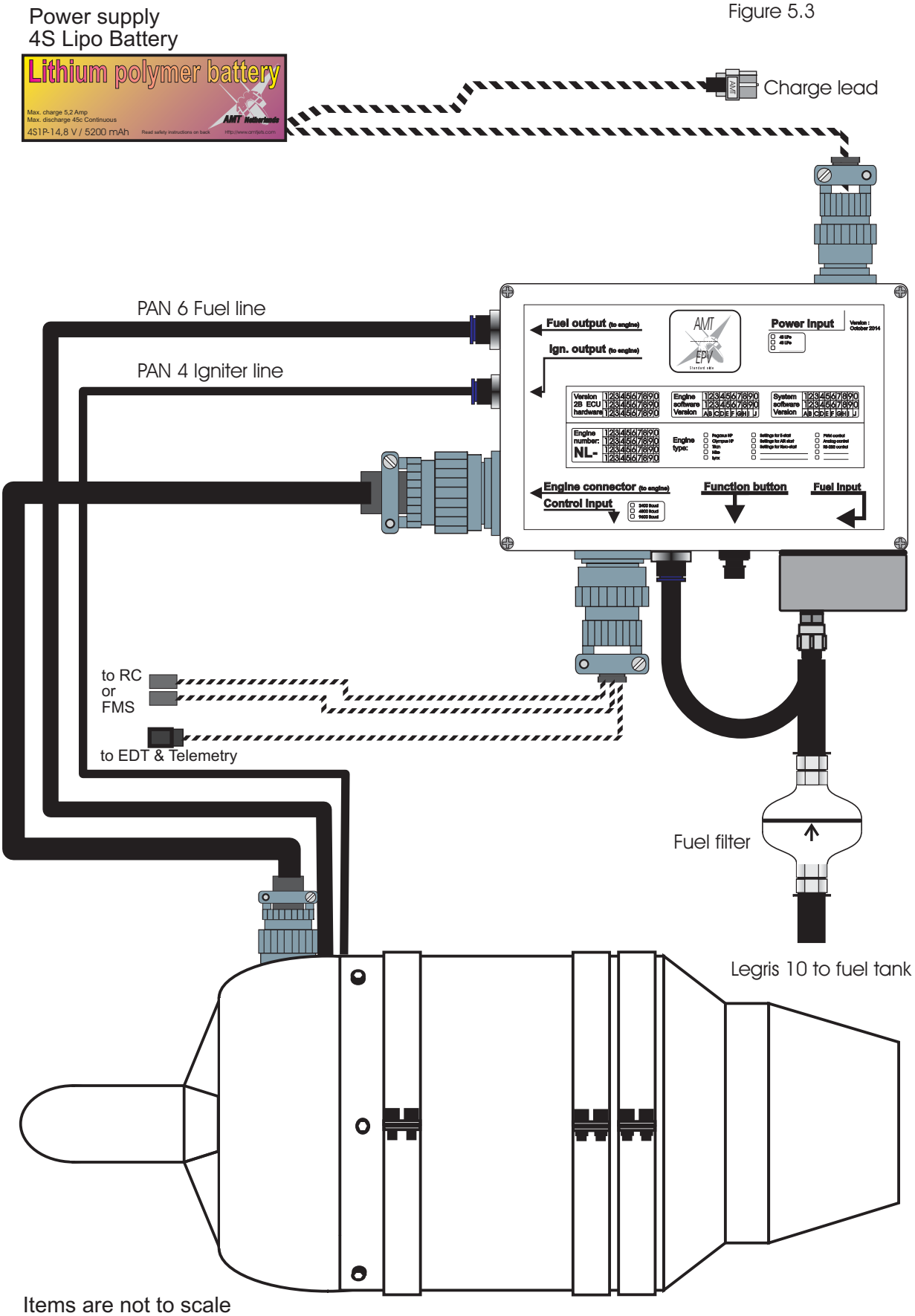
Most likely before using the gas turbine into an airborne vehicle the gas turbine will be tested, to control the EPV one could use the Flight Management System (FMS) of the vehicle or a RC set used in model aeroplanes.

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 system, PCM stands for **P**ulse **C**ode **M**odulation. When using a PPM system please go to chapter 5.3, as the failsafe option is not available in a PPM system.

When using a PCM system (for example a 2.4 GHz RC system) this failsafe option can be used with this type of EPV, AMT advises to use a such 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.

Figure 5.3



Items are not to scale

5.2.1 Adjustment of Failsafe using a PCM system

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

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 dual channel operation is used, 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 operating the turbine.

Go to the failsafe menu of your transmitter and set the failsafe function for 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 EPV 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 *. (* programmable time)

5.3 EPV input/output channels

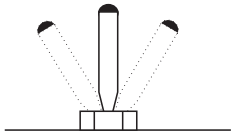
The EPV inputs:
A: Exhaust gas temperature (EGT).
B: Rotation speed (RPM).
C: Throttle channel (RC receiver / FMS*).
D: Switch channel (RC receiver / FMS*).
E: Power supply.
F: Function button.
G:Telemetry (to control the EPV via RS232)
H: Fuel input.

The outputs present are:
A: Igniter connection.
B: Electric starter connection.
C:Telemetry, also for EDT connection.
D: Main fuel output.
E: Igniter fuel output.

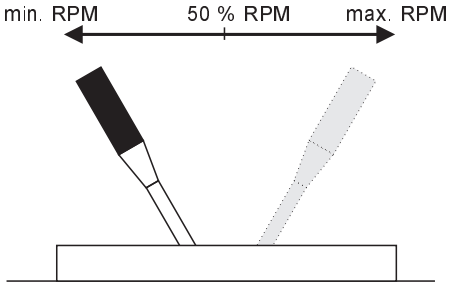
*FMS = **F**light **M**anagement **S**ystem.
Note: For connector layouts see supplied CD

figure 5.4 Dual channel operation

pos.1 pos.2 pos.3



side view switch on transmitter

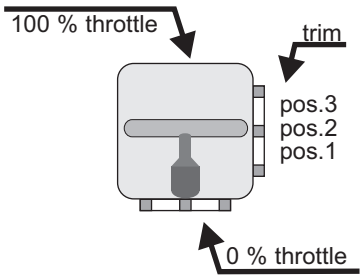


Side view transmitter throttle stick

pos.	tone	function	PWM signal
1.	low	system off	1.0 Msec
2.	middle	power down	1.5 Msec
3.	high	start & running	2.0 Msec

pos.	tone	function	PWM signal
1.	low	system off	1.0 Msec
2.	middle	power down	1.5 Msec
3.	high	start & running	2.0 Msec

figure 5.5 Single channel operation



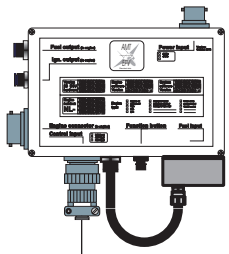
pos.	tone	function	PWM signal
1.	low	system off	1.0 Msec
2.	middle	power down	1.1 Msec
3.	high	start & running	1.2 Msec
0%	low	Idle RPM	1.2 Msec
100%	high	Max RPM	2.0 Msec

Throttle to thrust relation (approx.)

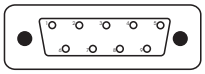
Stick	RPM	Thrust
min.	20.000	< 45 Newton
50 %	50.000	~450 Newton
max.	61.500	>784 Newton

Note:
For detailed engine information see the included testreport for each induvidual Nike engnie.

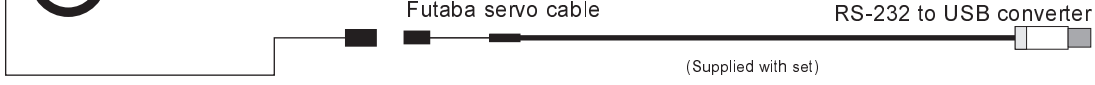
figure 5.6 Rear view 9 pol. connector to P.C. (Not supplied with set)



When connecting via a sub D con. to PC / Laptop



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



5.3.1 Throttle 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.

Note:
See figure 5.4 for dual channel mode, this mode requires 2 PWM channels. For calibrating in this mode see paragraph 5.4.1. below.

5.3.2 Switch channel input D

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.

Note:
When no PWM signal is connected to the "switch channel" during calibration the EPV will work automatically in the single channel mode, see figure 5.5. left. For calibrating in this single channel mode see paragraph 5.4.2. below.

5.3.3 Serial input F

This RS-232 based I/O channel gives full control over throttle, switch and all special functions of the EPV. For details of see the serial control document available on the download page of the AMT website and on the supplied CD.

5.3.4 Power supply input E

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.

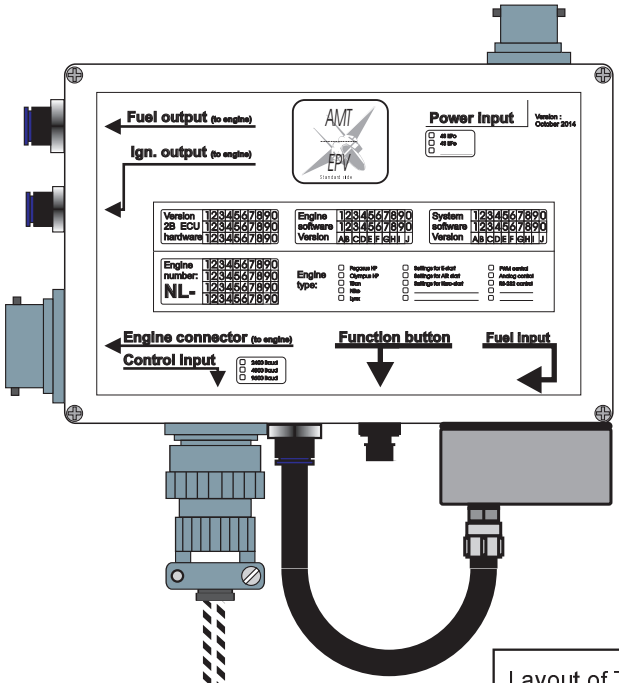
Note: To have LiPo batteries working properly, they need to be "balanced" on a regular base. LiPo chargers and balancing equipment are also separate available from AMT Netherlands.

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.

figure 5.7

Wiring diagram of throttle & switch input for dual channel and single channel operation.

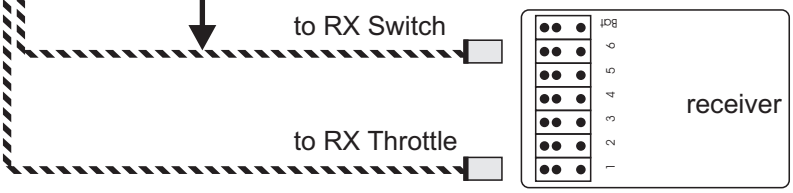


Layout of Throttle & Switch to EPV FMS connector.

Throttle & Switch cabels			FMS con.	
wire	color	function	Thr.	Sw.
1.	Brouwn	ext.ground	Pin H	Pin F
2.	Red	ext.+ 5 volt	Pin A	Pin E
3.	Orange	PWM input	Pin B	Pin D

Do not connect a switch signal when using the EPV in single channel operation mode.

EPV will automatically detect single channel operation when no signal is detected at switch input during calibration.



Information for the TMC (**T**urbine **M**anagement **C**entre) 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)

Note: 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.

5.4.1 Dual channel operation

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

The function button is used to "teach" the EPV the pulse width of the control system or FMS. To program two channel operation follow this sequence:

1 Connect the throttle lead to the correct channel on the 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 EPV function button, and hold it pushed down.
5 Switch "on" the EPV, after a few seconds a beep will sound.
6 Release the function button.
7 Put the 3 pos. switch in the "Off" position and push and release the function button. (EPV will giving a beep for confirmation)
8 Put the 3 pos. switch in the "Middle" position and push and release the function button. (EPV will giving a beep for confirmation)
9 Put the 3 pos. switch in the "Start" position and push and release the function button. (EPV will giving a beep for confirmation)
10 Put the throttle in the "Idle" position and push and release the function button. (EPV will giving a beep for confirmation)
11 Put the throttle in the "Max throttle" position and push and release the function button. (EPV will giving a beep for confirmation)

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

When a RC PCM system is used the failsafe option can be by switching OFF your transmitter.

When the failsafe time has passed the EPV will sound with a **high/ low** beep tone. This failsafe beep tone has to be reset like an engine error, see chapter 5.6.2

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

However if there is only one PWM channel for operating the turbine the single channel operation as described in the next paragraph can be used. 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.

5.4.2 Single channel operation

Note: The moment no signal is detected on input “D” (switch input) during the EPV calibration sequence the EPV will detect this and work in single channel operation. In this mode only one PWM signal is needed to operate the engine. The switch input is a “loose” input in this case.

To program the single channel operation follow this sequence:

1 Connect the throttle lead to the correct channel on the RC receiver or FMS.
2 Switch “on” Transmitter and RC receiver or FMS.
3 Push down the function button, and hold it pushed down.
4 Power up the EPV, after a few seconds a confirmation beep will sound.
5 Release the function button.
6 Put the throttle in the “Idle” position and put the trim of the throttle channel on the 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. EPV will give a beep for confirmation.
8 Put the trim of the throttle on the RC transmitter in the “Middle” position and push and release the function button. The EPV will give a beep for confirmation.
9 Put the trim of the throttle on your RC transmitter in the “On” position which must be in the same direction as the “full throttle” position of the throttle stick and push and release the function button. The EPV will give a beep for confirmation.
10 Leave the throttle in the “Idle” position and push and release the function button. The EPV will give a beep for confirmation.
11 Put the throttle in the “Max throttle” position and push and release the function button. The EPV will give a beep for confirmation.

Directly after program sequence no.11 the EPV will give a confirmation beep that all pulse widths are stored in the EPV. 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.

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. See figure 5.5 on page 3 left.

When using a RC PCM system the failsafe routine by switching OFF the transmitter.

When the failsafe time* has passed the EPV 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
(* programmable in EPV by operator)

5.5 Definition of relevant EPV output's

5.5.1 Output D, Main fuel output.

This EPV output must be connected to "main fuel" input of the engine, right side of the main engine connector.

5.5.2 Output E, Igniter fuel output to engine.

This EPV output must be connected to "igniter fuel" input of the engine, right side of the main engine connector.

5.5.3 Output F, Telemetry - EDT connection

This output can be connected to the **E**ngine **D**ata **T**erminal or to the RX side serial port of a personal computer/ Laptop were the TMC is "running". The TMC "terminal" displays all engine data on the screen. The telemetry software is available from the AMT Netherlands website and on the supplied CD.

Note: When the EPV is set to the serial control mode, which can be done by the operator using the TMC software, the EPV can be fully controlled via a serial protocol.

For details see the latest serial control document available on the download page of the AMT website

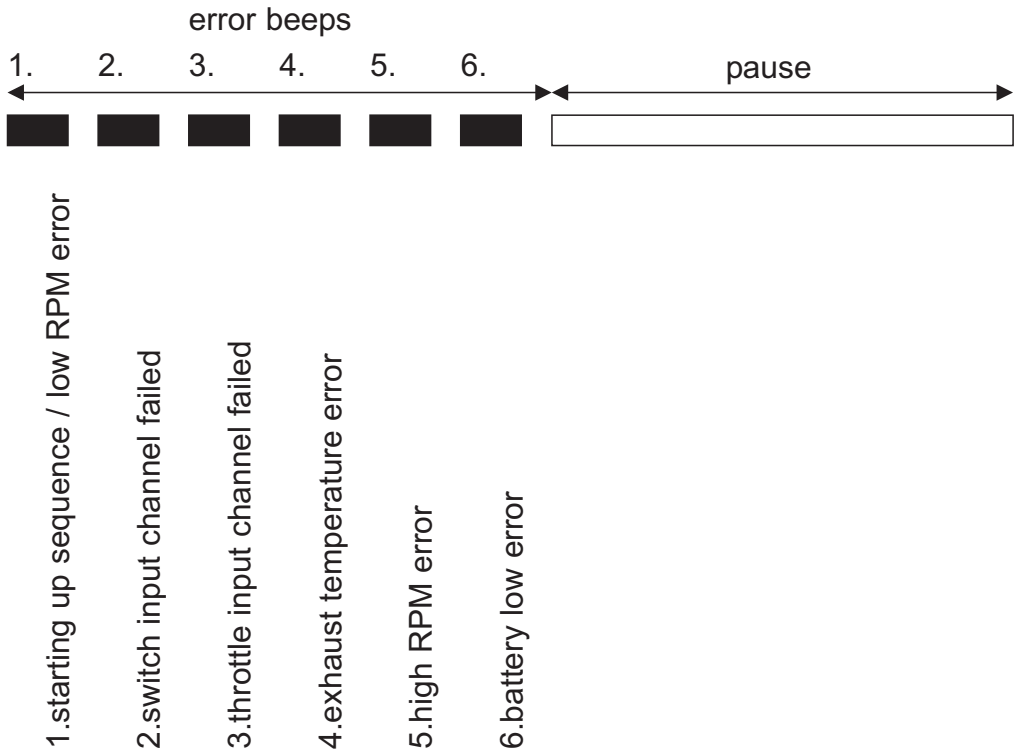
A version of the serial protocol is also available from the supplied CD.

5.6 Buzzer

5.6.1 Buzzer beeps

The EPV 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.


error beeps
1.
2.
3.
4.
5.
6.
pause
1.starting up sequence / low RPM error
2.switch input channel failed
3.throttle input channel failed
4.exhaust temperature error
5.high RPM error
6.battery low error

Starting beep: When the starting sequence is activated a series of 5 beeps will sound, after the fifth beep the starting sequence will start.

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 the igniter is faulty.

Failsafe beep: This beep is a high / low pitch tone. It occurs when the failsafe condition of the EPV 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 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: 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 an EPV error (5.6.2) also the error message in the EDT will be removed from the bottom line and from the serial protocol.

The error is also available in the “serial protocol” and in the log download of the EPV engine log. For download details see the help file on the TMC software.

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.

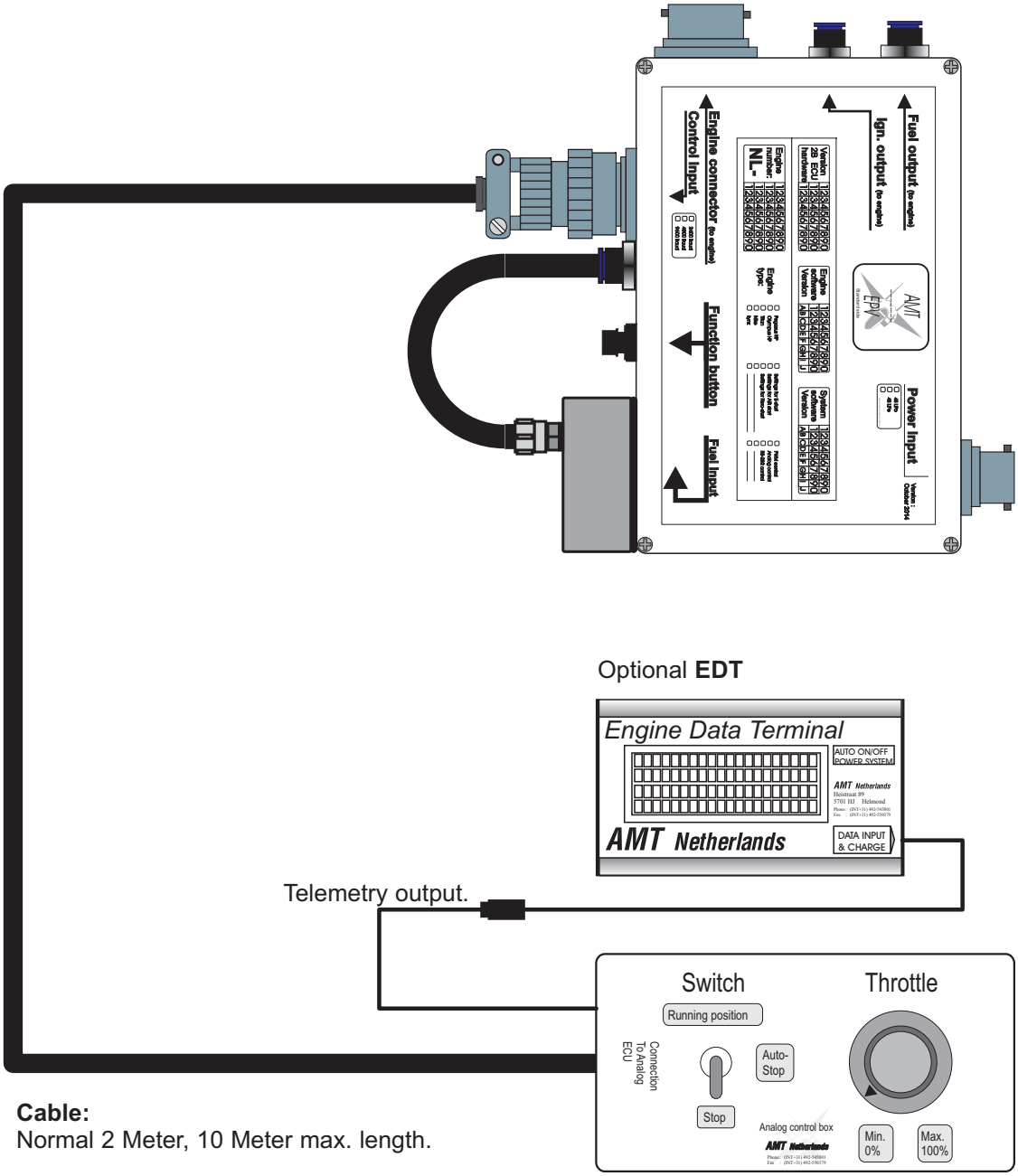
To reset an error beep put the 3-position switch on the transmitter must be set into the switch into the ‘off’ position (low pitch tone) and put the throttle stick into the full throttle position (high pitch tone). For a description of controls see manual section 7.2.
Also switching the EPV power off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

figure 5.9

Analog EPV and control box.

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

With an “analog EPV”there is not need to use a RC equipment to operate the engine, this type EPV works exept for the 2 inputs, throttle and switch, the same as the “RC” EPV. **Note:** This type of EPV can also “reprogrammed” for serial control.



Resetting errors for single channel operation.
To reset an error beep the throttle trim on the transmitter must be switched into the 'off' position (low pitch tone) and put the throttle stick into the idle throttle position (low pitch tone). Now push the Function button for 2-3 seconds to reset the error message.

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

When the EPV control is via the RS232 protocol, the system can be reset like the "dual channel" operation. The 3-position switch in the TMC program must be set into the switch the 'off' position and put the throttle into the full throttle position (100%).

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

5.7 Analog EPV and control box.

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

With this EPV type you do not need to use an RC equipment to operate the engine, this "analog" EPV works except for the 2 inputs, throttle and switch, the same as the "normal" EPV. For a description of controls see figure 5.9 on the left page.

5.8 Extra features.

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

As mentioned above these options are available in Version 24, probably higher versions will have more features as mentioned below.

10%	Not in use at this moment.	
20%	Not in use at this moment.	
30%	**Igniter switches on.**	(will switch on igniter)
40%	Not in use at this moment.	
50%	**Priming function.**	(opens EPV main fuel valve and activates fuel pump)
60%	**Priming function.**	(opens EPV igniter valve and activates fuel pump)
70%	Not in use at this moment.	
80%	**Activation of starter motor .**	(will activate electric starter)
90%	**Clutch check.**	(will activate clutch check with on/off 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 Function 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:

- Power up the TX, RX or FMS and the EPV.
- Calibrate the EPV as described in chapter **5.4.1** for dual channel operation, when EPV was already in dual channel operation you do not have to do this again.
- Put the 3 position in the “off” position.
- Put the throttle in the desired position. (e.g. 50% for the priming function of the main fuel line).
- Now push the Function button, after 2 seconds the selected feature will be activated.
- Releasing the Function 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:

- Power up on the TX, RX or FMS and the EPV.
- Calibrate the EPV as described in chapter **5.4.2** for single channel operation, when EPV was already in single channel operation you do not have to do this again.
- Push down the Function 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 Function button for 3 seconds, after releasing the Function button the selected feature will be activated.
- Power down of the EPV will deactivate the function.

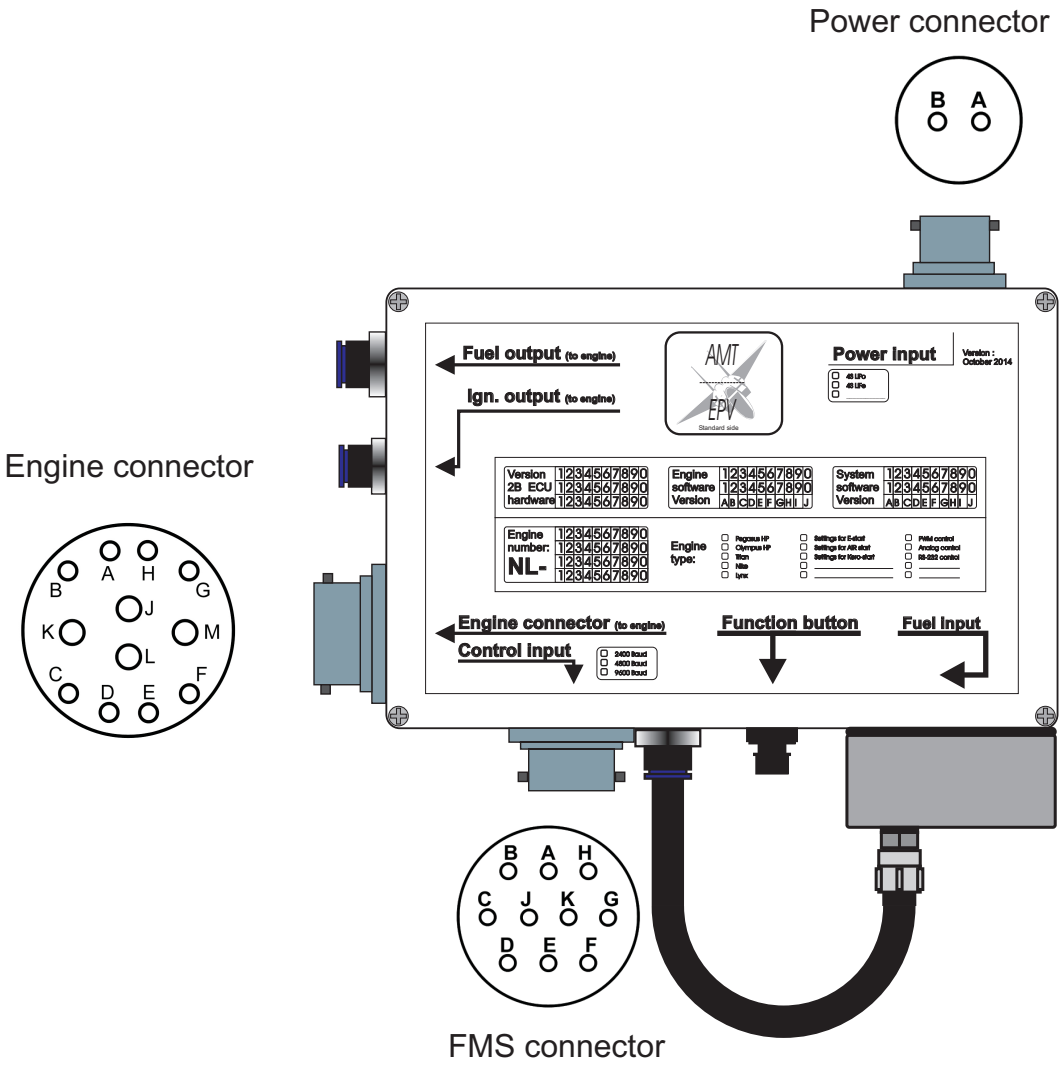
5.8.3 Activating of extra features in serial control mode

To activate extra features in serial control mode, please handle as follows:

- Power up the TX, RX or FMS and the EPV.
- Put the 3 positions switch, in the TMC program, in the “off” position.
- Put your throttle in the TMC program in the desired position. (e.g. 50% for the priming function of the main fuel line).
- Now push the Function button in the TMC software, after 2 seconds the selected feature will be activated. (Note: also pushing the Function button on the side of the EPV will active the extra features of the EPV)
- Releasing the Function button in the TMC software will deactivate the selected function.

Version 2.0 EPV

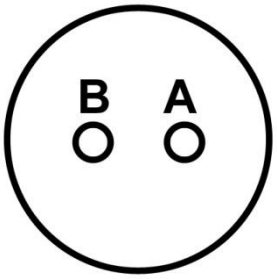
figure 5.9



5.9 EPV connector layout.

The EPV has 3 electrical connectors, all are military spec. Amphenol connectors, designated as follows:

5.9.1 Power connector.



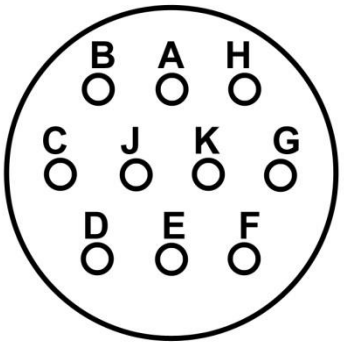
Pin layout is as follows:

A : Power – (GND)
B : Power +

5.9.2 FMS connector.

Pin layout is as follows:

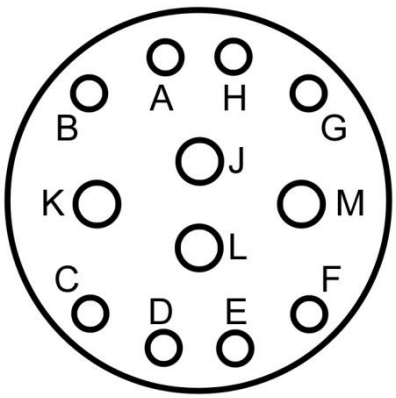
A : Throttle +5V (*from* control system)
B : Throttle signal
C : Not connected
D : Switch signal
E : Switch +5V (*from* control system)
F : Switch GND (*from* control system)
G : RS232 TX (output from EPV)
H : Throttle GND (*from* control system)
J : RS232 RX (input to EPV)
K : RS232 GND



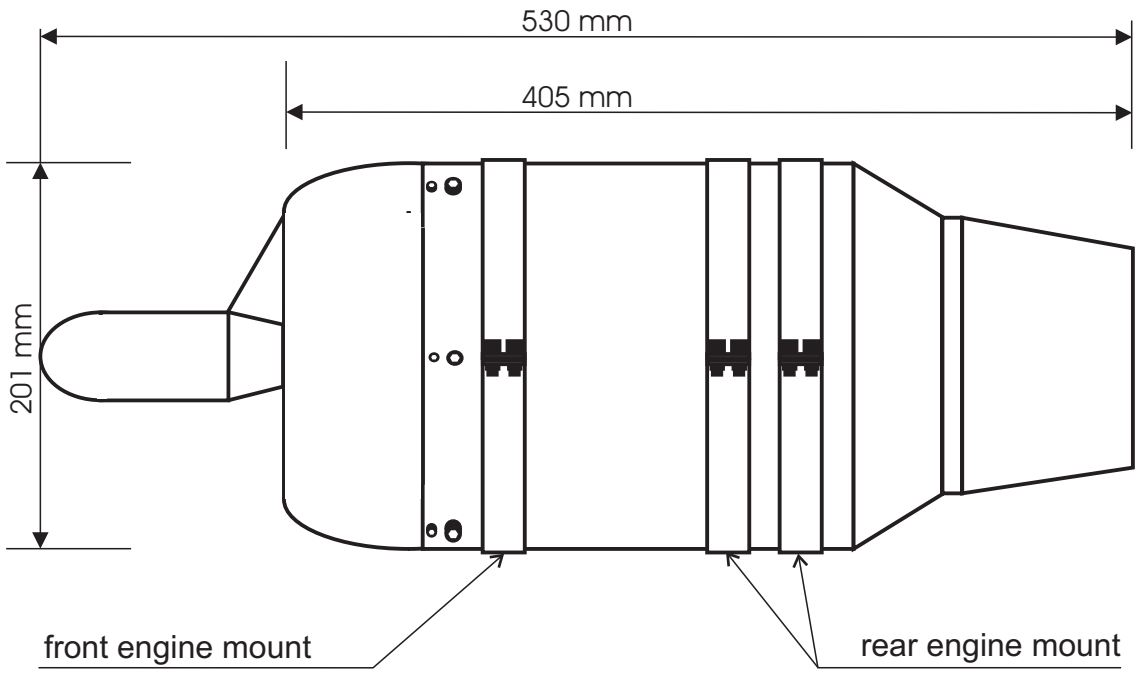
5.9.3 Engine connector.

Pin layout is as follows:

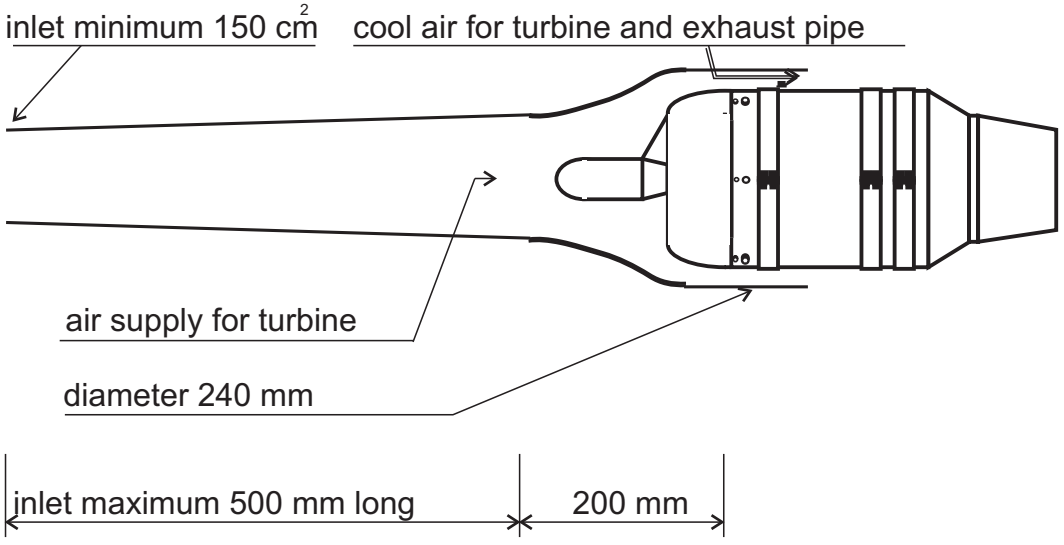
A : RPM +
B : RPM signal
C : Not connected
D : Not connected
E : EGT + (green)
F : EGT – (white)
G : Not connected
H : RPM GND
J : Internal igniter +
K : Internal igniter -
L : Starter unit +
M : Starter unit



side view Nike figure 6.1



inlet shape figure 6.2



6.1 Dimensions of Nike E-start.

Figure 6.1 shows 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 engine should always be mounted in such a way that marker **"top"** on the front cap in at **the "12 o'clock" position**, this must be accurate within +/- 15 degree. (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. Mounting this way also leaves save space at the 'Centre of Gravity' position, which is the optimum position for the fuel tanks. There must be a minimum clear distance of 15mm all around the turbine casing, when mounted in a bypass ducting or at least 15 mm from any bulkheads or formers in the vehicle. A continuous stream of air all around the engine 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^2. Therefore the air inlet duct of your vehicle needs to have a minimum area of 98.5 cm^2 for the engine air plus extra 50 cm^2 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 must not have sharp angles or edges, these should be smooth and aerodynamic shape. 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 intake 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.

When the turbine is running inside the duct the continuous air stream between the engine and the inside of the fibreglass duct is cooling the engine and engine ducting.

Ducting should have an minimum inside diameter of 230-240 mm, see figure 6.2 on left page.

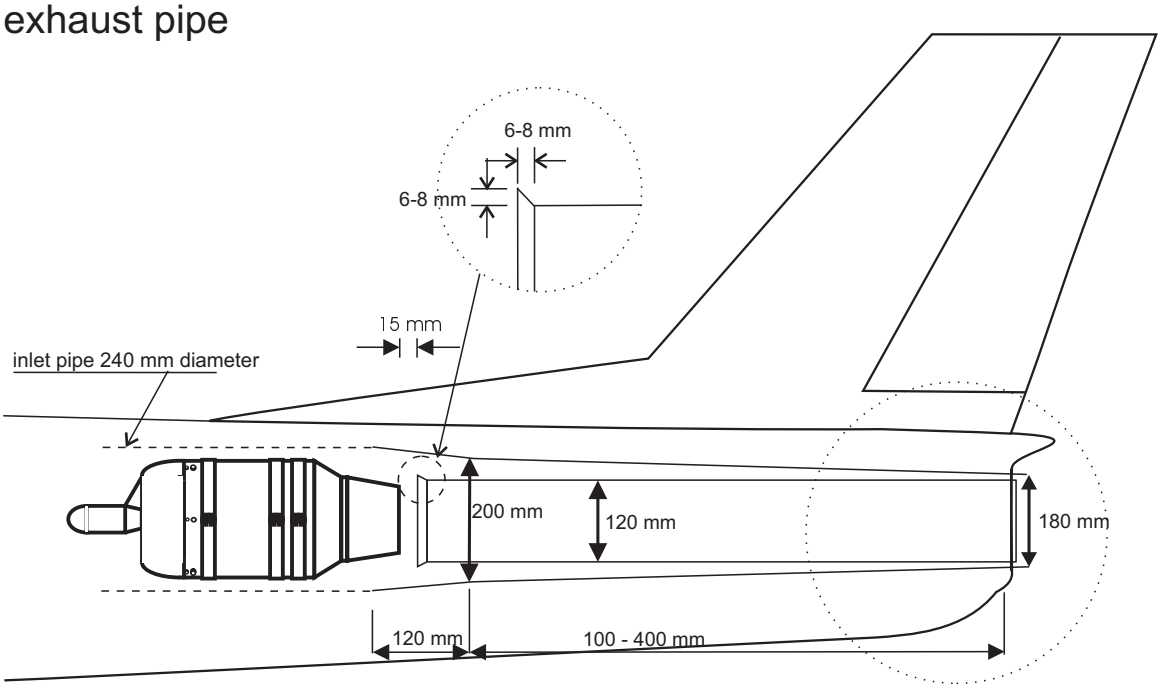


figure 6.3

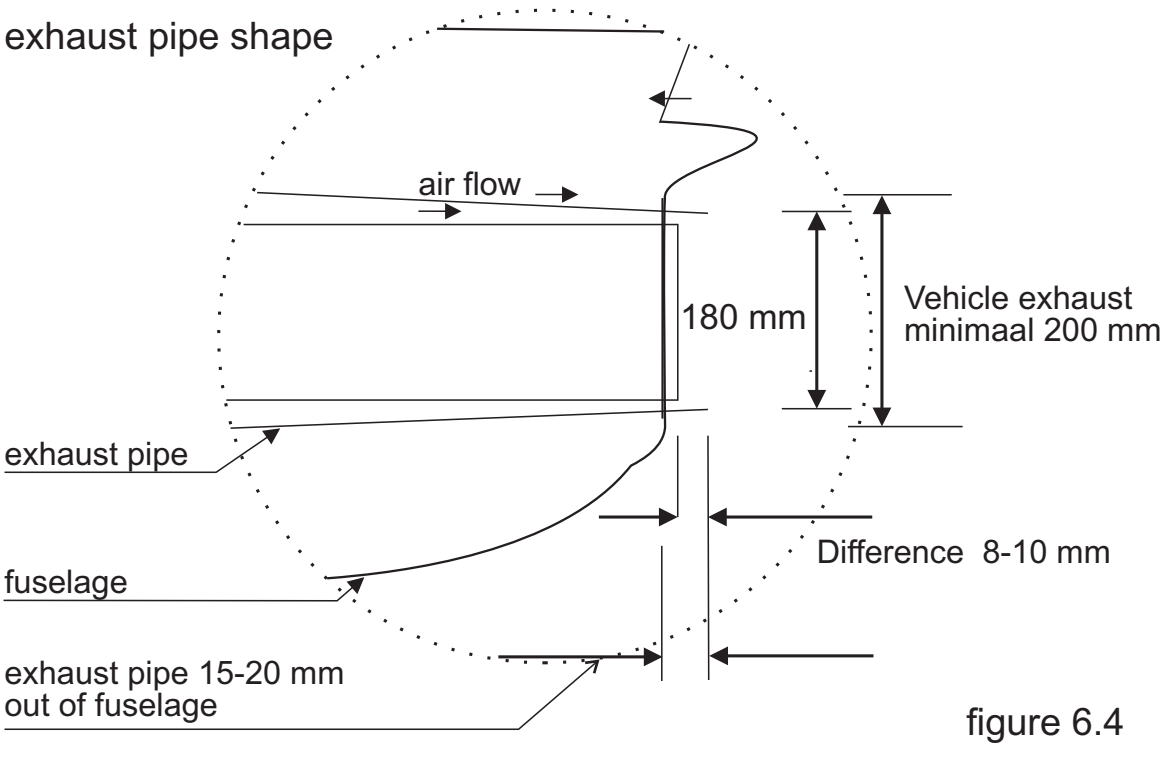


figure 6.4

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 400 mm. These typical dimensions can be used for exhaust ducts with an internal tube length between 100mm and 400mm.

As material for the inner tube a heat resistant CrNi steel can be used with a gauge of 0.25mm to 0.40mm. Stainless steel type 316, or Inconel 600, are some useful types. With these materials excellent spot-welded connections can be made, but also connections with steel pop-rivets can be used.
The outer tube can be made from the same material, but it only needs to be 0.2mm 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 engine blows its 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, this cold air mixes with the hot exhaust gases. In this way the inner tube does not become warmer than 300 - 400ºC (see figures 6.3 and 6.4).

As the inner tube is mounted 8 - 10 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 vehicle 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.15 -20mm outside the back of the vehicles 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 the inner and outer tube.

6.4.3 Installing the Exhaust duct.

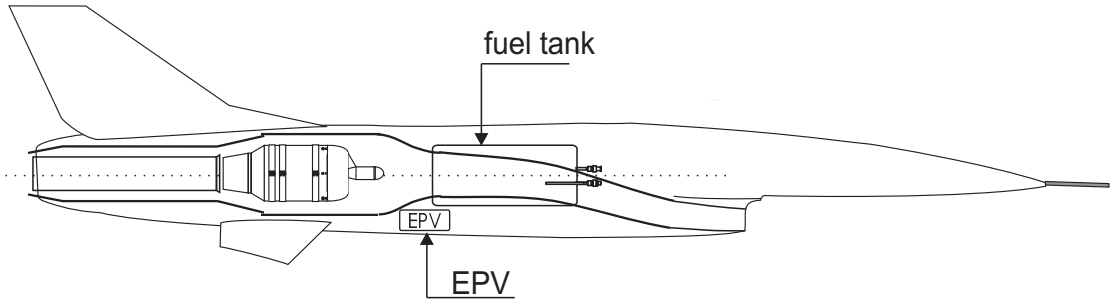
It is very important to mount the exhaust duct is mounted exactly centrally behind the engine. Any deviation will result in a duct that does not function properly, and can affect the performance of the engine or damage the exhaust tube itself.

6.5 Tubing size.

The total length of tubing (PAN 8) between EPV and fuel tank may up to 100 cm. Best is to mount the filter in the vertical way, exit up. For the fuel line from the EPV to main fuel output to the turbine fuel input the supplied Festo PAN 6 tubing with an internal

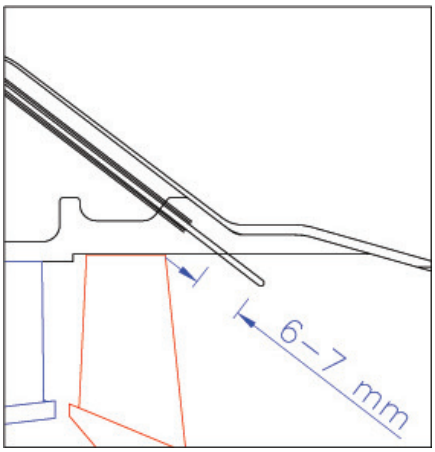
figure 6.6

Possible Engine, EPV & Fuel tank position



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

figure 6.7



Note: put thermo couple
6 - 7 mm inside exhaust.

tube diameter of 4 mm must be used. The maximum length of this fuel line is also 100 cm.
For the fuel line from the EPV igniter output to the turbine igniter input the supplied Festo PAN 4 tubing with an internal tube diameter of 3 mm must be used. The maximum length of this igniter fuel line is also 100 cm.

6.6 The thermo-couple.

The K-type thermo-couple, with 1,0 mm thickness is an isolated type, it is mounted in the EGT mounting bracket under the front cap. The tip of the thermo sensor is 6-7 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 EGT sensor needs to be replaced undo the locking screw in the EGT bracket and pull out the old EGT sensor gently. If needed line out the EGT sensor tip at the exhaust at an angle of 45 degree, to be sure the sensor can be removed easily.

A new EGT sensor must be mounted from the front of the engine, be sure that the thermo-couple sticks aprox than 6-7 mm inside the exhaust nozzle seen from the rear, a improperly mounted EGT sensor might give incorrect temperature readings and faulty start-ups. The EGT sensor has a short lead of 10 cm with a standard K-type connector under the front cover. Replacement part numbers are available at the delivery form.

6.7 On-board EPV.

The EPV 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.

AMT advises installation of the EPV and battery near to each other so that the standard cables do not need to be extended.

Do ***not*** modify, lengthen, or change the 50 cm EPV to Engine cable, when a different length is needed contact AMT Netherlands.

6.8 Hard fuel tank installation

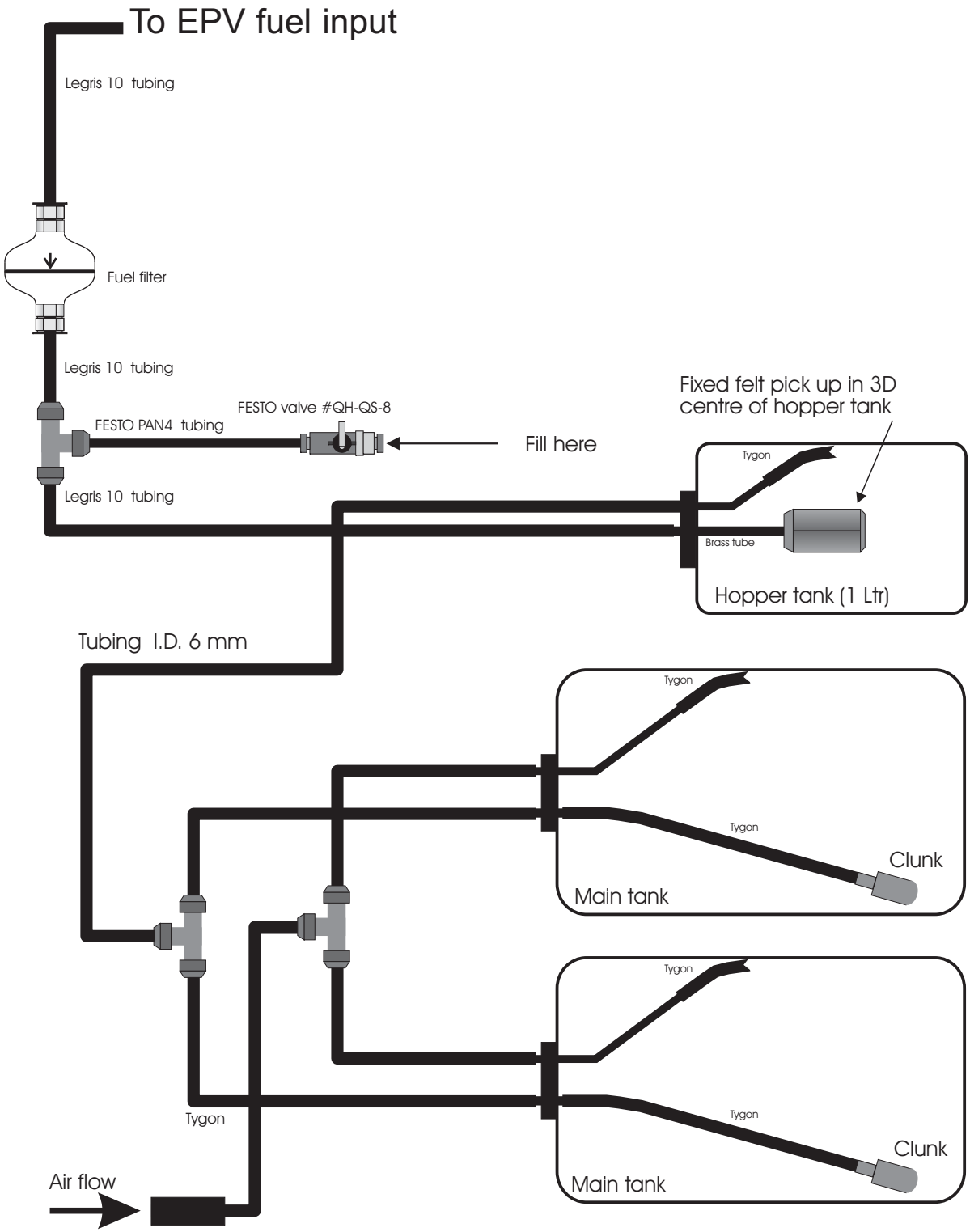
If possible follow the recommendations and hints below, and the diagram (figure 6.7) on the next page.

- Make sure all the stoppers in all main and hopper tanks are of the type suitable for 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.

Hard Tank fuel system

Figure 6.7



Fuel system ventilation (8-10 mm ID) thru fuselage pionting in flying direction to create positive pressure in fuel system.

- All the tubing used in the fuel system must be suited to kerosene type fuels. Tygon tubing but also the Festo PAN tubes supplied with an AMT turbine are all suitable for use with kerosene based fuels.

- It is very important that no air bubbles can be drawn into the EPV fuel pump, so we recommend to install a Hopper tank between the main tank(s) and the EPV fuel 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 vehicle (which would cause a ‘wet-start’), the EPV contains a high flow kerosene solenoid valve which only opens when the fuel pump is running.

- If 2 main tanks are being used a “T” piece needs to be connect the fuel tanks, be sure to use sufficient inner diameter for the “T” piece, 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 manoeuvres.

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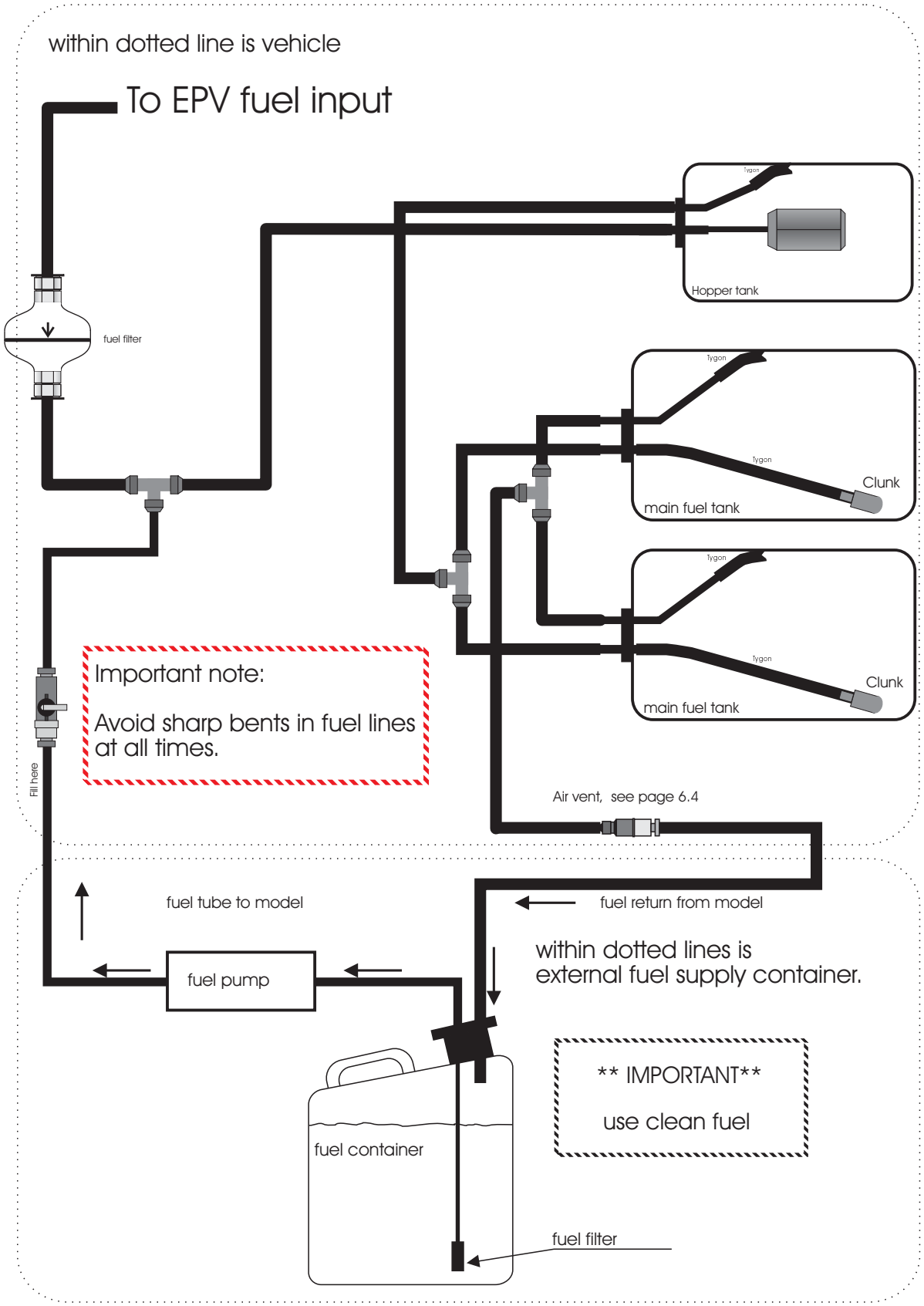
Figure 6.8


within dotted line is vehicle
To EPV fuel input
Tygon
Hopper tank
fuel filter
Tygon
Tygon
Clunk
main fuel tank
Tygon
Tygon
Clunk
main fuel tank
Important note:
Avoid sharp bents in fuel lines at all times.
Fill here
Air vent, see page 6.4
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

6.10 Fuelling up

Important: Before fuelling up the vehicle, make sure that the EPV is switched ‘off’.

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 6.8. AMT highly recommend that you install a good quality fuel filter in the filling tube between your external fuel container and the vehicle.

b) Connect a return tube from the vehicle fuel tank air vent tube 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 when full.

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.

Note: Leave the vehicle vent tube open - **do not block it**.

Space for notes:

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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 PAN 4 fuel line from the engine (Ign 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 PAN 6 fuel line from the engine (Main fuel connection) before you prime and prime into a small fuel container.

Be sure that the 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.

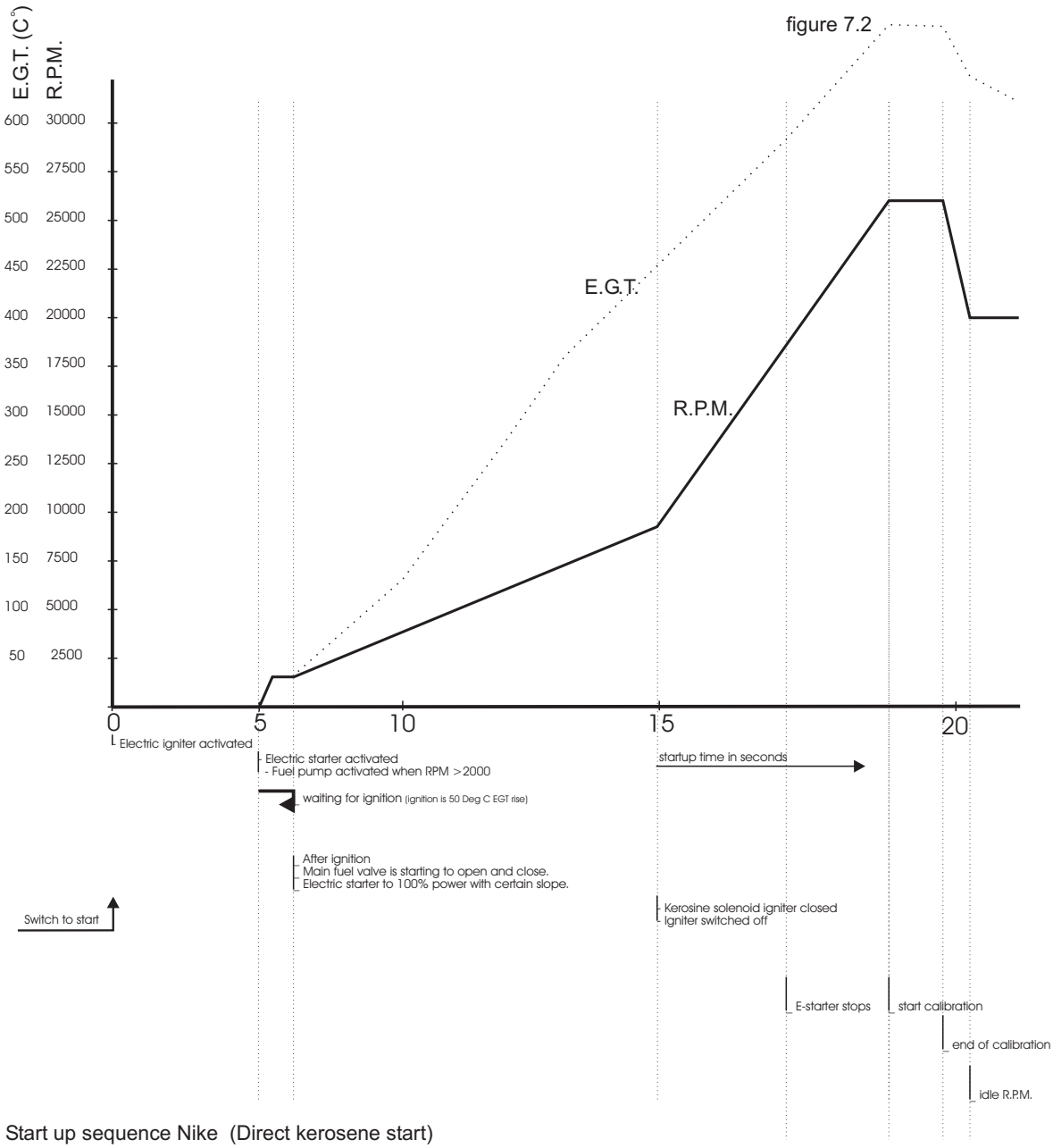
7.2 Powering up the system

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 EPV 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 EPV, 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) when using an RC system.
2 When using a PCM transmitter switch on the transmitter before your receiver,

figure 7.2



Start up sequence Nike (Direct kerosene start)

after this switch on the EPV. A “OK beep” should sound from the EPV.
When there is no “OK beep” please check the battery and its connections.

When there are no “start-up beeps” from the EPV and high pitch tone with short intervals and the EGT reading is above 88 Deg Celsius and the engine should be cooled down. When the EGT reads below the 88 Deg Celsius during this error the kerosene igniter is broken and should be replaced.
If there is a hear a “hardware error beep” (continuous low pitch tone) please contact AMT Netherlands or your AMT NL dealer.

3 When using dual channel operation there should be the 3 EPV beeps (low, middle and high beep tone) from the 3 position switch and 3 beeps from the throttle.

4 When using single channel operation there should be 3 EPV 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) or at the TMC program.

5 It is good practice to check throttle and switch (or throttle and trim) operation before every mission, 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

Note: AMT recommends to use fully charge the EPV LiPo battery before every mission, to be sure to 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 system or FMS in the 'start/run' position (high-pitched beep). Now the 5 “count down” beeps will come from the EPV, 5 seconds after the countdown beeps the EPV 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” I into the start sequence.

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 to 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 EPV will engage the starter motor up to 3000 RPM, start the fuel pump and open the starter solenoid valve inside the EPV.

5 At a an EGT rise of 50 °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 50 °C the position of the EGT sensor is very important. See chapter 6.6 for details.

6 At a RPM between 10-15000 RPM depending on a software setting the igniter fuel valve will be closed and the igniter will be switched off.

7 The EPV will automatically throttle up the turbine to its calibration point at approx. 25,000 RPM. The EPV will keep the turbine at approx. 25,000 RPM for about 3 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 control 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 EPV. 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 switch (or trim lever) on your RC transmitter or FMS to the middle position to activate the automatic power-down sequence.
- The EPV now regulates the engine to 5 % throttle (approx. 25,000 RPM) for about 4 seconds and waits until the exhaust temperature stabilizes.
- After this the EPV will stop the engine.
- Then the EPV will automatically switch the Electric-starter on and off several times, until the EGT is below 69 °C.

Note: Starting can already be activated when the EGT is below 88 °C.

Note: When the EPV stopped the engine and starts the normal cool down sequence the fuel pump will be activated for a short moment to lubricate the bearings during the automatic cool down procedure.

After a successful cool down procedure the system is 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, the 3 position switch, or throttle trim lever if using single channel operation with throttle into idle, can be placed into position 1, "off" (low pitch tone).
The EPV 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 used in the RC transmitter (PCM transmission mode).

Note: When the engine did have an emergency stop put the EPV into position 2 for cooling down the system if possible. The engine can be damaged when not properly cooled down.

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 engine runs works well.

1. Connect fast Lipo charger to the EPV battery and start charging, us a Lipo balancer on a regular base.

   (Be sure the EPV 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 info 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.

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 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 400 litres of fuel. **AMT NL** recommends replacing the filters every 200 litres of fuel, or sooner if they are contaminated.

8.1.2 Checking of bearings

If the engine shaft is turned by hand, the condition of both ball bearings can be reasonably well be judged. Watch for the following things:

If the turbine produces considerably more noise than before, the ball bearings are most likely damaged by contaminated the fuel, or contaminated ingested air, or a sequence of not properly executed cool down sequences. It is advisable to replace the fuel (and/or filter) and make a test run in a clean area.

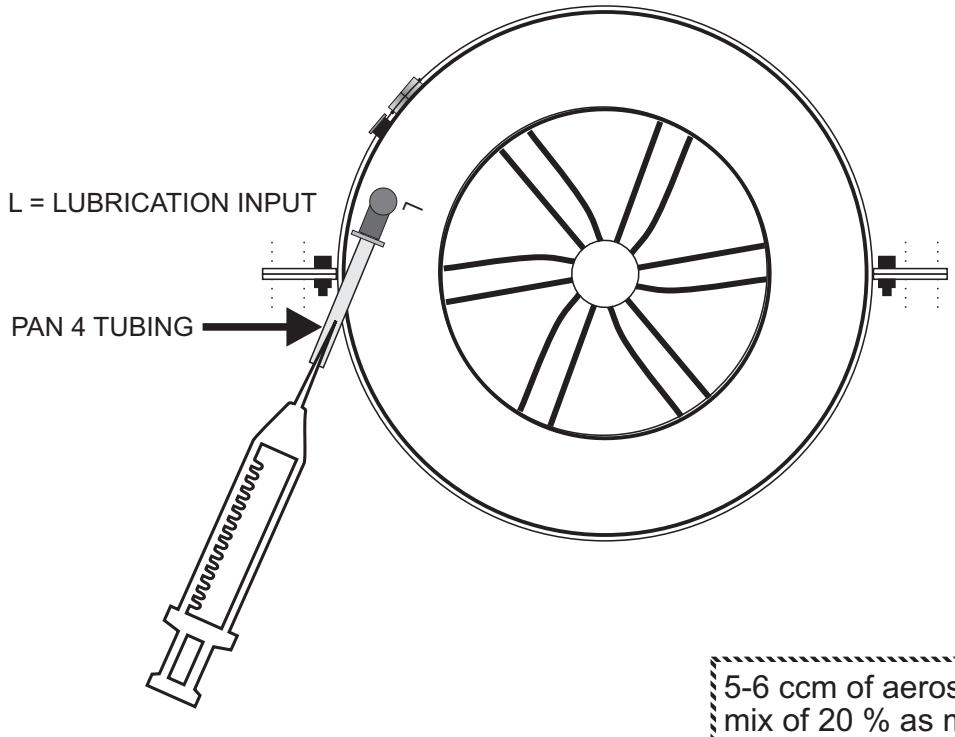
If the performance of the motor during test run is normal, it is not necessary to replace the bearings. It is advisable, however, to check the bearings more often now.

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.**

figure 8.1

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



5-6 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 AMT recommends that the engine gets 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 engine 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) Loosen 4 of the 5 M4 bolts that hold the hull to the motor by a 1/2 turn, using a 2.5 mm driver. Do not loosen the bolt that has the lead seal attached, as this may affect the warranty.

b) Remove now the 5 M3 bolts that hold the front cap using a 2.0 mm driver, the front cap should now be loose, and can be removed.

d) Remove the short PAN 4 tube from the Fuel elbow (marked 'L') 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 PAN 4 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 PAN 4 tube to the Lubrication fitting, 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. This can be done by using the special function 80% or with the use of compressed air on the air connector on the intake.

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 there is need to return the motor to AMT NL for service or repair please **only** send the items on the next page, 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.

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.

Nike EPV internet inspection 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_____
❑ EPV : NL_____
❑ Internal fuel pump

❑ Front engine strap
❑ Rear engine strap ❑ 2 x
❑ Front cap
❑ Internal EGT sensor
❑ Internal main fuel solenoide
❑ Internal igniter solenoide
❑ EPV power cable
❑ EPV to engine cable
❑ EPV control cable
❑ EPV Battery
❑ Battery charge cable
❑ _____
❑ _____

❑ Engine : NL_____
❑ EPV : NL_____
❑ Internal fuel pump

❑ Front engine strap
❑ Rear engine strap ❑ 2 x
❑ Front cap
❑ Internal EGT sensor
❑ Internal main fuel solenoide
❑ Internal igniter solenoide
❑ EPV power cable
❑ EPV to engine cable
❑ EPV control cable
❑ EPV Battery
❑ Battery charge cable
❑ _____
❑ _____

Incomming checked by:

Outgoing checked by:

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 fuel 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 and then squashed flat with pliers. Please fit the supplied red plastic caps to the turbine to stop anything getting inside the turbine.

2. EPV, close fuel in/outputs as mentioned above.

3. 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. For more details.

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. Occasionally check the RPM sensor to make sure that it is not touching the compressor wheel, at a Nike engine the clearance should be 0.25-0.30 mm. If there is a need to 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, 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 PAN 4 and PAN 6 tubing into the Festo quick-connect fittings for fuel and igniter at the side 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 or connectors of the EPV. 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 and available on the supplied CD.

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	vehicle type	A,B,C,D, Test
4th column	engine running time	(minutes)
5th column	remarks	----------

Example:

Log Nike gas turbine				
Date	**Location**	**vehicle type**	**engine running 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 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 EPV 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, EPV and completed Engine Log. Please use the original packaging material for this.

10.3 Warranty

The Warranty card is included with turbine set.

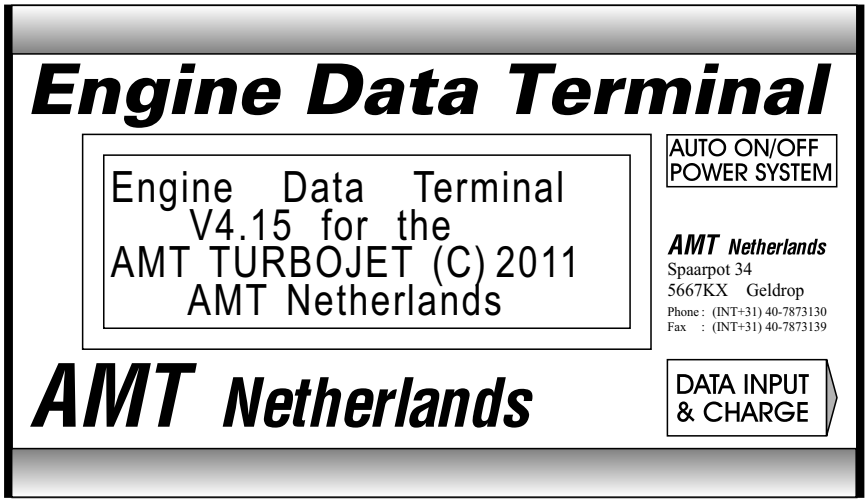


figure 11.1

(power up)

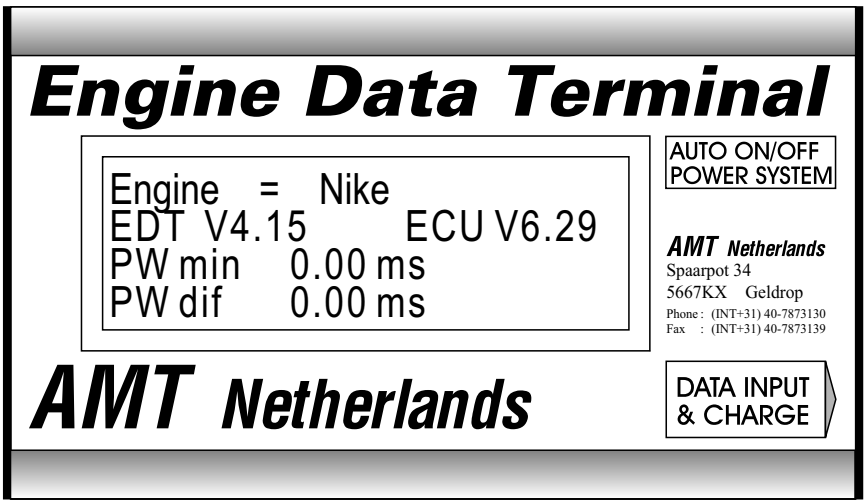


figure 11.2

(start up screen)

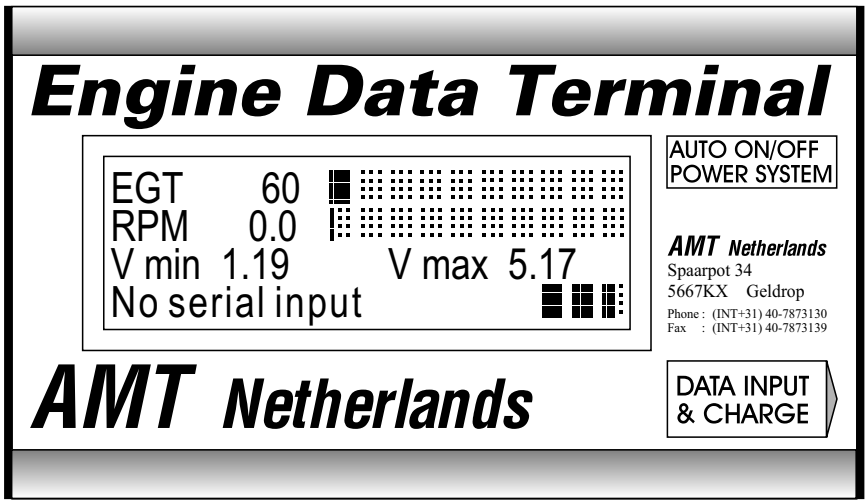


figure 11.3

(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 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.)

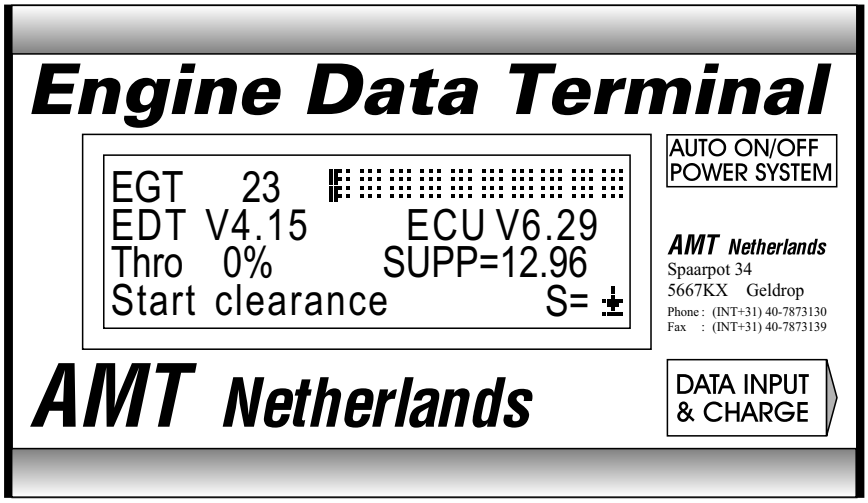


figure 11.4

(system off)

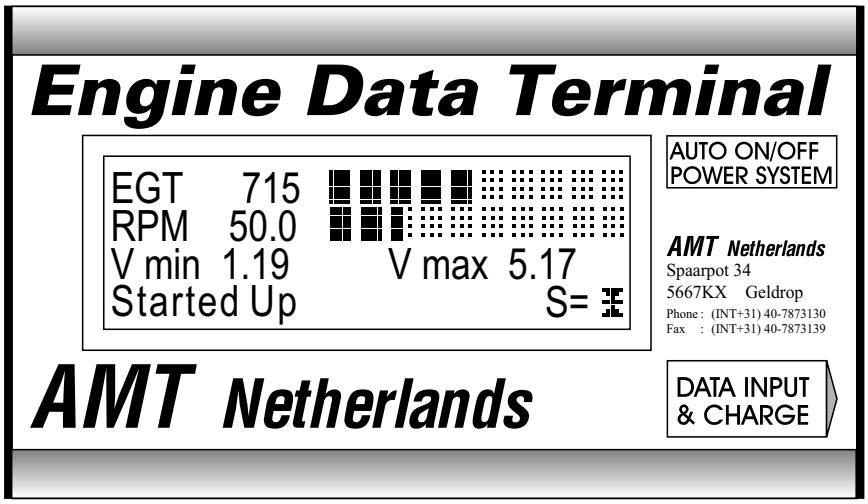


figure 11.5

(power down seq.)

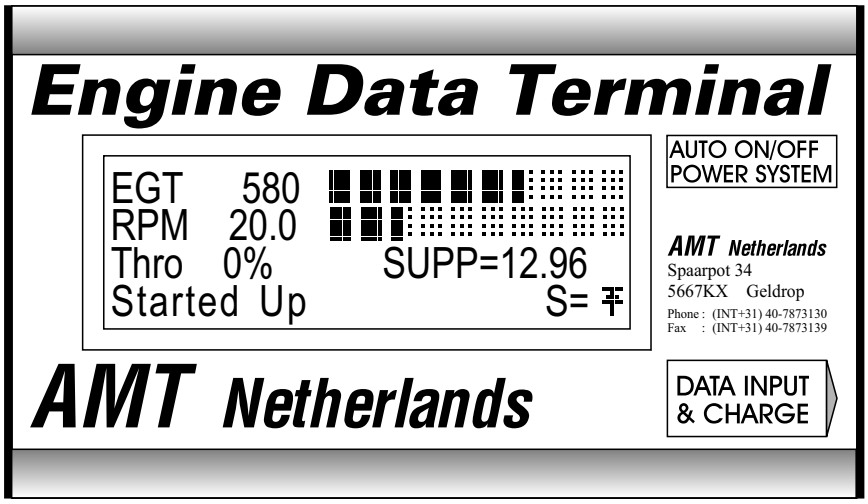


figure 11.6

(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"

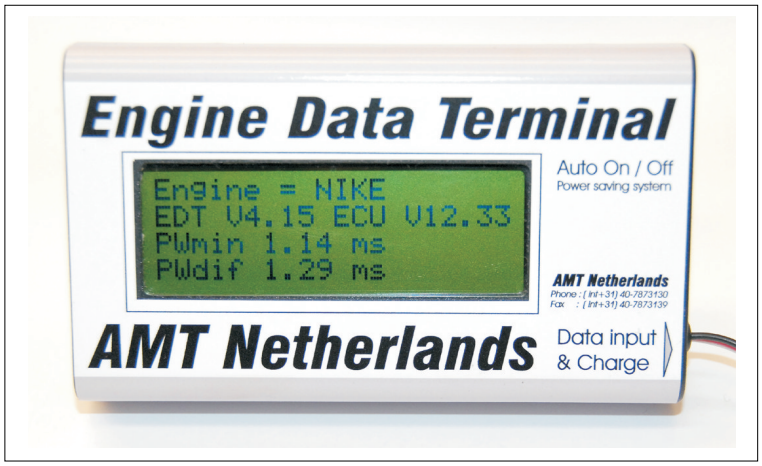
This screen is displayed when the three-position switch is in position 3, for "starting and running" the engine, indicated by the high beep tone. (figure 11.6)

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 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.


Engine Data Terminal
Engine = NIKE
EDT V4.15 ECU V12.33
PWmin 1.14 ms
PWdif 1.29 ms
Auto On / Off
Power saving system
AMT Netherlands
AMT Netherlands
Data input
& Charge

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 solenoide 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 occurswhen 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 wireing.

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

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 ℃ 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.

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.	
- -			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.	
- -			min.	

Advanced Micro Turbines

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

date	location	model	engine time	remarks
- -			min.	
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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

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

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