Owners Manual & ENGINE LOG (20190919)

Lynx gas turbine©

Serial number N L

AMT Netherlands

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General

This Owner's Manual has been issued by AMT Netherlands.
The purpose of this manual is to provide the necessary information, requirements, installation, programming, operating and maintenance info for the owner/operator to safely install and operate the engine. This manual is especially prepared for the engine identified on the front page and in the Header of this manual and shall not be used for other engine models.

Each page in this manual can be identified by its header which contains:

- Chapter number and description
- Page number in the chapter
- Revision number of the page.

Text pages have been include as right-facing pages.
Pages with drawings are left-facing pages and opposite of the relevant text where possible. Drawings have references numbers linking to the applicable text.

AMT Netherlands issues Owner's Manual revisions to provide new or revised procedures and information. With each update of this owner's manual, a revised manual will be sent as a digital document to the owner's last known address.
The table of contents serves to check the completeness of this owner's manual and to validate its content.
The Revision Highlights section contains short descriptions of the changes.

Revision Highlights

This is the second issue of this Owner's Manual.

Table of contents

1.1 Company

Advanced Micro Turbines Netherlands (AMT Netherlands) designs and produces small gas turbine engines. The engines are primarily used for the propulsion of UAV's, experimental aircraft and radio-controlled airplanes. Our engines are also used as a bringing home device for full size gliders and other applications. Furthermore, our engines can also be used for research and educational purposes.
On request, an engine can be adapted so that it may be used as a remote heat and/or power generator, or as an auxiliary power unit.

AMT Netherlands originates from Jet Team Holland which has been giving flight demonstrations with jet propelled models since 1987.
Our first and smallest engine Pegasus MK-1 was developed in 1991 with a thrust of 90 Newton at 90,000 rpm. As our knowledge increased, a demand enfolded and as a result the company was founded in 1994.

Over the years several engines have been designed with great success.
AMT Netherlands has grown rapidly and in 2012 a new large production facility was opened in Geldrop, the Netherlands.
Using state of the art equipment including 5-axis CNC milling machines and an indoor testing facility, AMT Netherlands designs, tests and produces all critical engine components in house.
All materials are carefully selected according extensive calculations, operational tests and our stringent quality control process.

1.2 Lynx gas turbine engine

The development of the Lynx commenced in 2014. The Lynx is designed as a single rotor gas turbine engine capable of delivering 1569 Newton of thrust at 46,000 rpm. Such specifications and performance have never been achieved before with an engine this size.

It's main components are:

- Electric starter motor
- Cowling
- Centrifugal radial flow compressor
- Diffusor
- Low pressure fuel injection system
- Annular combustion chamber with ceramic ignitor
- Axial flow turbine
- Exhaust nozzle

The electric starter motor engages the compressor through a Bendix clutch to start the engine. It disengages automatically at 10,000 RPM.

A cowling guides the ambient air smoothly towards the compressor.
Here the air is partially compressed and then ejected aft at very high velocity. The diffusor directs the air flow to the rear and increases the air pressure by reducing the air's velocity. The pressure ratio is about 4:1.

A fuel-oil mixture is atomized into the compressed air and ignited by a ceramic igniter during the start sequence. Once the engine has reached operating speed, the combustion is self-sustaining. The combustion process adds energy by heating the compressed air.
This high energy air mass is then directed towards an axial flow turbine which extracts a small part of the energy to drive the compressor. The remaining air mass exits through the nozzle which increases the velocity even further. The reaction force results in propulsion.

Besides combustion, the fuel-oil mixture serves to cool and lubricate the two hybrid bearings. Therefore, a separate lubrication system is not required.

A compressor pressure outlet is available for pressurization of smoke tanks etc.

1.3 EPV

A fully automatic integrated digital Engine control, Pump and Valve unit (EPV) regulates the engine. The modular design requires only three connections to the engine: a single cable, a main fuel line and an igniter fuel line. Electrical power to the EPV is provided by a 22.2V (6S) 4500mAh 25C rated LiPO battery.

The EPV requires a Flight Management System (FMS) containing an operating switch (OPS) and a throttle (THR).

The EPV can be controlled with a serial protocol (RS232) requiring only one connection but providing normal controls and engine data monitoring.
If the FMS produces Pulse Width Mode (PWM) signals similar to Radio Controlled (RC) systems it can be connected directly to the EPV. Single channel operation using the Throttle and its associated mechanical Throttle trim is also possible.
Alternatively, the EPV can be controlled with analogue signals. In a stationary application AMT Netherlands can provide an Analogue EPV and an Engine Control Box.
Data is then monitored by an optional Engine Data Terminal (EDT). Optionally, similar controlling, monitoring and data collection may be done using our PC application Turbine Maintenance Control (TMC).
The EPV continuously logs various engine data and stores the last 25 minutes in its memory. The data can be extracted via the TMC software.

A built-in buzzer indicates system status before engine start and after engine shut down.

*** DELIVERY FORM ***

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

000009 AMT Netherlands

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

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

number	article description		items
50035300	Lynx engine		1
05401103	RPM sensor	(mounted on engine)	1
05400107	Thermo sensor	(mounted on engine)	2
05890340	EPV unit V3		1
05890313	EPV FMS control connector	(empty connector)	1
05890344	EPV FMS connector (incl.Futaba connector)+ safety clip		1
05890343	EPV to engine cable (length 75cm.)		1
05030498	Lithium polymer battery 22.2V/4500Mah.	(read instructions)	1
05030511	Battery pack charge cable XT90		1
57390106	Front engine mount	(mounted on engine)	1
57390108	Middle engine mount	(mounted on engine)	1
57390107	Rear engine mount	(mounted on engine)	1
08470521	Festo PAN 4 Tube / EPV to engine	(igniter tubing)	1
08470523	Festo PAN 8 Tube / EPV to engine	(main fuel tubing)	1
08470621	Legris tube 12 / EPV to fuel tank		1
08470516	Fuel filter Lynx	(between tank and EPV)	1
05300151	TMC software V _._ + USB cable		1
84890502	Engine manual V_._		1
05890111	Engine data terminal V_._ + charge cable		1
90001082	Festo tube cutter		1
84890503	Test data		1
24890503	Warranty card		1

Note: After final assembly, each engine and EPV are subjected to three test runs. All performance data is stored in our factory database. For reference, the data of the third run is enclosed in the engine delivery package.

1.4 Owner's Manual

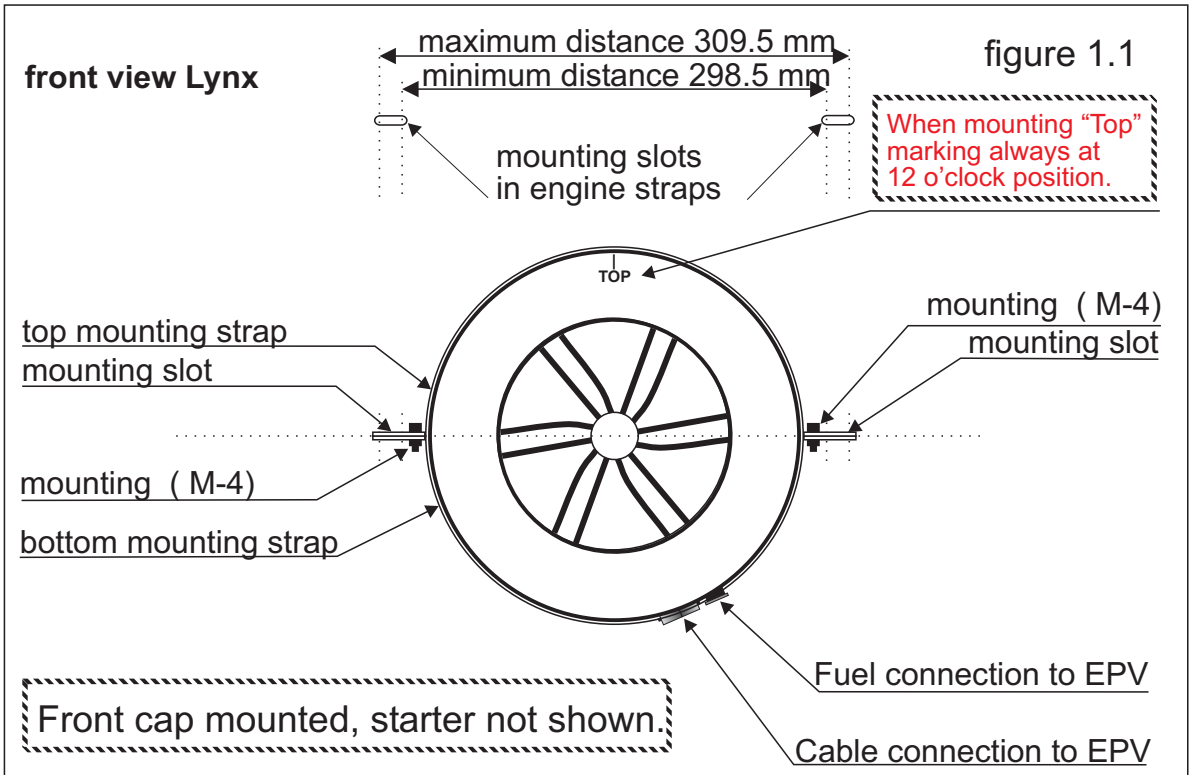
It is very important that the operator does study this manual carefully before installing or operating the engine, in order to understand the Lynx and its systems properly.

1.5 Sundries

Besides the Lynx gas turbine engine, the delivery also contains a number of additional items such as tubes, connectors, battery, battery charging cables etc.
All items are listed on the DELIVERY FORM.

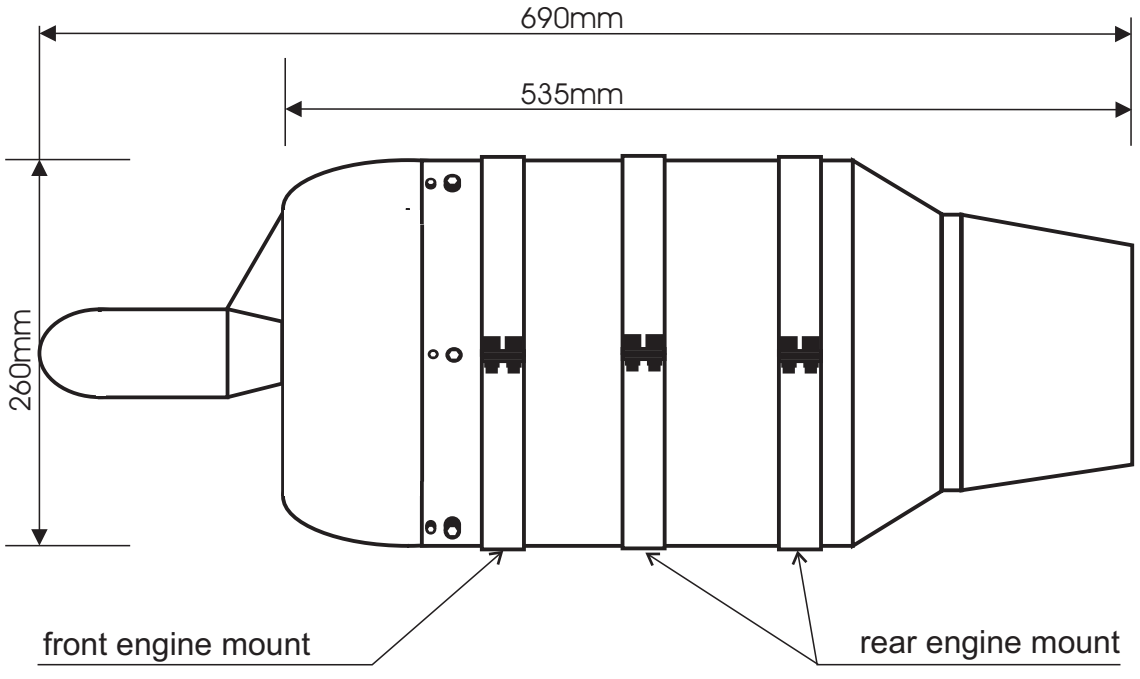
front view Lynx

figure 1.1



side view Lynx

figure 1.2



1.6 Technical data

All data at S.T.P: 15°C and 1013 mBar (59°F and 29.91 in); accuracy +/- 2%.

Diameter	260 mm	10.2 in
Length	690 mm	27.1 in
Weight	21450 gram	47.2 lbs
Inlet surface area	176.7 cm²	27.38 in²
EPV dimensions (LWH)	200 x 110 x 88 mm	7.87 x 4.34 x 3.46 in
EPV weight	2700 gr	5.51 lbs
System airborne weight *	25650 gr	56.55 lbs
Maximum allowable RPM	46,000	46,000
Thrust @ 46.000 RPM	1569 N	352.0 lbf
Mass flow @ design RPM	2500 gr/sec	5.51 lb/sec
Idle RPM	15,000	15,000
Thrust @ idle RPM	70 N	15.7 lbf
Pressure ratio @ design RPM	4:1	4:1
EGT typical	800 °C	1472 °F
Maximum EGT	875 °C	1607 °F
Fuel flow @ design RPM	3600 gr/min	127 oz/min
Fuel type	refer to chapter 3	
Oil	refer to chapter 3	
Fuel tubing	Festo PAN 4, 8 and Legris 12-10	
Electrical power	a 22.2V (6S) 4500mAh 25C rated LiPO battery	

(* System airborne weight includes Engine, EPV, mounting straps, fuel filter, LiPo battery and associated cabling and tubing)

Refer to figures 1.1 and 1.2 for dimensions of the engine.

2.1 Scope

This manual provides the requirements, installation and operation instructions of the engine.
Regarding installation in an airframe or in a stationary environment, the information in this manual is guidance material only.
This manual is written under the assumption that the end user has the required expertise and skills to build, install and operate the airplane/UAV safely and that the end user adheres to all applicable national safety regulations.

It is the sole responsibility of the airframe designer and/or builder to use suitable design and construction methods in order to achieve a safe and efficient end product in which the engine is to be used.

It is the sole responsibility of the end user to ensure safety of the operating crew, bystanders and surroundings - whether in a stationary situation or in an airframe - and to adhere to all applicable national safety regulations, including regulations regarding airplane/UAV flying if applicable.

2.2 Warnings, Cautions and Notes

The following advisories are used throughout the manual:

WARNING: **An installation requirement, operating procedure, technique, etc., that may result in personal injury or loss of life if not carefully followed.**

CAUTION: **An installation requirement, operating procedure, technique, etc., that may result in damage to equipment if not carefully followed.**

Note: An installation requirement, operating procedure, technique, etc., considered essential to emphasize. Information contained in notes may also be safety related.

2.3 Safety

The engine is manufactured with utmost precision and care, it is important that maintenance personnel and user treat the engine as a precision instrument.

WARNING: In general gas turbine engines are dangerous and require specific knowledge and expertise to install and operate. If you do not possess the required knowledge and skills, do not install or operate the engine and seek expert advice.

During all engine operations, use the two-man crew concept. This means that there must be at least one assistant who is familiar with the operation of the engine and safety features such as a fire extinguisher. The assistant should scan the surroundings regularly and inform the operator of any risks. In case of incapacitation of the operator, the assistant shall take emergency action to ensure safety and keep positive control of the engine, airplane or UAV.
Both must be physically and mentally fit before and during engine operation.
Safety of the operating crew, bystanders and surroundings must be ensured during all engine operations.

HAZARDS: Typical engine hazards are:

Noise
The Lynx gas turbine engine has a typical jet engine noise spectrum and produces noise well above safe limits. All persons in the vicinity of the engine must use suitable personal hearing protection.

Ingestion
During operation, the engine sucks in large amounts of air. Near the engine and airplane/UAV inlets, the suction can be so strong that loose objects, human hair or even a human hand is sucked into the engine. Besides Foreign Object Damage (FOD), this may cause serious injury.
The construction of the airplane/UAV shall be such that no other parts, cables, fuel tubes etc. can ingested into the engine.
Make sure there are no loose objects in the immediate vicinity during engine start and operation.

High temperatures and fire

The engine fuel is very combustible. Fuelling shall only be done when safety allows. During fuelling, the operator must carefully monitor the process.
During engine operation and for several minutes after engine shutdown, all parts of the engine and exhaust duct are very hot. Make sure installation is such that no fire hazard exists. Do not touch the engine by hand until it has cooled down sufficiently.
The jet blast from the exhaust is very hot and may cause fire. Always check if the area behind the exhaust is clear.
Have a CO2 or Halon fire extinguisher available during fuelling and engine operation.

Jet blast

The jet blast of the engine, even at idle power is strong enough to move small objects at high speed. This may cause damage or personal injury.
Always check if the area behind the exhaust is clear.

Vapours, exhaust gas and fumes

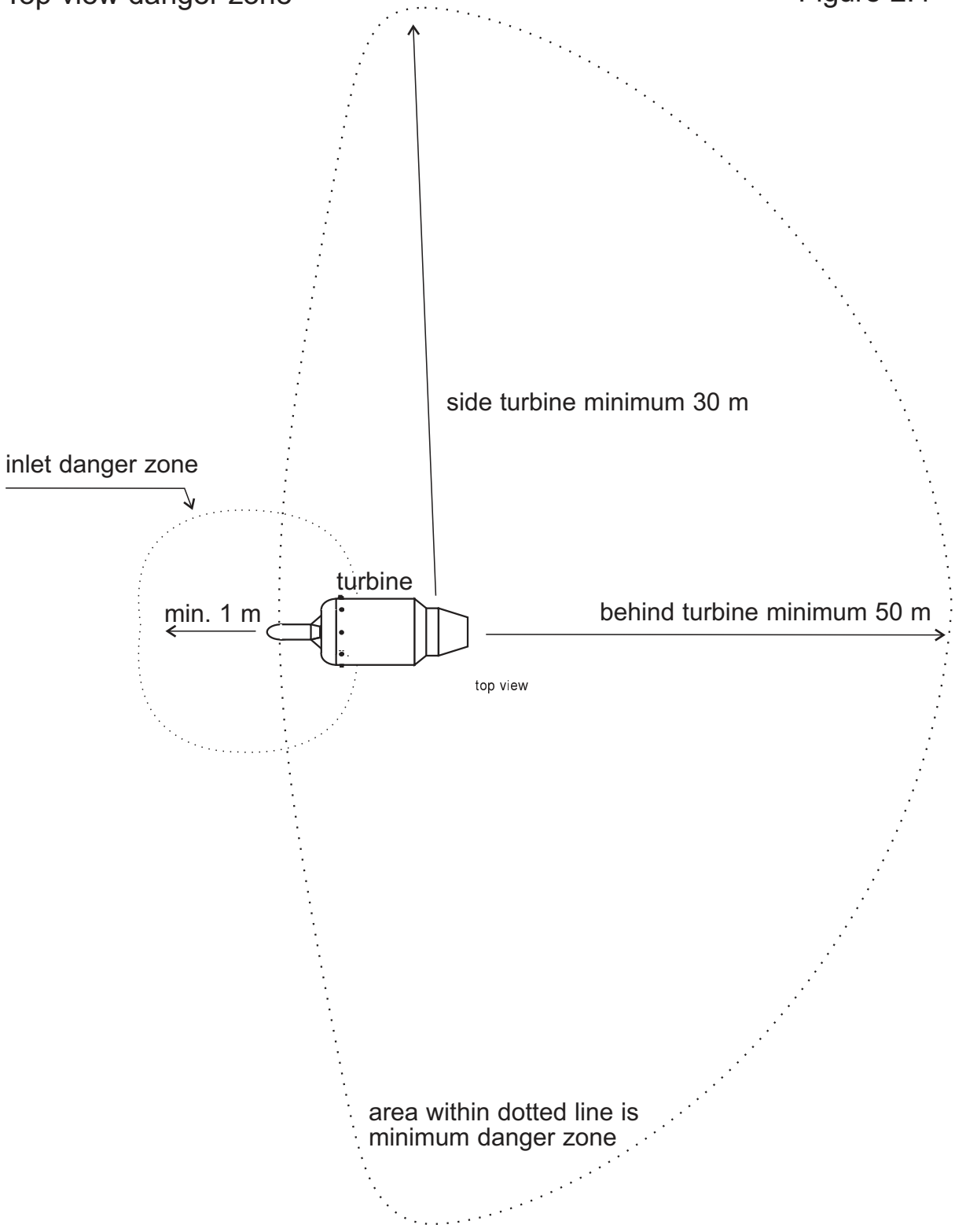
The main part of the exhaust gas consists of water, N2 and CO2, however the gas also contains toxic substances such as Hydrocarbons and CO.
As with all combustion engines, care must be taken not to inhale any fuel and oil vapours, exhaust gasses or fumes.

Power

The engine is capable of delivering tremendous thrust and power. The engine must be firmly secured to its mounting. Due to the engine power, airplanes/UAV’s can achieve very high speeds. Exercise the necessary caution.

Top view danger zone

Figure 2.4



turbine and danger zone not drawn on same scale !

2.4 Danger zones

The danger zones are shown in Figure 2.4.
During engine start, operation and cooling, unauthorized personnel is not allowed inside the danger zones.

2.5 LiPo battery safety

LiPo batteries are very reliable and well suited, however they are also sensitive and can be dangerous if not handled correctly. The operator must be familiar with LiPo battery installation, charging, balancing, use, cooling requirements, discharge and storage procedures and limitations as this is beyond the scope of this manual. Use of other than fully automatic chargers with built-in balancing and safety features is not recommended.

2.6 RC Systems

AMT Netherlands strongly advises to use a spread spectrum GHz range RC system as these systems greatly increase reliability and are much less susceptible to interference. If not available, a VHF PCM coded RC system with a protected frequency shall be used.
A PPM coded RC system can be used but is not recommended as these are prone to interference and usually do not have a fail-safe option.

2.7 Liability

The purchaser and end-user assume all risk of injury, harm and damage, of every nature whatsoever arising out of the handling or operation of any AMT Netherlands product or service rendered.
AMT Netherlands is not liable in any way for whatever damage or injury – direct or consequential- resulting from the use its products. The latest actual revision of the AMT Netherlands GENERAL TERMS AND CONDITIONS OF SALE AND PURCHASE are applicable.

Engine: NL0000-Lynx

All data at STP conditions

AMT Netherlands
Spaarpot 34, 5667 KX Geldrop
http://www.amtjets.com

THR [%]	RPM [1000x]	EGT [°C]	Vout [V]	Thrust [N]	Tot. Fuel [cc/min]	Burner [cc/min]	Bearing [cc/min]	SFC [gr/kN*sec]
0	15,0	630	0,83	76	747	732	15	132,69
10	25,0	557	1,37	244	1313	1275	38	72,65
20	31,0	543	1,79	431	1740	1683	57	54,50
30	35,0	543	2,23	606	2107	2034	73	46,94
40	37,5	561	2,65	766	2437	2351	86	42,95
50	40,0	589	3,09	951	2803	2703	100	39,79
60	42,0	621	3,51	1114	3159	3046	113	38,28
70	43,0	663	3,89	1253	3480	3356	124	37,49
80	44,5	709	4,34	1388	3841	3707	134	37,36
90	45,5	732	4,78	1497	4134	3991	143	37,28
100	46,0	768	5,23	1595	4401	4252	149	37,25

All data at STP (15°Celcius / 1013 mBar)

Example STP test data. Final report included with engine.

3.1 Ambient air

The engine requires large amounts of ambient air. Ensure that the supply of ambient air is sufficient.
For airplane/UAV installation guidelines, see chapter 4.
For stationary set-ups such as in a teaching environment, ensure adequate ventilation by means of a ducting and ventilation system capable of handling flow velocity, flow mass and exhaust temperature.

3.2 Fuel and oil

Fuel must be pre-mixed thoroughly with 4.5% oil. In this manual, this mixture is referred to as fuel: its serves both combustion and lubrication of the engine.
Any combination of the allowable fuel and oil types below is permitted, however AMT Netherlands recommends that you stick to a combination once it has been chosen.
It is therefore important check local availability before making this decision.

Allowable fuel types:

- Jet A and Jet A-1
- JP-4/Kerosene
- Paraffin
- Diesel mix Additional specifications apply: contact AMT Netherlands prior to using Diesel.

CAUTION: Ensure that clean fuel is used. The filling tube between the external container and the vehicle/engine fuel system must contain a high quality fuel filter.

Typical fuel consumption figures during STP conditions are indicated in the graph on the left page.
Refer to the enclosed Lynx gas turbine engine run test parameters for fuel consumption measured in STP conditions.

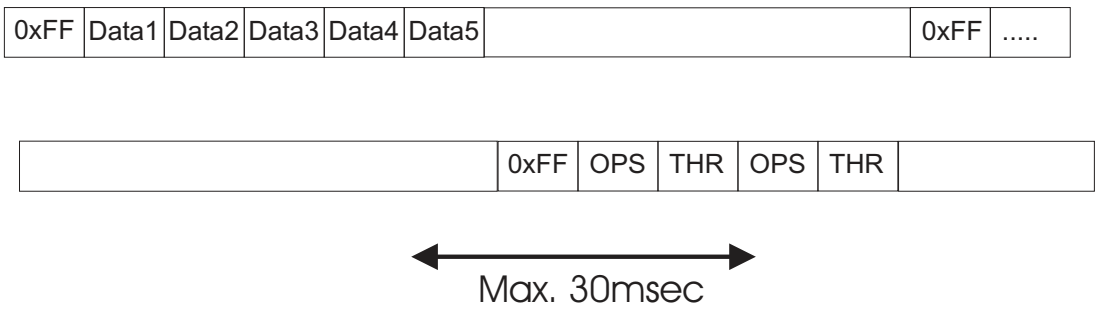
Note: that actual fuel consumption depends on many variables and may deviate considerably.

Allowable oil type:

- Aeroshell 500

The above lists of allowable fuel and oil types are subject to change without prior notice.
Check our website www.amtjets.com for fuel and oil specifications.

figure 3.2


0xFF
Data1
Data2
Data3
Data4
Data5
0xFF
.....
0xFF
OPS
THR
OPS
THR
Max. 30msec

3.3 Control input and data monitoring

To control and to monitor the engine, the EPV requires input control signals. The EPV returns data of the current state of the engine as a serial data stream.

Following three options can be used as input control signal for the EPV:

- Serial data control and telemetry:
  - RS232 (2400/4800/9600/19200 Baud)
  - Signal levels -12V / 12V
  - 8 bits / 1 stop bit / No parity
- Analogue control signals:
  - AMT Analogue Control Box
  - Levels 0….5V / max. 0.5mA
  - Cable length standard 2 meter, max. 10 meter
- PWM control signals:
  - Single or Dual channel (RC) system
  - PWM 1 to 2ms; repetition time 20….25ms; 2.7V to 5V

Note: Serial data control and telemetry is always available. During the ordering process a dedicated type must be chosen either analogue control or PWM control.

3.3.1 Serial data communication

A dedicated serial data stream must be send to the EVP for controlling the functionality of the Operations Switch and Throttle. Also the function button functionality can be give via the serial data stream (figure 3.2).

The serial data stream contains a header and two times the value of the Operations Switch (OPS) and Throttle (THR).

Header:	character 255 (0xFF)
OPS:	character 17 = EMER. STOP
	character 18 = AUTO. STOP
	character 20 = START/RUNNING
	character 145 = CTF
THR:	Throttle percentage * 2 + 32
CTF:	character 145

Data stream to the EPV.

{255}, {OPS}, {THR}, {OPS}, {THR}

Further information regarding the RS-232 protocol can be found in the enclosed CD.

3.4 Electrical power

Normally, a 22.2V-4500mAh (6S) LiPo battery capable of delivering at least 25C is included in the delivery package. The LiPo type battery has been chosen as it is capable of delivering the required peak amperage during engine start (40 – 50 A) and sustainable power during full throttle engine operation (8 – 10 A).
An engine start consumes approximately 500mAh.
Typical electrical power consumption during STP conditions is indicated in the table below.

Throttle input	Current [A]	Consumption [mAh]
0%	1	1000
50%	5	5000
100%	8	8000

Note: that actual electrical power consumption depends on many variables and may deviate considerably. Use of a higher capacity battery is allowed.

An alternative DC power source may be used provided it is capable of delivering similar power and peak power output.

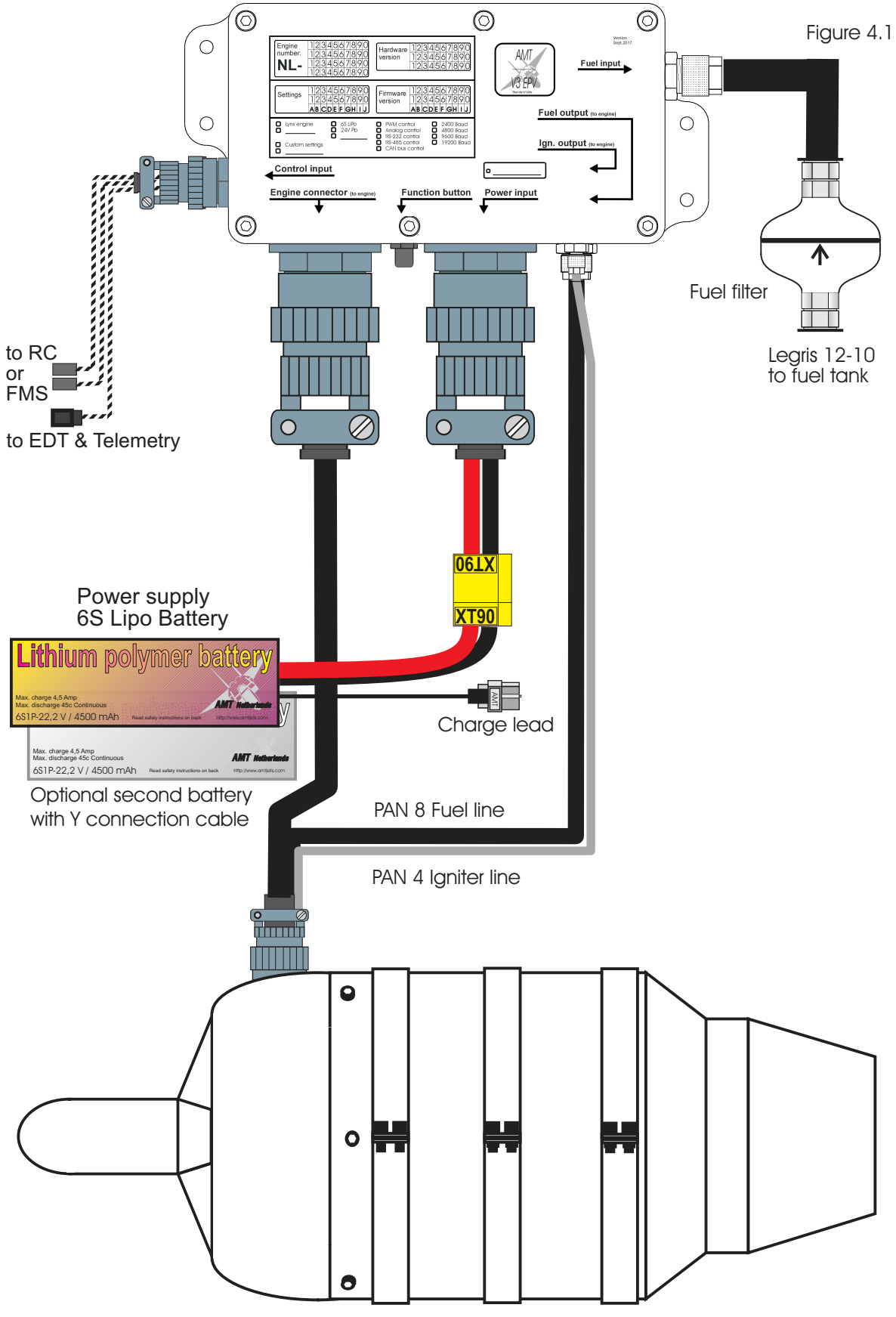
WARNING: during engine operation, 18.0 V is the preset low battery error and results in immediate engine shutdown.

3.5 Fire extinguisher

As safety is of utmost importance, make sure a fully charged CO2 or Halon fire extinguisher available and within reach.
Both the operator and the assistant must be able to handle the extinguisher.

Note: other extinguisher types may leave residue in the engine and are not recommended.

Figure 4.1



Items are not to scale

4.1 General

Figure 4.1 shows the complete engine to EPV connection.

Study the engine, fuel and igniters lines, EPV, battery and associated connectors and cables to determine safe and logical installation.

Be aware of FOD and chafing of the engine and its accessories. All equipment must be securely fastened.

For performance reasons it is usually preferable to keep the exhaust duct as short as possible. Installation of the engine behind the centre of gravity also allows optimum positioning of the fuel tank(s) at or near the centre of gravity.

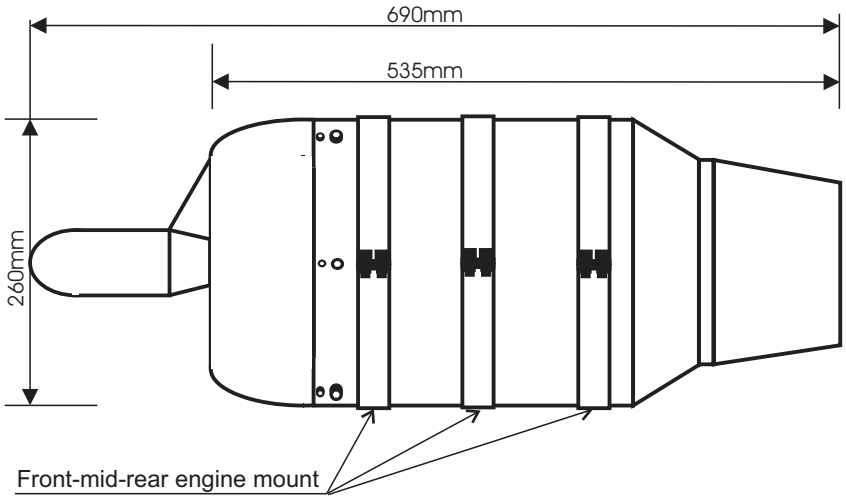
The engine may be mounted either un-ducted or using an inlet duct with bypass. Either installation method requires at least 15 mm clear space around the engine casing for cooling.
An un-ducted installation does not guide ambient air to the engine. Instead, the engine also sucks in air from any opening in the fuselage such as gear door openings.

Using an engine duct with bypass is recommended as it:

- prevents ingestion of cables or other material inside the fuselage,
- forces cooling air around the engine
- reduces noise.

side view Lynx

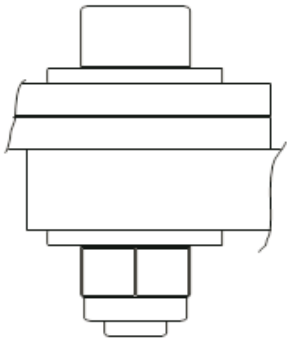
figure 4.2



Engine strap detail

figure 4.3

M5 socket head cap screw
Flat washer
Engine mounting straps



Mounting bracket
vehicle or object

Flat washer
M5 self locking nut

figure 4.4

4.2 Engine mounting

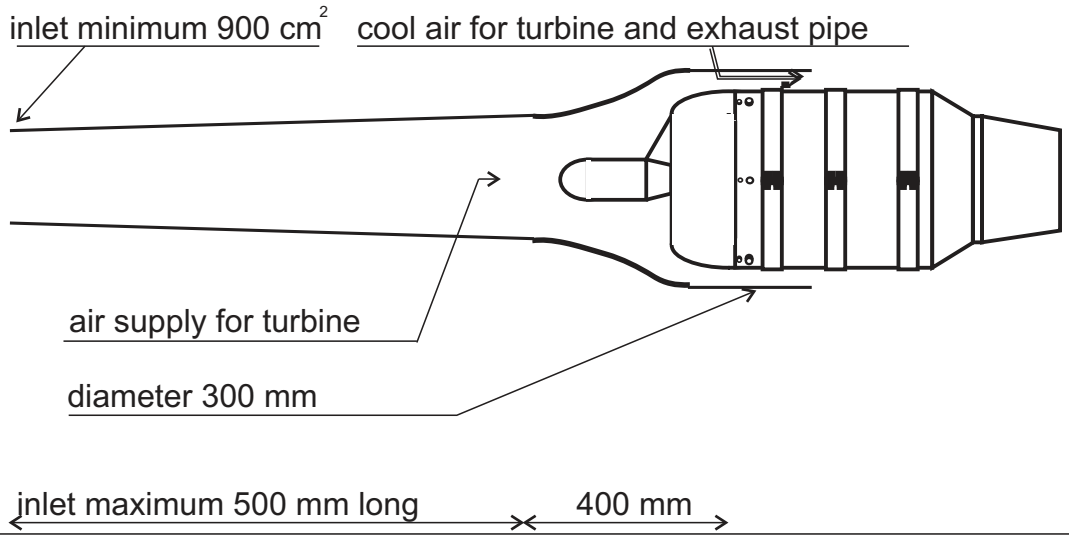
Figure 4.2 shows the dimensions of the engine.

Note: that the engine diameter of 260 mm is the maximum diameter of the casing excluding mounting brackets, connectors.

The engine is mounted using one front, one in the middle and one rear mounting straps. Each strap consists of a top and a lower halve.

1. Place the mounting straps around the engine and make sure that the ‘TOP’ marker on the cowling is at the 12-o’clock position +/- 10 degrees. (figure 4.4)
2. Secure the mounting straps on the engine with 12 x M4 bolts.
3. Using the left and right mounting slot of each strap and fasten the engine with 6 x M5 socket head cap screws, flat washers and self-locking nuts as shown (figure 4.3).

inlet shape figure 4.5



4.3 Inlet duct

AMT Netherlands recommends the use of a high quality epoxy resin, which is resistant to approximately 100 °C after curing/tempering.

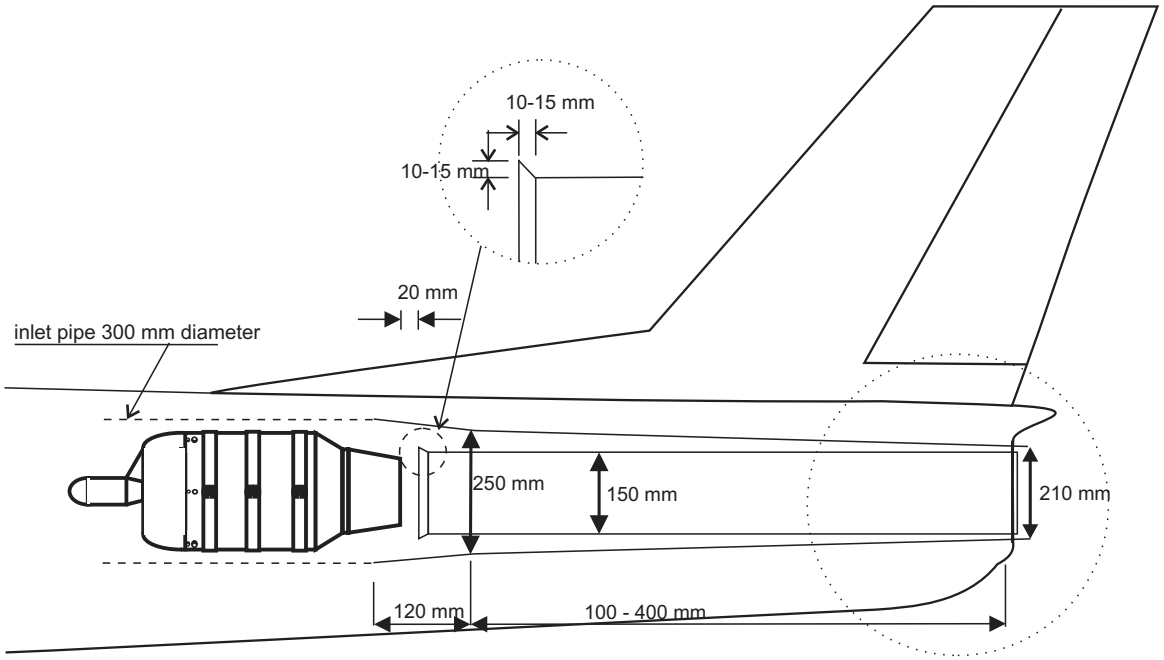
Ducting should have an minimum inside diameter of 300-350 mm (figure 4.5).
The minimum required air intake surface area should be about 1.5 times the engine inlet surface area.
Avoid sharp angles or protruding edges, the duct lining should be smooth. A bad aerodynamic shape, and/or not enough air flow, will result in a higher exhaust temperature and a higher noise level on the intake side of the engine.

At least 15 mm space around the engine casing is required for cooling.

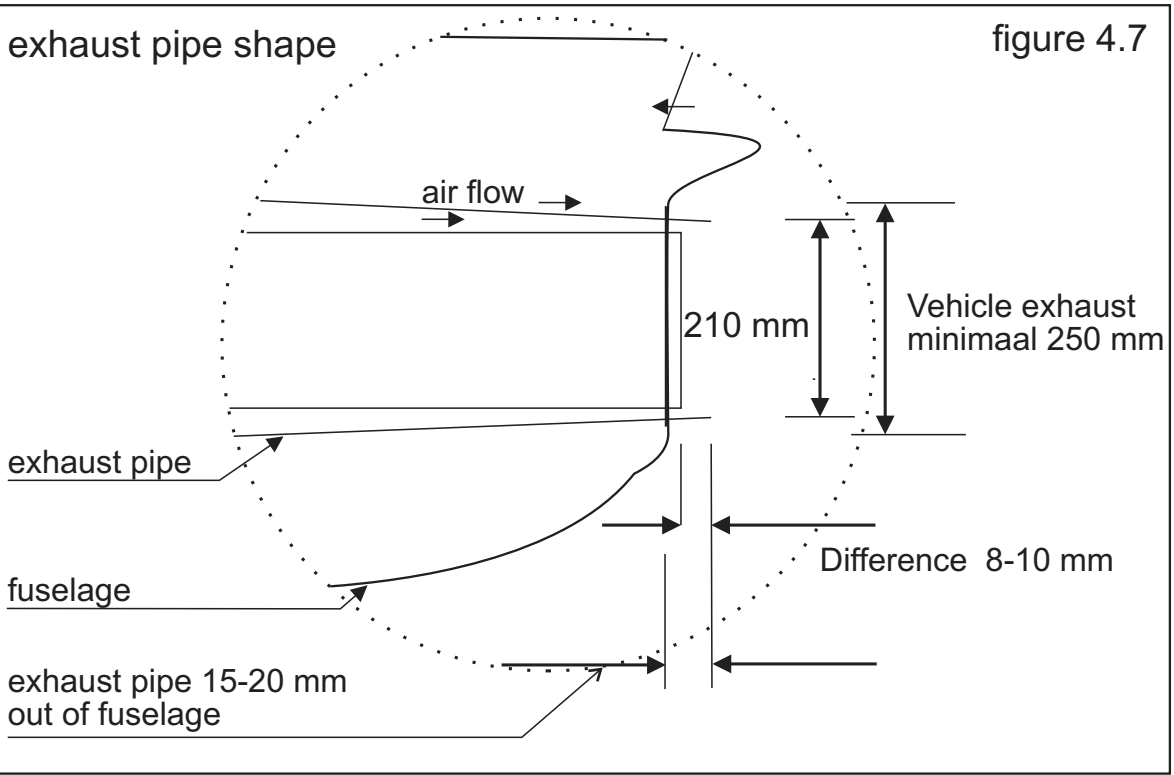
A properly designed inlet, ducting and bypass may also reduce drag and increase airspeed. Figure 4.3 shows the required inlet, ducting and bypass dimensions for an airspeed of approx. 100 m/s (200 Kts).
The optimum design of air intake, ducting and bypass depends on many factors such as number of intakes, intake duct length, airplane/UAV speed, exhaust length etc. and is therefore beyond the scope of this manual. The information in this chapter is therefore advisory only.

CAUTION: If FOD is to be expected, e.g. when operating from a gravel paved runway and/or when using an under mounted air intake, a fine mesh inlet air screen must be installed to prevent damage to the engine.

exhaust pipe figure 4.6



exhaust pipe shape figure 4.7



4.4 Exhaust duct

To prevent high temperatures inside the fuselage, a dual tube exhaust is highly recommended. AMT Netherlands recommends the use of a heat resistant CrNi steel, stainless steel type 316, titanium or Inconel 600 with a gauge of 0.25 mm to 0.40 mm for the inner tube.
The outer tube can be made from the same material, but it only needs to be 0.2 mm to 0.3 mm thick. This will save weight. Some customers have also successfully used 0.2mm thick aluminum for the outer tube.

The high exhaust gas velocity automatically draws cooler air from around the engine into the exhaust duct which then mixes with the hot exhaust gases. Therefore the inner tube does not become warmer than 300 - 400 ºC, see figures 4.6 and 4.7.

As the inner tube is mounted 8 - 10 mm inside the rear end of the outer tube, cooler air from around the engine is also drawn into the area between the two tubes.
This dual tube design reduces the temperature of the outer tube to about 60 - 90 ºC, see figure 4.7.

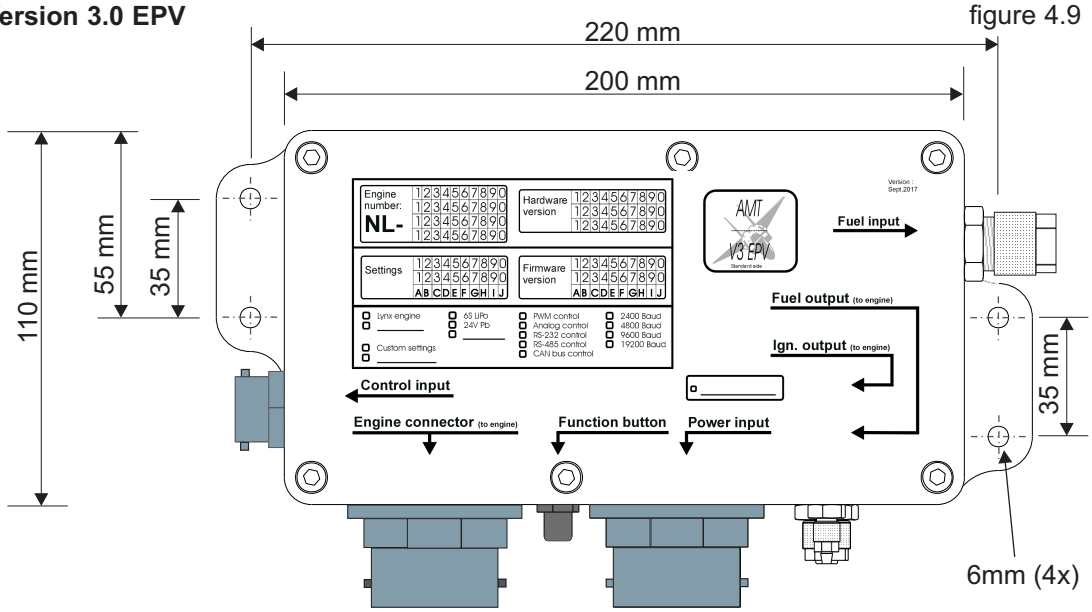
Note that the outer tube should protrude approx.15 -20mm outside the back of the fuselage. This creates a small negative pressure inside the fuselage resulting in a positive airflow through the fuselage which enhances cooling of the exhaust tubes.

WARNING: The exhaust duct must be constructed and installed according figure 4.6 and 4.7. Also ensure that the duct is mounted centrally and in line with the engine. This will result in optimal cooling air drawn in. Too much cooling air results in a severe reduction in thrust.
Insufficient cooling air may result in overheating, structural failure, loss of the vehicle and personal injury or death.

figure 4.8

Version 3.0 EPV

figure 4.9



Height : 88 mm
Weight : 2700 Gram
Box material : Aluminium

4.5 EPV

4.5.1 Mounting instructions

The EPV should preferably be located slightly below the level of the fuel tank. This ensures immediate fuel supply when starting the engine.
In extreme conditions, the temperature of the EPV can rise up to 70ºC. If possible, try to install the EPV in such a way that cooling air can flow along the EPV.
Whenever possible, try to install the Lynx gas turbine engine, EPV and battery near to each other so that the standard cables do not need to be extended.

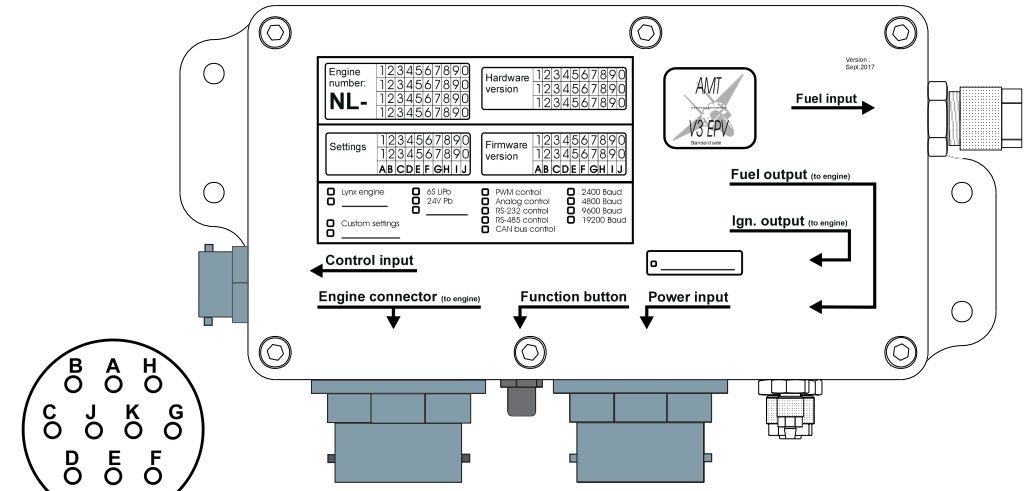
Caution: the EPV to Engine cable is calibrated for correct transmission of sensor data. Do not alter this cable. An altered cable could result in damage to the engine. If a different length is required, contact AMT Netherlands.

For ease of installation and maintenance, the EPV has fixed mounting lugs. Care should be taken that the EPV mounting structure can withstand the loads during takeoff, manoeuvring and landing as the EPV weighs 2700grams/5.95lb.

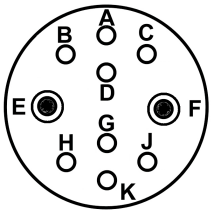
Accessibility of the connectors and the Function button is very important. If controlling of the EPV is done without a serial communication link, the function button must be reachable during the set-up and programming phase.

Finally, connect the engine with the supplied cable to the Engine connector on the EPV.

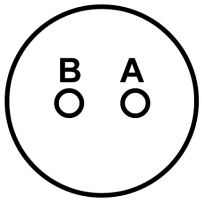
Version 3.0 EPV figure 4.10



FMS connector



Engine connector



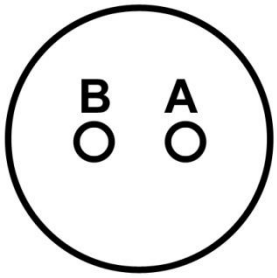
Power connector

4.5.2 EPV electrical connections

The EPV has 3 electrical connectors, all are military spec. Amphenol connectors.

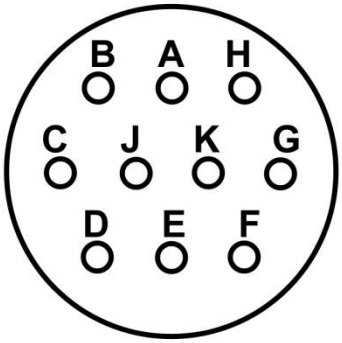
4.5.2.1 Power connector

A : Power - (GND)
B : Power +



4.5.2.2 FMS connector

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



4.5.2.3 Engine connector

A : EGT2 - (white)
B : Internal igniter +
C : EGT2 + (green)
D : Internal igniter -
E : Starter unit +
F : Starter unit -
G : EGT1 - (white)
H : RPM -
J : EGT1 + (green)
K : RPM +

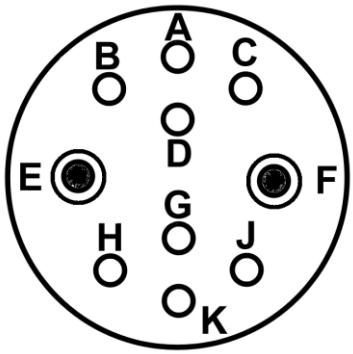


Figure 4.10

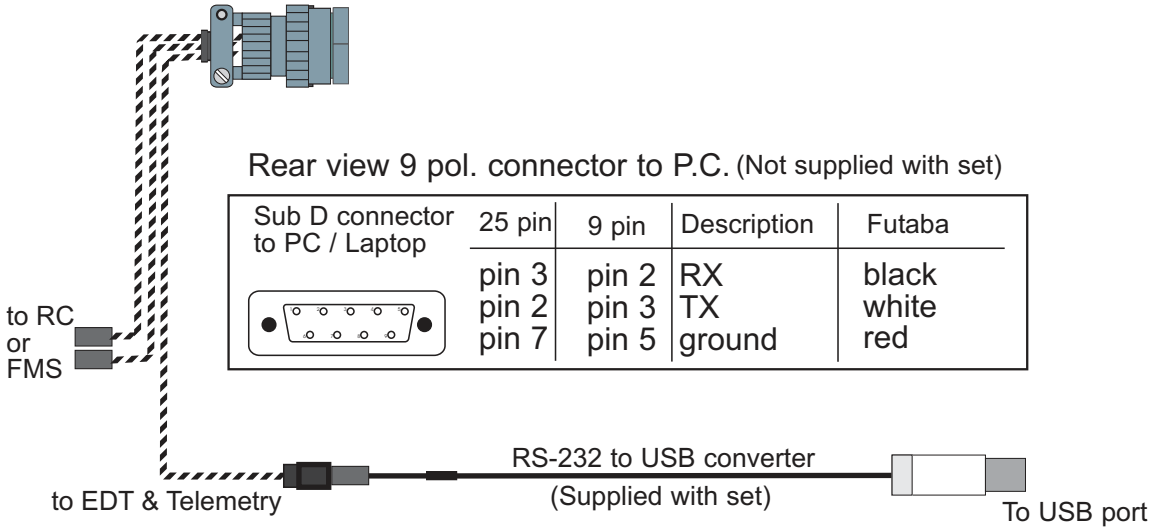
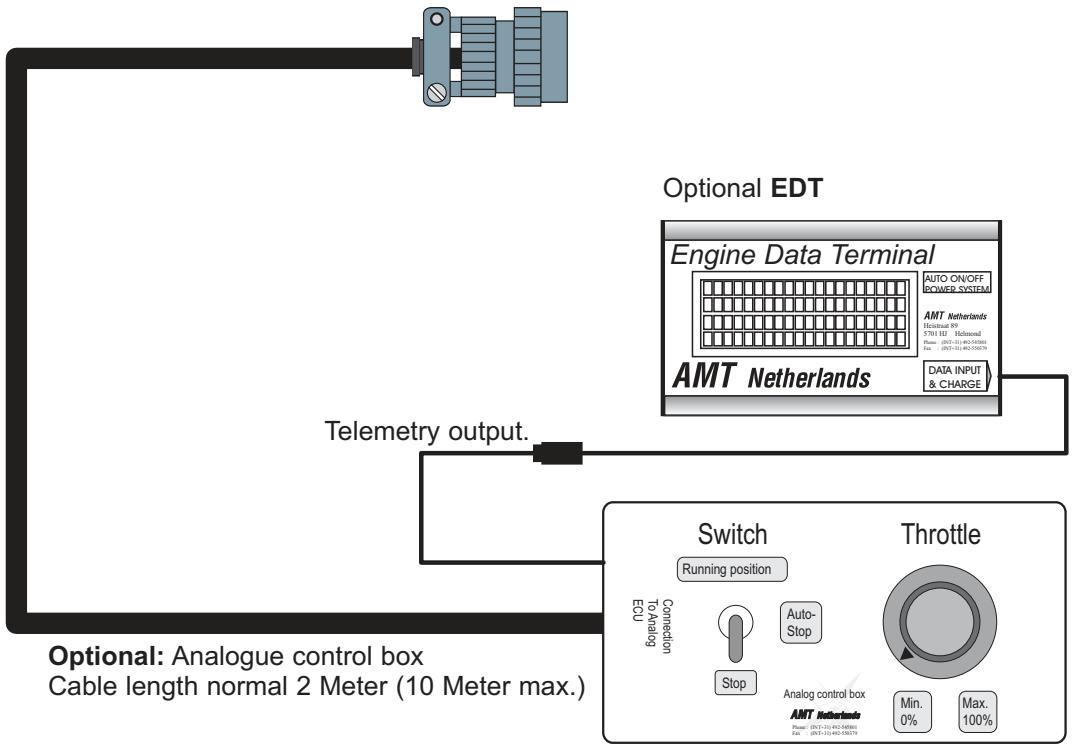


figure 4.11



4.5.2.4. Control cable installation

When using a RS232 source:

1. Connect the Control input cable to the EPV and the RS232 source.

When using an analogue FMS (specified at ordering):

1. Connect the Control input cable to the analogue EPV and the FMS.

When using a stationary set-up:

1. Connect the Control input cable to the analogue EPV and the analogue control box.
2. Connect the cable of the Analogue Control Box to the Throttle, Switch and EDT leads.
3. Connect the EDT to the Analogue Control Box.

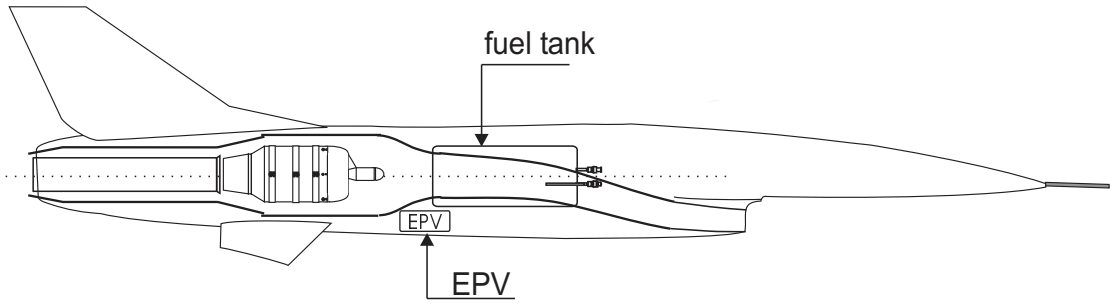
When using a PWM (RC system):

1. Connect the Control input cable to the EPV.
2. Connect the RC system or FMS to the Throttle and Start Switch leads of the Control input cable.
3. Connect the EDT to the EDT & Telemetry lead.

If the RC system or FMS has only one channel available for engine control, Single channel engine control is possible provided the Throttle stick has a mechanical trim.
In this case, connect only the Throttle lead and leave the Start Switch lead unplugged.
The requirements for the standard dual channel control or alternatively single channel control are explained in chapter 3

WARNING: make sure all cable connections and installations are safe. Chafing or disconnection may lead to an unexpected engine stop.

Possible Engine, EPV & Fuel tank position figure 4.15



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

4.6 Fuel system and connections

A proper designed leak-proof fuel system which ensures pressured fuel supply under all circumstances shall be used.
AMT Netherlands recommends the use of high quality glass fibre or Kevlar fuel tanks.
The use of a hopper tank or air trap is highly recommended to ensure fuel flow to the engine during manoeuvring and prevent air bubbles being sucked into the fuel lines.

Although fuel system design is beyond the scope of this manual, some general requirements and recommendations are given below (figure 4.15 & 4.16).

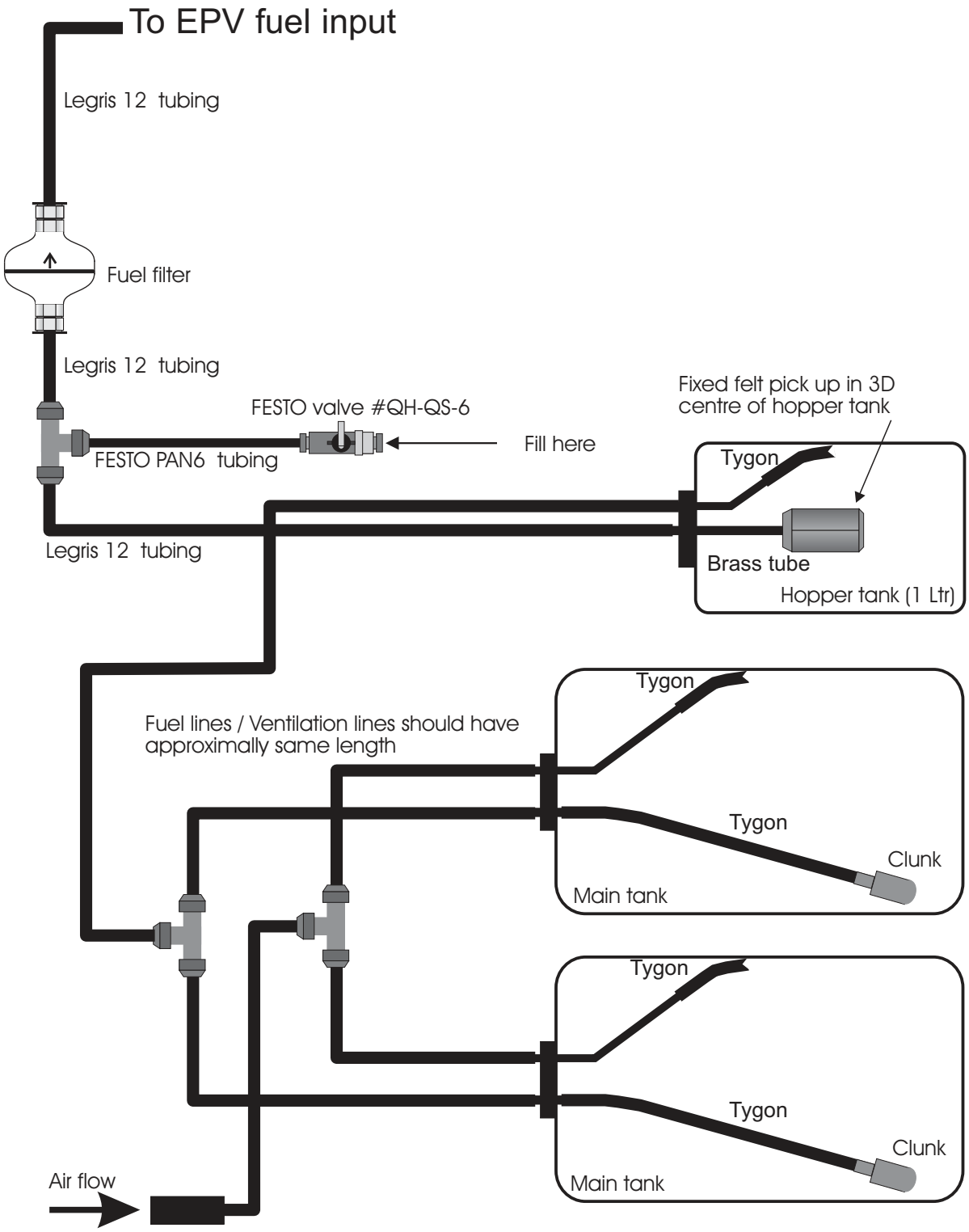
1. Make sure the fuel tank(s), hopper or air trap are of sufficient size. A hopper tank shall have a minimum capacity of 1 litre.
2. Tank(s) shall be properly secured to withstand the loads during manoeuvring.
3. All materials shall be suitable for kerosene type fuels.
4. Do not use flexible seals/tank stoppers which expand directly into the fiber as leaks will develop over time. Correct is a metal tank stopper which is glued into the fibre tank and a flexible seal which expands into the metal stopper.
5. The metal fuel and vent pipes shall have an ID (Inner Diameter) of 10 mm or more.
6. All metal fuel pipes shall be barbed and tubing is to be fitted using proper safety wiring.
7. If a hopper tank is used, ensure it has a felt-covered fuel pickup, mounted in the 3D centre of the tank. The hopper tank, or alternatively an air trap, shall be able to supply the required fuel flow.
8. Use Festo PAN 12 or equivalent (ID 10 mm) between fuel tank(s) and EPV, maximum total length is 100 cm.
9. Use Festo PAN 8 or equivalent (ID 6 mm) between EPV and engine as main fuel line, maximum length is 75 cm.
10. Use Festo PAN 4 or equivalent (ID 3 mm) between EPV and engine as igniter fuel line, maximum length is 75 cm.
11. If using other tubing, ensure that the ID is identical to the specified Festo PAN tubing.

Caution: soft tubing such as Tygon is incompatible with certain Festo connectors. Soft tubing may only be fastened on suitable connectors or barbed metal fittings/pipes using proper safety wiring.

12. Use flexible tubing (ID 10 mm) between fuel tank stopper and clunk.
13. Ensure all tubing is neatly cut at a 90-degree angle and does not contain any burrs or particles.
14. The clunk shall have an ID of 10 mm and shall be heavy enough to allow it to move around the fuel tank during manoeuvring.

Hard Tank fuel system

Figure 4.16



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

15. Ensure that all connectors and T-pieces have an ID identical to the fuel tube.
16. Install the fuel filter vertical, exit up.
17. In a multiple main tank set-up, the tanks are to be arranged in parallel for minimal drag. Ensure that fuel tubing from the T-piece is identical in length so that the tanks are emptied all at the same rate.
18. It is recommended to connect the air vent tube to a short 8 - 10 mm ID pipe which is placed facing forward into the air stream. This ensures a positive air pressure to the fuel tanks.

4.7 LIPO battery

Install the battery in such a way that it cannot be displaced by the expected acceleration and deceleration forces of the vehicle.

CAUTION: Prolonged maximum engine operation requires high electrical current from the battery. This will cause the battery temperature to rise. For operation during high ambient temperature conditions, do not wrap the entire battery with protective material as this will insulate the battery and may cause heat build-up and reduction of battery life.

5.1 General

The engine is controlled by the EPV. This unit contains all electronics, fuel pump, solenoid valves and associated cables and tubing.
The EPV needs control signals which can be provided through a FMS system, such as serial communication, analogue control or PWM signals from a FMS or RC system.

For stationary set-ups such as in a teaching environment, the engine can be controlled with an Analogue EPV and an Analogue Control Box.
The Analogue EPV can also be user programmed with the same serial communication providing the same benefits.

Data is then monitored by an optional Engine Data Terminal (EDT).

5.2 Serial communication set-up

The EDT-Telemetry lead can be used to connect the EPV to a serial communication channel giving full control over the Operations Switch, Throttle and all functions of the EPV. Normally, this feature is used when controlling the engine from a FMS without analogue or PWM channels.

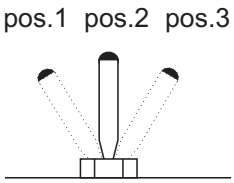
During stationary ground operation, the TMC software application monitors and displays engine parameters digitally and graphically.
This TMC software application is located on the supplied CD and runs on a Windows environment. It also allows the user to change several user selectable parameters in the EPV.
If a computer or laptop is used in combination with the TMC software application a dedicated RS-232 port is needed. If such port is not available on the computer or laptop the supplied RS-232 to USB converter cable can be used.

If the vehicle has a serial communication downlink capability, various engine data can be monitored during flight as well.

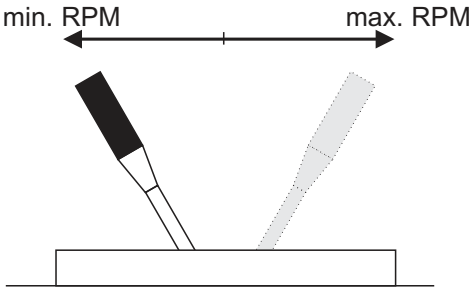
The CD contains a RS-232 protocol document, however check the download page of the AMT Netherlands website for the latest version of this document.

1. Install the TMC software and help files on the computer or laptop.
2. Study the help files thoroughly.
3. Make sure the EPV is disconnect from the power source (OFF).
4. Connect the EDT-Telemetry cable to the EPV
5. Connect the EDT-Telemetry cable to the computer.
6. Connect power to the EPV (ON).
7. Using the help file, start the TMC software and switch the EPV to serial control mode.
8. The EPV can now be controlled using the TMC software.

Dual channel operation figure 5.4



side view switch on transmitter

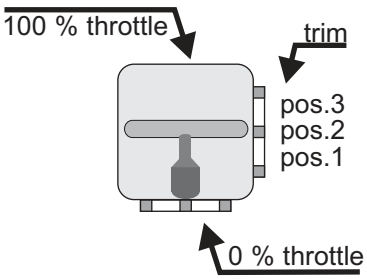


Side view transmitter throttle stick

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

Single channel operation figure 5.5



pos.	tone	function	PWM
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.	15,000	< 100 Newton
50 %	40,000	~1000 Newton
max.	46,000	>1568 Newton

Note:
For detailed engine information see the included testreport for each induvidual Lynx gas turbine engnie.

WARNING: changing user selectable parameters changes EPV and engine behaviour and therefore requires in-depth knowledge. Changing parameters without understanding all related implications may result in unexpected engine behaviour.

5.3 Analogue set-up

The Analogue EPV and control box are pre-programmed and only require cable connection as shown in figure 4.13 (Chapter 4, page 7).
The controls are self-explanatory.

5.4 PWM (RC-system) dual channel set-up and programming

Two channel control is highly recommended and the preferred method of controlling the engine. This requires two transmitter controls and two channels:

Operations Switch: 3-position switch to select the following engine functions:

- EMER. STOP (Emergency stop)
- AUTO. STOP (middle pos.= Automatic stop)
- START/RUN

Throttle: linear control device (stick) which is used to select a thrust setting between Idle and full power.

The following programming sequence ensures that all PWM signals are stored correctly in the EPV memory. If errors are made during programming, switch off all systems and repeat the programming sequence from the first step.

Note: in case a PPM RC system is used, start with step 14 as the EPV does not provide for a PPM failsafe option.
During programming, a spare servo is used to ensure correct failsafe settings.
Do not program the failsafe option with the EPV connected because an actual failsafe requires an EPV reset.

1. Ensure the EPV is disconnect from its power source (OFF) and that the cables to FMS are <u>not</u> connected.
2. Power ON the FMS (RC) transmitter.
3. Program the Operations Switch throw <u>and</u> limit to 100% on both sides.
4. Program the Throttle throw <u>and</u> limit to 100% on both sides.
5. Ensure that for both the Operations Switch and the Throttle all other programming features such as dual rate, exponential/logarithmic control, idle cut-off, trim memory etc. are selected OFF.
6. Program the Throttle trim to OFF; if this is not possible, set the trim in the middle position and <u>do not use</u> it either during set-up or actual engine operation.

7. Power ON the FMS receiver system.
8. Program the failsafe for Throttle to go to the desired setting in case of a failsafe condition: normally idle power.
9. Connect a spare servo to the Throttle channel and test the failsafe function by e.g. switching off the transmitter: the servo should move to the idle position.
10. Switch the transmitter ON: the servo should move to the actual Throttle stick position.
11. Re-program the Throttle throw to 50% throw on the idle side, the full power side must remain at 100% throw. The EPV is pre-programmed to recognize these settings and provides linear RPM increase from the Throttle idle position to the full power position.
12. Re-check the failsafe with the spare servo: it must move from the 50% throw position (new idle) to 100% throw: this is about 10-20 degrees further.
13. Connect the Throttle and Operations Switch leads to the correct channels on the FMS (RC receiver).
14. Push and hold the EPV function button while powering-up the EPV. After a few seconds the EPV will respond with a confirmation beep.
15. Release the function button.
16. Move the Operations Switch to the EMER. STOP position and momentarily push the function button. The EPV will respond with a confirmation beep.
17. Move the Operations Switch to the AUTO. STOP position and momentarily push the function button . The EPV will respond with a confirmation beep.
18. Move the Operations Switch to the START/RUN position and momentarily push the function button . The EPV will respond with a confirmation beep.
19. Move the Throttle to the Idle position and momentarily push the function button . The EPV will respond with a confirmation beep.
20. Move the Throttle to the full power position and momentarily push the function button . The EPV will respond with an end-of-programming beep.

This last confirmation beep indicates that all pulse widths are stored in the EPV and that the EPV is set to Dual channel operation.
As long as the Operations Switch and Throttle channels in the FMS / RC-system are not altered, this programming sequence does not have to be repeated.

5.5 PWM (RC-system) single channel set-up and programming

If there is only a single PWM channel available, the Throttle and the mechanical Throttle trim may be used to perform the functions as follows:

Throttle trim: used as a 3-position Operations Switch to select the following engine functions:

- 1.0ms = EMER. STOP (must be same direction as throttle idle position)
- 1.1ms = AUTO. STOP (middle position)
- 1.2ms = START/RUN (must be same direction as full power throttle position)

Throttle : linear control device (stick) which is used to select a thrust setting between Idle and full power.

- 1.2ms = 0% throttle (idle thrust)
- 2.0ms = 100% throttle (maximum thrust)

WARNING: in Single Channel mode, the trim 3-position switch feature and the throttle settings are combined in the same single channel. Therefore, the trim 3-position switch feature works only with the throttle set to idle.
A throttle setting past idle, even with the trim set to the OFF position, but at or above 1.2 ms will generate the start-up sequence as soon as the EPV is switched on.
Likewise, an emergency engine shutdown requires both throttle to idle and throttle trim to OFF.

WARNING: safety requires a mechanical trim which can be moved rapidly and accurately to each of the three required positions. Use of an electronic trim is prohibited.

The following programming sequence ensures that all FMS/RC transmitter signals are stored correctly in the EPV memory. If errors are made during programming, switch off all systems and repeat the programming sequence from the first step.

Note: in case a PPM RC system is used, start with step 14 as the EPV does not provide for a PPM failsafe option.

1. Ensure the EPV is disconnect from its power source (OFF) and that the cables to FMS/RC-system are not connected.
2. Power ON the FMS/RC transmitter.
3. Program the Throttle throw and limit to 100% on both sides.
4. Ensure that for the Throttle all other programming features such as dual rate, exponential/logarithmic control, idle cut-off, trim memory etc. are selected OFF.
5. Program the Throttle trim to normal rate and normal; use a spare servo to check sufficient trim movement).
6. Power ON the FMS/RC receiver system.
7. Program the failsafe for Throttle to the desired setting in case of a failsafe condition: normally idle power.
8. Connect a spare servo to the Throttle channel and test the failsafe function by e.g. switching off the FMS/RC transmitter: the servo should move to the idle position.
9. Switch the FMS/RC transmitter ON: the servo should move to the actual throttle stick position.
10. Re-program the Throttle throw to 50% throw on the idle side, the full power side must remain at 100% throw. The EPV is pre-programmed to recognize these settings and provides linear RPM increase from the Throttle idle position to the full power position.

11. Re-check the failsafe with the spare servo: it must move from the 50% throw position (new idle) to 100% throw: this is about 10-20 degrees further.
12. Connect the Throttle lead to the correct FMS/RC channel.
13. Do not connect the Operations Switch lead, but secure it for example with a ty-wrap.
14. Push and hold the EPV function button while powering-up the EPV. After a few seconds the EPV will respond with a confirmation beep.
15. Release the function button.
16. Move the Throttle to the Idle position and set the trim to the EMER. STOP position (ensure same direction as throttle idle) and momentarily push the function button. The EPV will respond with a confirmation beep.
17. Set the Throttle trim to the AUTO. STOP (middle) position and momentarily push the function button. The EPV will respond with a confirmation beep.
18. Set the Throttle trim to the START/RUN position (ensure same direction as full throttle) and momentarily push the function button . The EPV will respond with a confirmation beep.
19. Leave the Throttle in the Idle position and momentarily push the function button . The EPV will respond with a confirmation beep.
20. Move the Throttle to the full power position and momentarily push the function button . The EPV will respond with end-of-programming beep.

This last confirmation beep indicates that all pulse widths are stored in the EPV and that the EPV is set to Single channel operation.
As long as the Throttle channel in the transmitter or FMS is not altered, this programming sequence does not have to be repeated.

5.6 Programming parameters

The EVP firmware is modeled by parameters and can be modified via the TMC software application. The engine is tested with a set of pre-programmed parameters. These are the optimal values and should normally not be changed. In special cases, some pre-programmed parameters such as Low battery error settings may have to be changed

For more explanation see chapter 8.

Note: Contact AMT Netherlands when parameters must be changed

5.7 Low battery error settings

The EPV is pre-programmed for LiPO use and contains the following low battery threshold levels:

- During engine start greater than 21.5 V else a low battery error message will be generated resulting in an aborted engine start.
- During engine operation greater than 18.0 V else a low battery error message will be generated resulting in an immediate engine shutdown.

WARNING: during flight operations engine LiPO battery voltage should be carefully monitored to avoid an unexpected engine shutdown.

Note: When a different power supply is used, use the TMC software application to change the battery error levels accordingly.
For more detail on how to use the TMC software application see chapter 8.

6.1 System error reset

After correcting a System error, the EPV must be reset before normal operation can continue. The reset procedure depends on the control mode.

Reset procedure for dual channel, serial control or analogue operation:
Set the Operations Switch to EMER.STOP and the Throttle to full power, or switch off the EPV.

Reset procedure for single channel operation.
Set the Throttle to idle, the Throttle trim to EMER STOP and push the function button 2-3 seconds until a confirmation beep is heard.

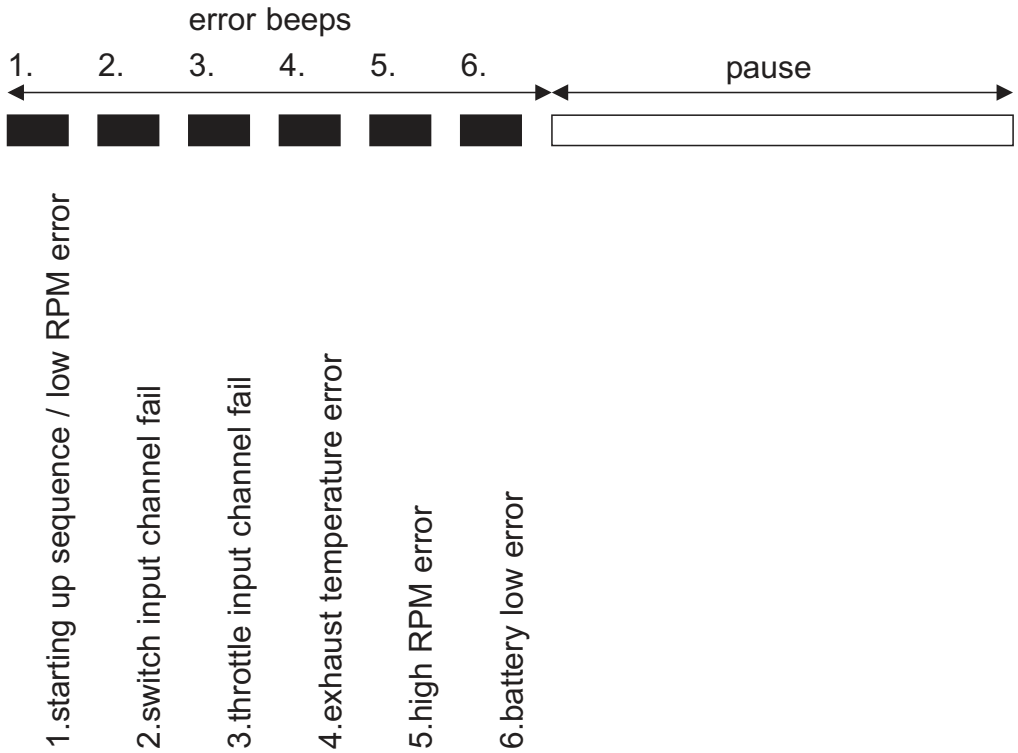
6.2 Engine monitoring

For engine monitoring purposes, a serial data stream is available from the EPV on the EDT & Telemetry connection lead. When using the TMC application, all available data will be displayed real time. A second option is using the optional EDT which can be connected directly to the EDT & Telemetry cable, or indirectly to the Analogue Control Box. The EDT displays all essential data such as RPM and EGT.

6.3 Buzzer

The built-in buzzer uses low and high pitch tones to indicates system status before engine start and after engine shut down according the table below.
Except for the No radio beep, all errors need a system error reset.

System ready:	Low-high beep sounds after power up, indicating system is ready.
Engine start:	When initiating engine start, 5 beeps (high) will sound before commencing the engine start sequence.
No radio beep:	Low pitch tones with short intervals. Indicates no Operations Switch or no receiver input signal.
No start-up beep:	High pitch tones with short intervals. Indicates EGT too high or a faulty igniter.
Failsafe beep:	High-low beeps in regular intervals. Indicates a failsafe condition. After the user-programmable failsafe time (pre-set 2 seconds) has elapsed, the engine is shut down.


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

System error: A recurring series of six short beeps. The position of the low pitch tone(s) in the series indicates the error according to the table below.

position 1: start-up sequence error or low RPM error.
position 2: Operations Switch input channel failed.
position 3: Throttle input channel failed.
position 4: exhaust temperature high.
position 5: high RPM error.
position 6: battery voltage low error.

Hardware failure: A continuous low pitch tone indicates a hardware failure. Do not operate the engine and contact AMT Netherlands.

After switching OFF the engine, the error is noted in the EPV engine log and is also available in the optional EDT and in the “serial protocol” data.
For download details see chapter 8 TMC software.
When resetting a System error, the error message is removed from the EDT and the serial protocol.

6.4 Test features

6.4.1 Introduction

The EPV software contains extra features which may be useful during system installation and maintenance. A specific Throttle setting (accurate within 2%) and operation of the function button activates a feature according the table below. Each feature must be enabled separately. The extra features are not available until the EPV has been set-up and programmed for dual channel mode, single channel mode, RS-232 mode or for operation using the Analog Control Box.

It is recommended to use the TMC software as this allows accurate throttle settings and function button operation via the computer/laptop.
Alternatively, use the EDT to select accurate throttle settings and use manual operation of the function button .

10%	Not in use	
20%	Not in use	
30%	**Igniter ON**	Activates igniter
40%	Not in use	
50%	**Engine Priming function**	Opens main fuel valve and activates fuel pump
60%	**Igniter Priming function**	Opens igniter valve and activates fuel pump
70%	**Engine Priming function**	Opens sec. main fuel valve and activates fuel pump
80%	**Starter motor ON**	Activates starter motor
90%	**Clutch check**	Activates starter motor with on/off interval
100%	**Quick Cooling**	Activates starter motor until EGT is below 88ºC

WARNING: once the Quick Cooling function is activated, the starter motor will keep the engine spinning continuously, even with released function button, until the EGT drops below 88 ºC.

CAUTION: avoid prolonged use of the Starter motor ON and Cooling ON features as the engine is not being lubricated by the fuel mixture.

6.4.2 Activating extra features in serial control mode

1. Ensure all equipment is disconnected from its power source (OFF
2. Connect the computer and activate the TMC software.
3. Activate serial control by checking the “Control ECU via RS232” on the tab OPTIONS.
4. Set Throttle to idle and Operations Switch to EMER STOP
5. Power up the EPV by connecting the power cable.
6. Set the Throttle to the desired position e.g. 50% for the priming function of the main fuel line.
7. Push and hold the function button in the TMC software, after 2 seconds the selected feature will be activated.
8. Releasing the function button will deactivate the selected feature, except for the cooling function which will continue until EGT drops below 88 ºC.

Note: operating the function button on the EPV will also active the extra feature.

6.4.3 Activating extra features in analogue control mode

1. Ensure all equipment is disconnected from its power source (OFF.
2. Set Throttle to idle and Operations Switch to EMER STOP
3. Power up the control system.
4. Power up the EPV by connecting the power cable.
5. Set the Throttle to the desired position e.g. 50% for the priming function of the main fuel line.
6. Push and hold the function button on the EPV. After 2 seconds the selected feature will be activated.
7. Releasing the function button will deactivate the selected feature, except for the cooling function which will continue until EGT drops below 88 ºC.

6.4.4 Activating extra features in dual channel mode

1. Ensure all equipment is disconnected from its power source (OFF.
2. Set the Throttle to idle.
3. Set the Operations Switch to EMER STOP.
4. Connect the EDT to the EPV.
5. Power up the control system.

6. Power up the EPV by connecting the power cable.
7. Using the EDT, set the Throttle to the desired position e.g. 50% for the priming function of the main fuel line.
8. Press and hold the function button. After two seconds the feature will be activated.
9. Releasing the function button will deactivate the function, except for the Cooling function which will continue until EGT drops below 88 ºC.

6.4.5 Activating of extra features in single channel operation

1. Ensure all equipment is disconnected from its power source (OFF.
2. Set the Throttle to idle.
3. Set the Operations Switch to EMER STOP.
4. Connect the EDT to the EPV.
5. Power up the control system.
6. Power up the EPV by connecting the power cable.
7. Push and hold the function button for 5 seconds: the EPV will respond with a confirmation beep.
8. Using the EDT, set the Throttle to the desired position e.g. 50% for the priming function of the main fuel line.
9. Press and hold the function button for three seconds, after releasing the function button the selected feature will be activated.
10. Power down the EPV will deactivate the function.

6.5 Fuel system Priming

Priming (filling) of all fuel lines is only required when the lines contain a lot of air, e.g. after installation or maintenance. Without primed fuel lines, the engine may not start successfully during the first attempt.

WARNING: to prevent fire, the engine must be cool to the touch.

1. Ensure all equipment is disconnected from its power source (OFF).
2. Set the Throttle to IDLE.
3. Set the Operations Switch to EMER STOP.
4. Power up the control system.
5. Power up the EPV by connecting the power cable.
6. Disconnect the igniter line from the engine and make sure spilling fuel will be directed to a small container.
7. Prime the igniter line using the Special Feature 60% setting. Reconnect the igniter line to the engine.
8. Disconnect the main fuel line from the engine and make sure spilling fuel will be directed to a small container.
9. Prime the main fuel line using the Special Feature 50% setting.
10. Reconnect the main fuel line to the engine.
11. Check all fuel lines and ensure that there are no air bubbles.

Note: After a normal engine run, the fuel lines will be free of air bubbles and should be primed enough for a next engine start.

6.6 Pre-flight inspection

Perform a pre-flight inspection to ensure the engine/ vehicle and the surroundings are safe to fuel and operate.
Amongst others, the engine inlets and compressor blades shall be checked for FOD, all batteries should be fully charged and all fuel lines should not contain large amounts of air.

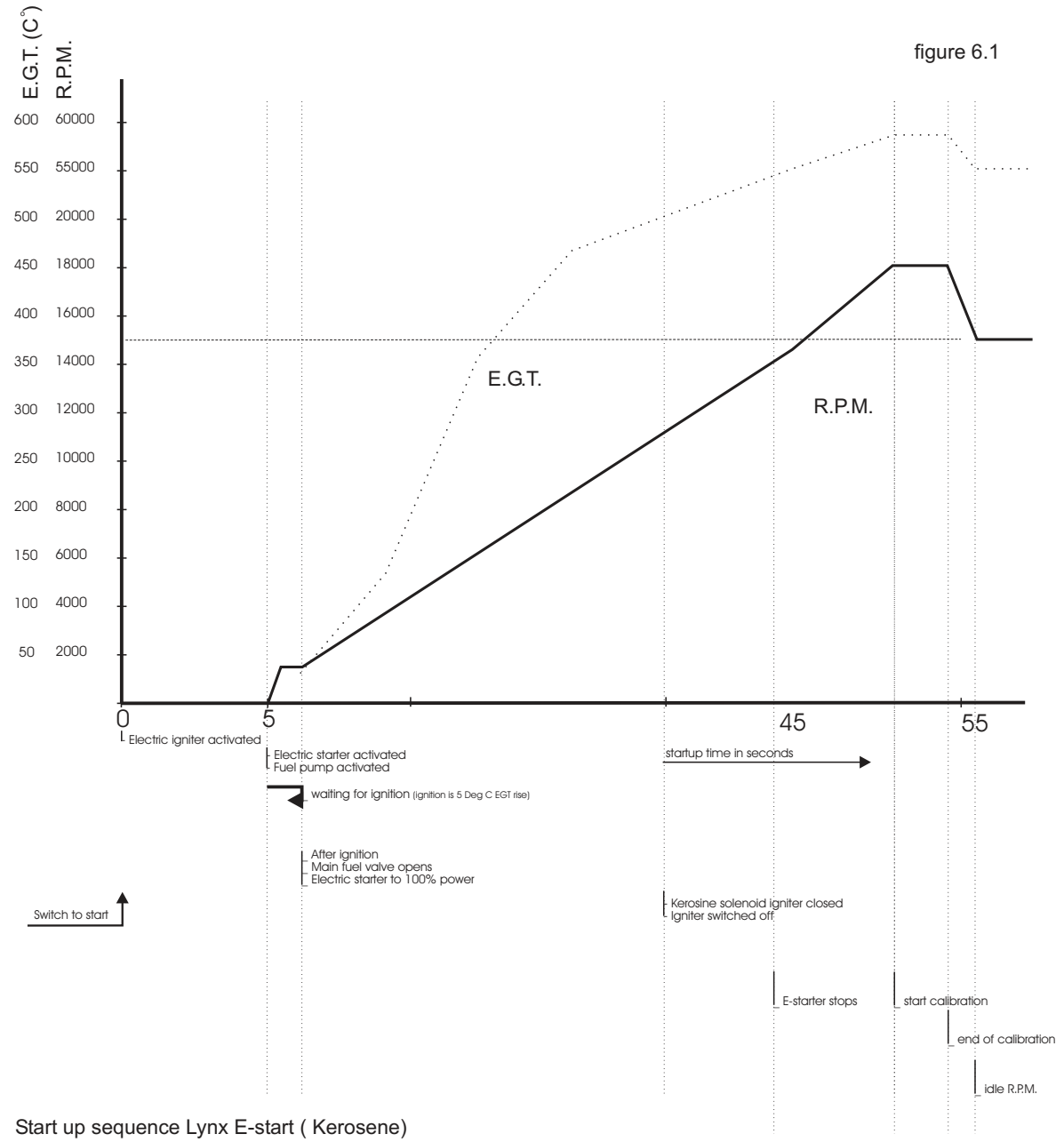
6.7 Fuelling

CAUTION: Before fuelling, ensure the EPV power is disconnected. This causes the solenoid valve to stay closed and prevents fuel entering the (hot) engine.
If fuel has entered the engine, hold the vehicle/engine in a vertical position with the nozzle pointing down for ca. 5 minutes to drain all excess fuel.

CAUTION: The filling tube between the external container and the vehicle/engine fuel system must contain a high quality fuel filter.

1. Ensure the EPV power is switched OFF.

figure 6.1



Start up sequence Lynx E-start (Kerosene)

2. Connect the overflow tube (from fuel system air vent to the vent on the external fuel container).
3. Connect the filling tube (from external fuel container to hopper tank/air trap).
4. Start fuelling and continue until main tank(s) and hopper tank/air trap are full and no large air bubbles remain. Excess fuel will return to the external fuel container through the overflow tube.
5. Disconnect the fuelling tube and close the fuelling point.
6. Disconnect the overflow tube and ensure the fuel system air vent remains open.
7. Check if the fuel lines are filled with fuel and are free of large amounts of air. If not, perform the Fuel System Priming procedure (see para. 6.5).

6.8 System power up

1. Set the Throttle to IDLE.
2. Set the Operations Switch to EMER STOP.
3. Power up the control system.
4. Power up the EPV by connecting the power cable. The EPV responds with a System Ready beep (low-high pitch tone)

6.9 Engine start

1. Check that the engine/vehicle and the surroundings are clear. The vehicle should be firmly held in position.
2. To enable engine start, the EGT has to be below 88 ºC.
3. Set the Operations Switch to START. The EPV responds with an Engine start beep (5 high pitch tones) before initiating the start sequence.

   The start sequence contains the following events:

   - Ignition is switch on for a pre heat time of 7 seconds.
   - Starter Motor accelerates the engine to 1,500 RPM.
   - Fuel Pump, Igniter fuel solenoid valve are activated.
   - When EGT rises 50 ºC, the main fuel solenoid valve starts to pulsate and the starter motor continues accelerating the engine.
   - At 12,000 RPM, the starter motor disengages, the igniter fuel solenoid valve closes and the igniter is switched off. The secondary main fuel valve opens for maximum fuel flow at 12,000 RPM.
   - After engine start, the EPV increases engine RPM to its calibration point (ca. 18,000 RPM) and after 5 seconds reduces RPM to the normal idle power setting (ca.15,000 RPM).
   - The EPV enables engine control via the Throttle after it has detected that the Throttle is in Idle position.

Note: A timeout of 90 seconds will stop the starter motor in case of an invalid EGT signal.

If an error occurs during the start-up, the engine will be cleaned automatically. For this purpose the starter engages for approx. 20 seconds.

6.10 Engine maximum power calibration

After engine start, the first maximum power setting is limited to 95% thrust for ca 2 seconds due to EPV calibration. Hereafter, power is increased to 100%.
For a maximum power takeoff, set maximum power and wait 4 seconds before brake release/launch.

6.11 Engine shut down

The normal engine shut-down procedure is designed to obtain the coolest possible engine and results in minimal engine wear.

1. Set the Throttle to IDLE.
2. Set the Operations Switch to AUTO. STOP. The EPV increases RPM slightly and waits for the EGT to stabilize. This takes about 10 seconds. Hereafter, the engine is shut down.
3. The EPV automatically switches to the cooling function and engages the starter motor at regular intervals until EGT drops below 69 ºC. The fuel pump is engaged briefly to lubricate the bearings. The cooling function has stopped when the RPM decreases to zero.
4. When RPM is zero, set the Operations Switch to EMER STOP.
5. Disconnect power from the EPV.
6. Switch the control system to OFF.

6.12 Emergency engine shut down

CAUTION: Use this procedure only in an emergency. An emergency engine shut down will not automatically engage the cooling function and therefore may result in significant wear and possible damage to the engine.

1. Set the Throttle to IDLE.
2. Set the Operations Switch to EMER STOP.
3. When the situation is under control and the circumstances allow, engage the cooling function by setting the Operations Switch to AUTO STOP. The EPV automatically engages the starter motor at regular intervals until EGT drops below 69 ºC. The fuel pump is engaged briefly to lubricate the bearings. The cooling function has stopped when the RPM decreases to zero.
4. When RPM is zero, set the Operations Switch to EMER. STOP.
5. Disconnect power from the EPV.
6. Switch the control system to OFF.

6.13 Engine log

Completing the log correctly is of great importance for the optimal use of the engine. Careful logging all information does not only provide the accumulated engine run time, but is also useful for maintenance, fault finding, guarantee, or sale to a third party.

Log Lynx gas turbine				
Date	**Location**	**vehicle type**	**engine running time**	**remarks**

All engine runs and flights shall be entered in the log.

Note: Extra engine log pages are integrated at the end of this owner's manual.

6.14 Recommended charging sequence

From experience, AMT has found that the following sequence between engine runs works well. The concept is that fully automatic chargers with built-in balancing and safety features are used so that full attention can be given to fuelling while still being able to monitor charging as well.

1. Ensure all equipment is switched off.
2. Disconnect EPV battery
3. Start charging the EPV battery.
4. Fuel according the procedure in this chapter.
5. After fuelling has finished, start charging all other batteries as required.

Note: For charging the EPV battery use a Lipo charger with balancing feature. Balancing Lipo cells will increase life time of the Lipo cells.

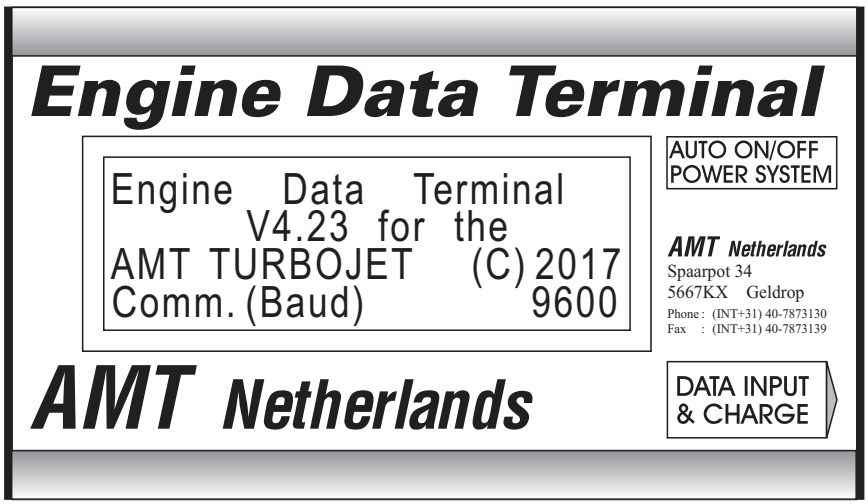


figure 7.1

(power up)

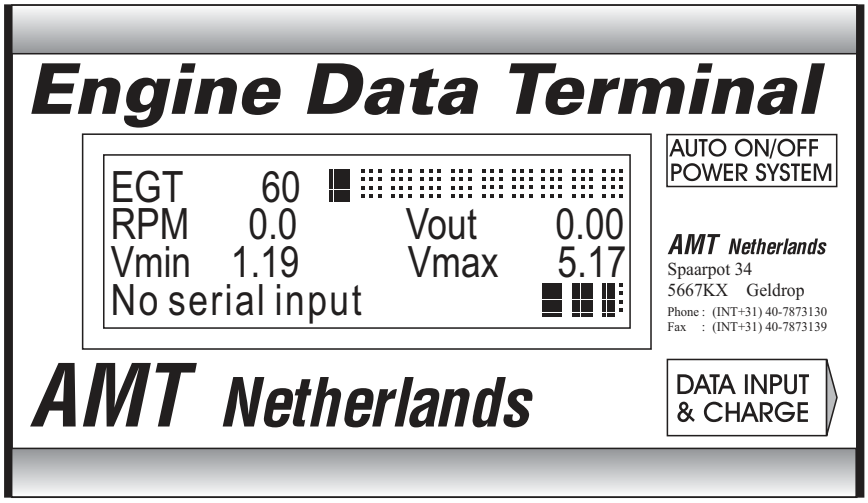


figure 7.2

(no data input)

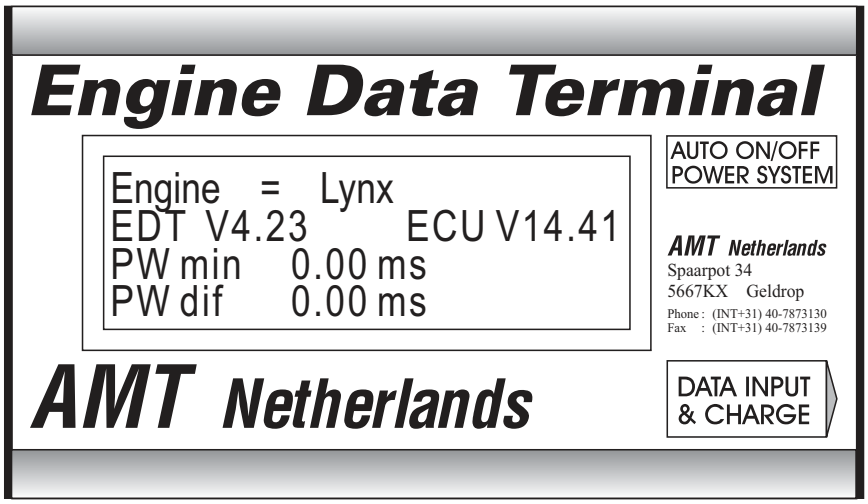


figure 7.3

(start up screen)

7.1 General

The EDT is a microprocessor controlled Human Media Interface and displays all 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 EPV, which provides the data output.

7.2 EDT power supply

The EDT has a built-in NiMH-battery. It switches on automatically when data is received. The intro screen is shown in figure 7.1 .
If no data is received, a time bar is displayed. The time bar decreases in 3 minutes after which the EDT switches off automatically.(see figure 7.2.

7.3 Charging the EDT

The EDT should be charged with the supplied cable. Charging is possible from any 12 volt DC supply. The EDT internal charge circuit will regulate the current. The time required to fully charge the EDT battery is 14-16 hours.

CAUTION: Do not use any quick charging methods.

7.4 Startup Screen

This is the 2nd screen displayed after the EDT receives data from the EPV. The EDT will display the engine type. If the EPV uses PWM mode like a RC system, the EDT will display the retrieve pulse width data from the EPV.

This screen will be displayed for about 5 seconds and will not be available again until the EPV under goes a power cycle. (see 7.3).

After the startup screen display time has elapsed, 3 screens are available, depending on the Operations Switch position.

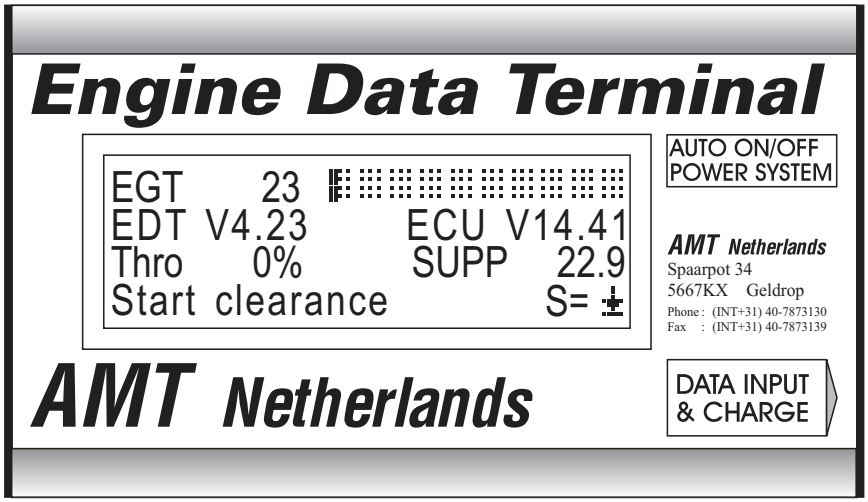


figure 7.4

(system off)

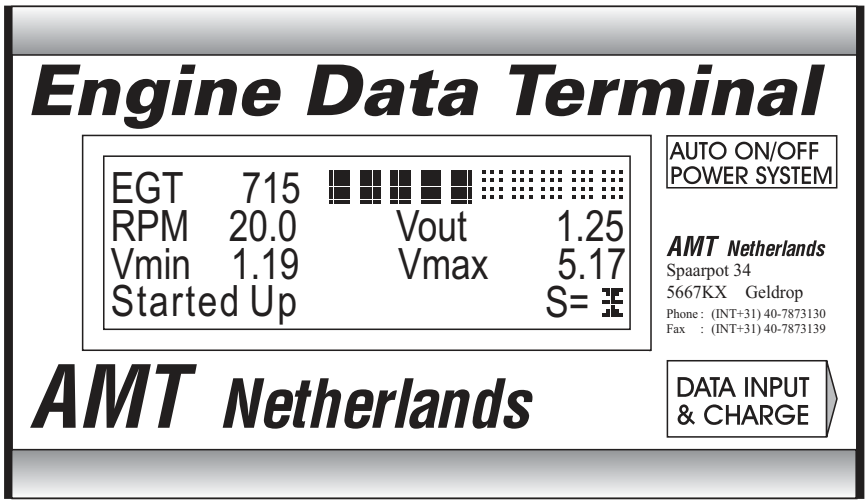


figure 7.5

(power down seq.)

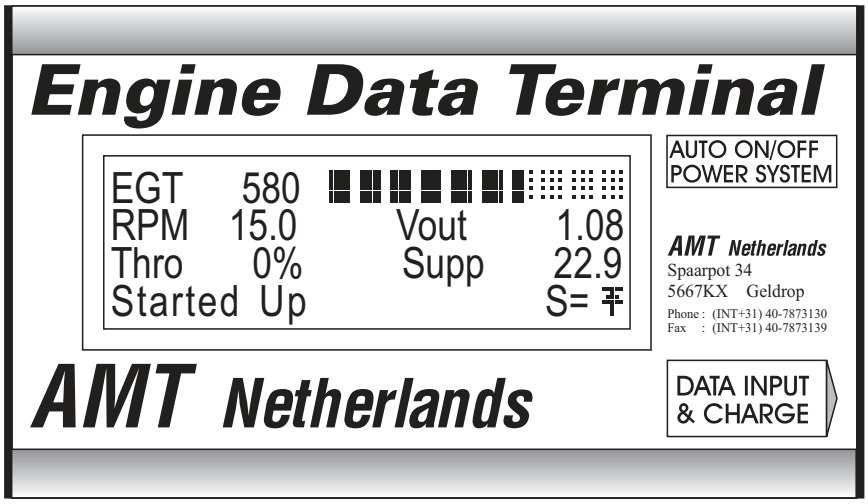


figure 7.6

(starting)
(and running)

7.5 Screen 1 : EMER STOP

This screen will be displayed when the Operations Switch is in the EMER STOP position, see figure 7.4.

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

7.6 Screen 2 : AUTO STOP

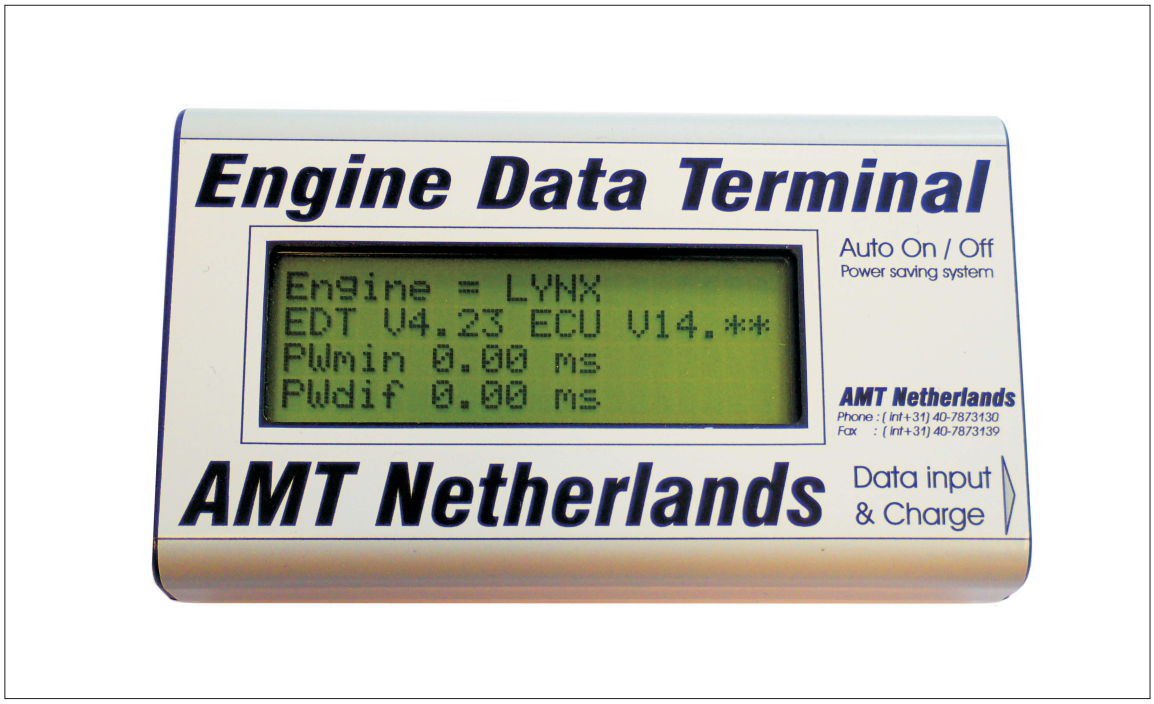
This screen will be displayed when the Operations Switch is in the AUTO STOP position, see figure 7.5.

1st line: Exhaust Gas Temperature in °C (EGT)
2nd line: Engine RPM
3rd line: pump voltage at idle and pump voltage at max RPM
4th line: additional text and position of the Operations Switch.

7.7 Screen 3 : START/RUN

This screen will be displayed when the Operations Switch is in the START/RUN position, see figure 7.6.

1st line: Exhaust Gas Temperature in °C (EGT)
2nd line: Engine RPM and actual pump voltage (V out)
3rd line: throttle position and EPV supply voltage or additional text
4th line: additional text and position of the Operations Switch.


Engine Data Terminal
Engine = LYNX
EDT V4.23 ECU V14.**
PWmin 0.00 ms
PWdif 0.00 ms
Auto On / Off
Power saving system
AMT Netherlands
Phone : (Int+31) 40-7873130
Fax : (Int+31) 40-7873139
AMT Netherlands
Data input
& Charge

7.8 EDT line four additional text messages

Line four of every screen displayes additional information. These are either engine status messages or error messages. All messages are listed below. Possible corrective actions are also listed.

Status message	Explanation/cause	Initial corrective action
Start clearance	Engine is ready	-
Starting	Start phase initiated	-
Ignition	EGT increasing	-
Started up	Engine is running	-
Calibration	EPV calibrates pump voltages	-
Max RPM set	Max RPM available	-
No start clearance	EGT high (> 88°C).	Initiate cooling.
	Ignitor not detected.	Check EPV to engine cable.
No serial input	EDT not receiving serial data.	Power up EPV
		Check EDT cable.
Supply low error	EPV voltage low.	Charge EPV battery.
Switch fail	Operations Switch input fail	Check FMS programming.
		Check cables.
Throttle fail	Throttle input fail	Check FMS programming.
		Check cables
RPM low error	Engine RPM below 12,000 RPM for more than 7 seconds	Check fuel system
		Check fuel pump
RPM high error	Engine RPM over 48,000 RPM for more than 1 second	Check fuel sytem
		Check fuel pump.
EGT error	EGT over 1100 °C at startup for more than 20 seconds	Check inlet duct.
		Check fuel system.

When the engine shuts down because of an error, connect the EDT to the EPV. The EDT will display the detected error condition. After the EPV has been switched off, the error message is no longer available.
To retrieve the error message and other info after the EPV has been switched off, use the TMC software.

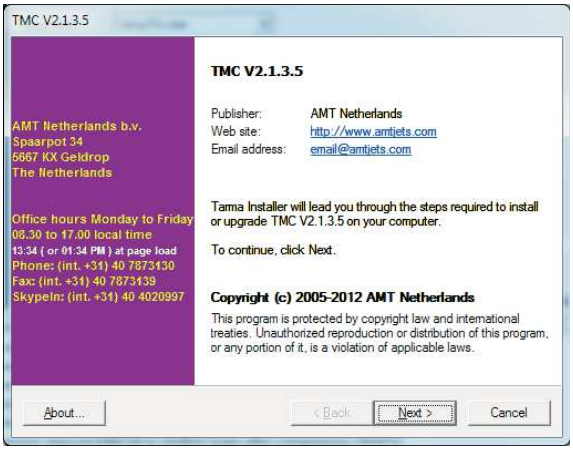


figure 8.1

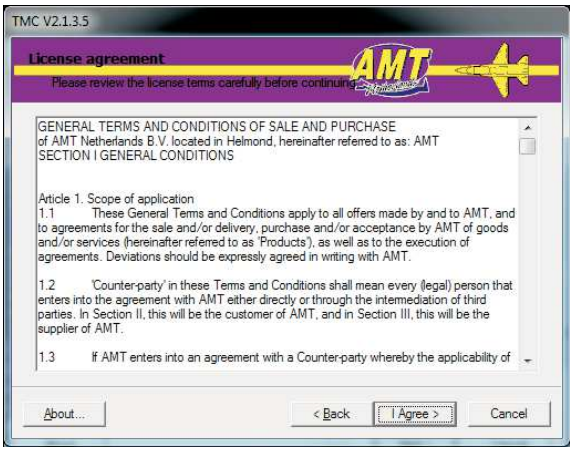


figure 8.2

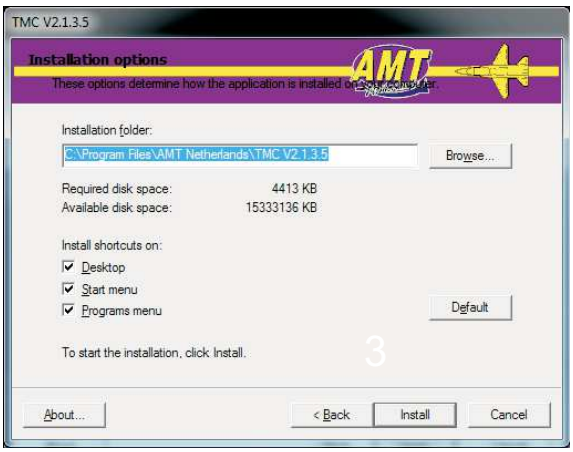


figure 8.3

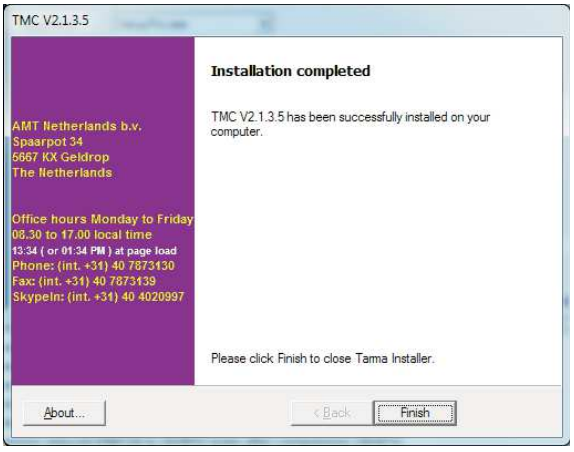


figure 8.4

8.1. General

The TMC software application is Windows based and especially designed to interact with the EPV. Following Window platforms can be used:

- Windows 7

To communicated with the EPV a serial protocol communication must be set up. As modern PC/Laptops don't have a dedicated RS232 serial port, a serial to USB adapter cable is provided. For this device, the correct drivers need to be installed.

Make sure you understand and are familiar with the functionality and the consequences of changing parameters. When in doubt, please contact AMT Netherlands or the local dealer in your country.

WARNING: changing user selectable parameters changes EPV and engine behaviour and therefore requires in-depth knowledge. Changing parameters without understanding all related implications may result in unexpected engine behaviour and severe damage.

8.2. TMC software installation

If problems arise during installation, consult your system administrator.
To install the TMC software, proceed as follows.

1. Insert CD into a CD-drive and close the drive.
2. Open Windows Explorer and click on Setup.exe. When asked if you want to allow installation of this program / APP, click Yes.
3. Screen figure 8.1 will appear.
4. Click Next to continue.
5. Screen figure 8.2 will appear.
6. Please read license agreement and click I Agree to continue.
7. Screen figure 8.3 will appear.
8. The installer requests an installation folder path. The default install location is in C:\Program Files folder of Windows. Adjust as desired using the Browse button and select the required Shortcuts.
9. Click Install to start installation.
10. After a correct installation screen figure 8.4 will appear.
11. Click Finish to close the installation.

Note: do not change the path or folder name(s) after installation as this may cause program instability.

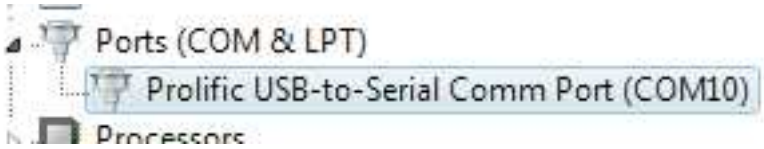


figure 8.5

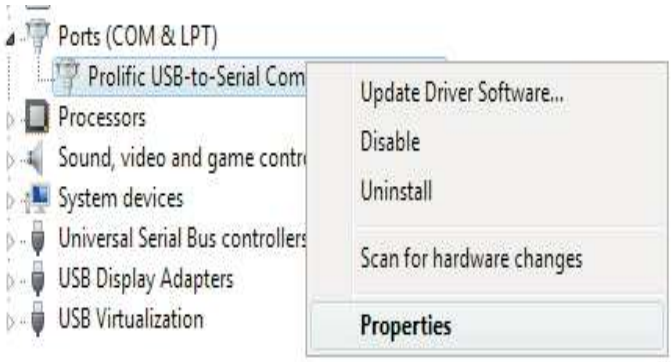


figure 8.6

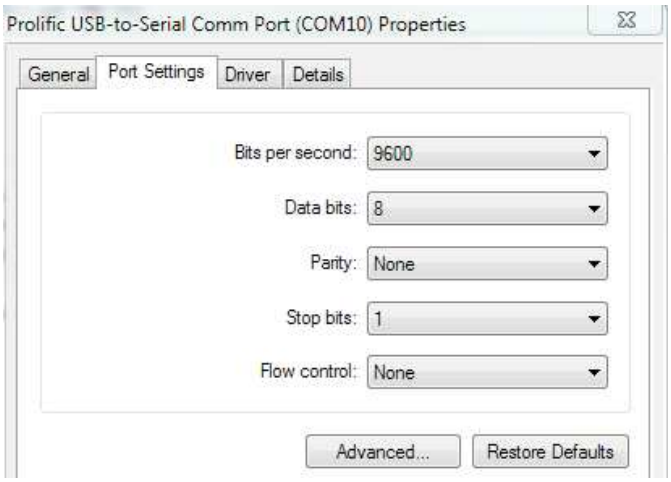


figure 8.7

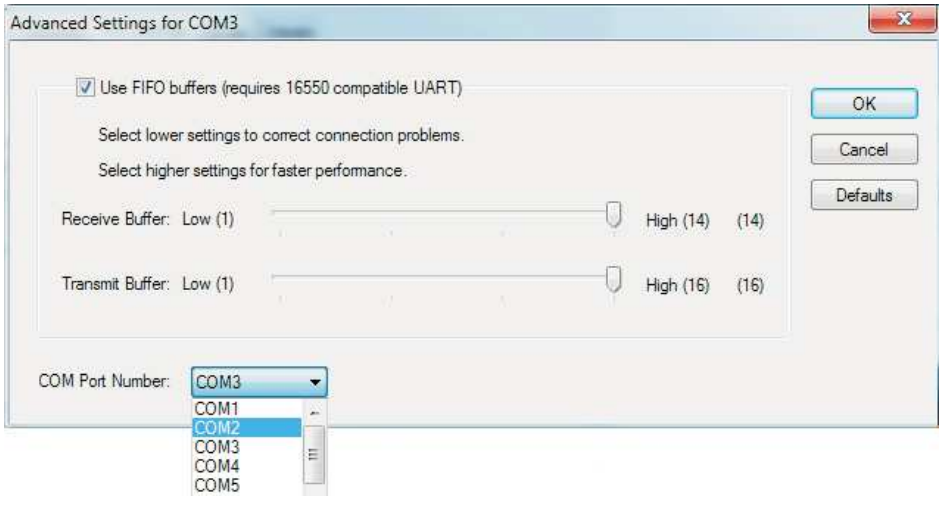


figure 8.8

8.3. Installation of serial to USB device drivers and COM port

Do this procedure only if the computer has no dedicated RS-232 port.
Choose a dedicated USB COM port to use the serial to USB device in combination with the TMC software.
After the serial to USB device is plugged in, it is normally automatically detected by Windows and the required drivers should install automatically. Check correct installation of the device and the required drivers as follows:

1. Go to the Device Manager and click to expand the Ports (fig. 8.5).
2. Right-click on the device and select Properties (fig 8.6).
3. The General tab opens: check if it states that the device works properly. If not, or if an error message is displayed such as : *This device is not working properly because windows cannot load the drivers required for this device*, please contact your system administrator.
4. Select the Port Settings tab.fig. 8.7
5. Select Bits per second as desired (range 2400 – 19200).
6. Check all other settings as shown in fig. 8.7.
7. Then click on Advanced.
8. Change COM port number if required and then click OK, see fig. 8.8.
9. Close all the Device Manager windows.

figure 8.9

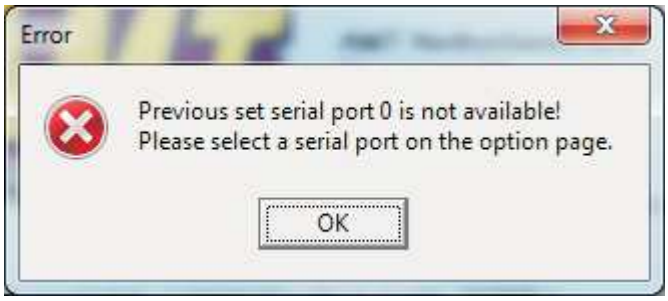


figure 8.10

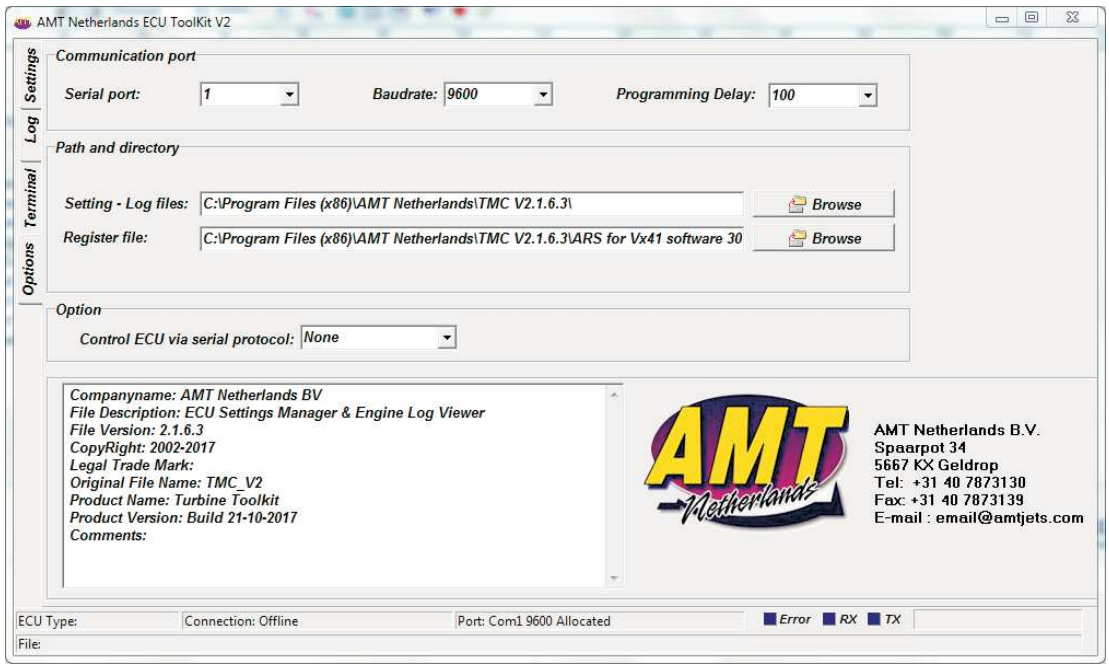


figure 8.11

8.4. TMC software communication set-up

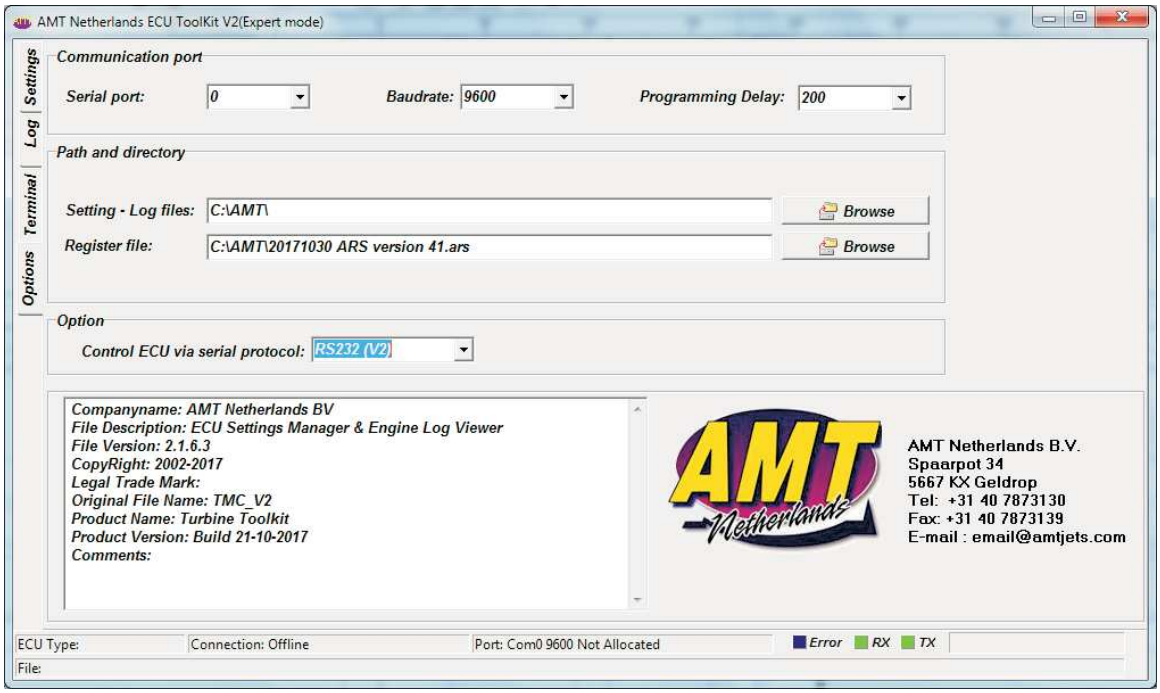
1. Connect the RS-232 cable or the serial to USB adapter cable to the dedicated port of the computer.
2. Start TMC software application.
3. If the COM port was not set or detected, an error message will be displayed (fig. 8.9) and the correct COM port must be set as described in paragraph 8.3.
4. Select Options page (fig. 8.10).
5. If required, select dedicated Serial port..
6. Chose the desired location for storage of the Log files.
7. Select Terminal page to store and activate selected COM-port.

To set-up a communication event with an engine, proceed as follows.

1. If an engine is connected to the EPV make sure the engine can run freely.
2. Connect the RS-232 cable / USB device Futaba lead end to the EDT lead of the EPV.
3. Power on the EPV.
4. Start TMC software application.
5. Switch to the Terminal page (fig. 8.11).
6. Check if the correct engine name is displayed in the left lower part of the page..
7. Check if the RX green light is blinking in the lower right part of the page.

Note: If the green RX light is not blinking, please check correct baudrate on the Options page.

figure 8.12


AMT Netherlands ECU ToolKit V2(Expert mode)
Settings
Log
Terminal
Options
Communication port
Serial port: 0
Baudrate: 9600
Programming Delay: 200
Path and directory
Setting - Log files: C:\AMT\
Browse
Register file: C:\AMT\20171030 ARS version 41.ars
Browse
Option
Control ECU via serial protocol: RS232 (V2)
Companyname: AMT Netherlands BV
File Description: ECU Settings Manager & Engine Log Viewer
File Version: 2.1.6.3
CopyRight: 2002-2017
Legal Trade Mark:
Original File Name: TMC_V2
Product Name: Turbine Toolkit
Product Version: Build 21-10-2017
Comments:
AMT Netherlands B.V.
Spaarpot 34
5667 KX Geldrop
Tel: +31 40 7873130
Fax: +31 40 7873139
E-mail : email@amtjets.com
ECU Type:
Connection: Offline
Port: Com0 9600 Not Allocated
Error
RX
TX
File:

8.5. Settings page

Select the Settings page (fig. 8.12), then click on Download ECU to load the EPV internal values.

The upper left half of the page displays all parameters and values..

Item	Description
Addr	Parameter Address
Internal	Internally stored digital parameter value
Description	Brief description of parameter functionality
Value	Calculated value of internal digital parameter value
Unit	Unit of parameter
Compare	Displays value of a loaded parameter (last run or file)

Note: Before changing values please contact AMT Netherlands

On this page, the following buttons and selection features are available:

Item	Description
Load settings	Loads parameter values from a file
Save settings	Saves displayed values to a file
Print settings	Prints displayed parameter values
Download ECU	Downloads ECU or EPV parameter values
Program Changed	Uploads altered parameters to the EPV
Erase LRI	Erase Last Run Information in the EPV
Category	Used to select a parameter group
Swap Value and Compare fields	Swaps parameter values of these columns
Load compare fields	Loads parameter values into compare fields
Save ARS file	Saves Description fields and Unit fields to a file
Show differences	When this box is checked, only parameters which Values differ from the Compare field are shown

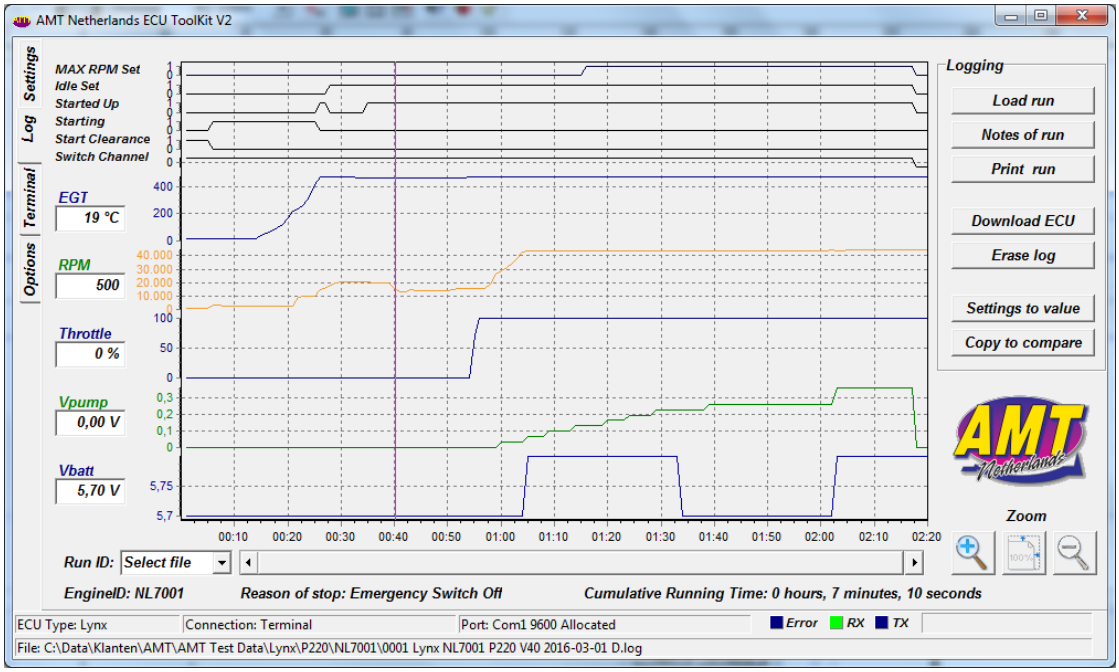


figure 8.13

figure 8.14

8.6. Log page

During starting and running of the engine, essential data is stored into the internal memory of the EPV. After engine shutdown, this information can be retrieved from the EPV for display and analysis.
To view run data, first click on Download ECU, then open the Log page (fig. 8.13).
On this page, the following buttons and selection features are available:

Item	Description
Load run	Load data from file
Notes of run	Present editor for making notes to the current run
Print run	Print current run with notes
Download ECU	Download all stored run data from EPV internal memory
Erase log	Erase all stored run data from EPV internal memory
Setting to value	Copies the parameter settings from current displayed run to internal values of the settings page
Copy to compare	Copies the parameter settings from current displayed run to compare values of the settings page
Run ID	Select a run for display
Zoom	Use Zoom buttons to zoom in and out on the graph

8.7. Terminal page

Self-explanatory screen (8.14) which displays essential operational data and contains operational controls.

Note: To use the Input controls OPS (Switch) and THR (throttle), select the option RS232 (V2) beside Control ECU via serial protocol on the Options page. Click on the arrow and the option will be displayed.
The EPV must also be programmed to serial control mode.

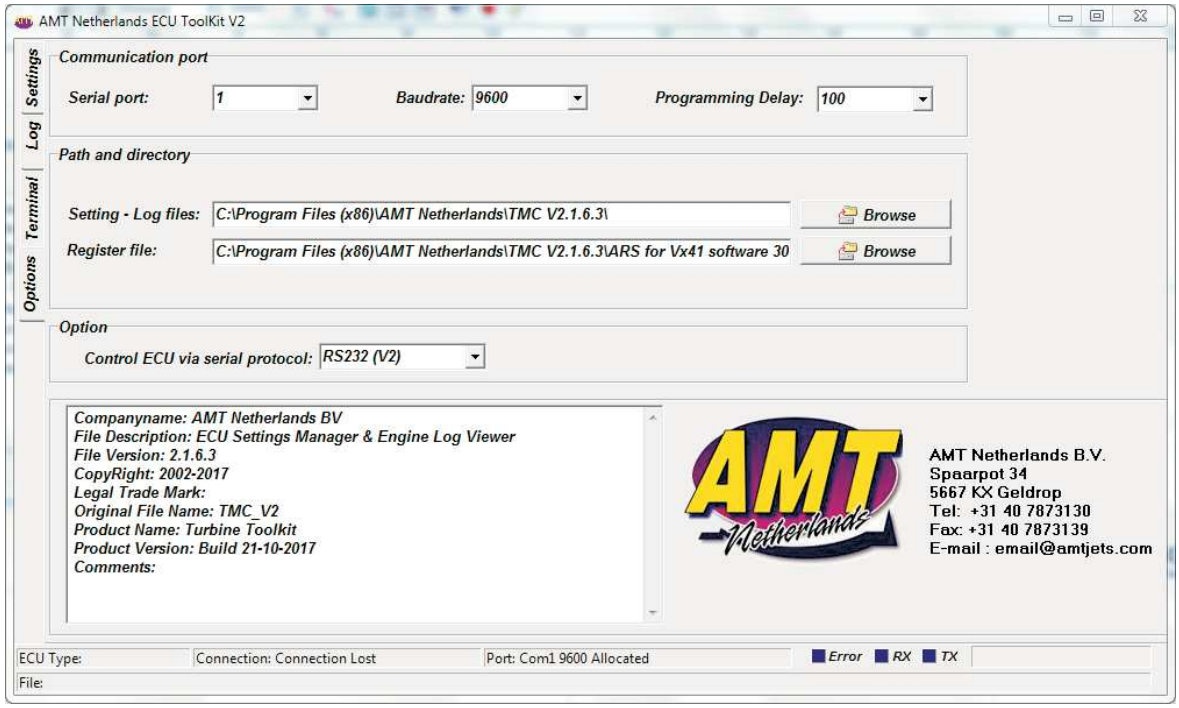

AMT Netherlands ECU ToolKit V2
Settings
Log
Terminal
Options
Communication port
Serial port: 1
Baudrate: 9600
Programming Delay: 100
Path and directory
Setting - Log files: C:\Program Files (x86)\AMT Netherlands\TMC V2.1.6.3\
Browse
Register file: C:\Program Files (x86)\AMT Netherlands\TMC V2.1.6.3\ARS for Vx41 software 30
Browse
Option
Control ECU via serial protocol: RS232 (V2)
Companyname: AMT Netherlands BV
File Description: ECU Settings Manager & Engine Log Viewer
File Version: 2.1.6.3
CopyRight: 2002-2017
Legal Trade Mark:
Original File Name: TMC_V2
Product Name: Turbine Toolkit
Product Version: Build 21-10-2017
Comments:
AMT Netherlands B.V.
Spaarpot 34
5667 KX Geldrop
Tel: +31 40 7873130
Fax: +31 40 7873139
E-mail : email@amtjets.com
ECU Type:
Connection: Connection Lost
Port: Com1 9600 Allocated
Error
RX
TX
File:

figure 8.15

8.8. Options page

Besides communication settings, this page (fig. 8.15) contains settings for file path and and a option box to enable control of the EPV via the TMC Terminal page.

Item	Description
Serial port	Selection of port for serial data
Baudrate	Selection of serial data stream speed
Programming Delay	Sets delay between characters which are send to the EPV
Setting – Log files	Path and directory for Log files.
Register file	Path and directory for ARS file
Control ECU via RS232	Enables EPV control via Terminal page.

Note: EPV must be set to serial control mode.

9.1 Preventive maintenance

Preventive maintenance is regularly performed at various intervals to lessen the likelihood of increased wear and of the engine failing.

During the pre- and post-flight checks, pay special attention to the engine inlet, compressor blades and exhaust for foreign objects and check general condition.

After each 1 hour running time, perform the following checks:

1. Visually inspect the colouring of the engine outer casing. Extreme temperatures are indicated by unusual colouring of the metal.
2. Inspect the mounting brackets for possible cracks.
3. Check each compressor blade for damage.
4. Rotate the engine briefly by hand or compressed air and let it come to a complete stop. Check that rotation decreases slowly and evenly: any hesitation points indicate ball bearing wear which requires further inspection. Also listen for abnormal sounds which may indicate wear of the ball bearings.
5. Check the fuel system for visible signs of fuel leaks.
6. Check and if needed change the fuel filter in the vehicle and in your external fuel container at least every 4000 litres of fuel. AMT Netherlands recommends replacing the filters every 2000 litres of fuel, or sooner if they are contaminated.

After each 2000 litres of fuel, replace the fuel filters of the engine fuel system and in the fuel filling line.

After each 25 hours, perform the following checks:

1. Remove the engine from the vehicle or mounting stand.
2. Visually inspect the colouring of the engine outer casing. Extreme temperatures are indicated by a more distinct colouring of the metal.
3. Inspect the mounting brackets for possible cracks.
4. Check each compressor blade for damage.
5. Check each turbine blade for damage.
6. Check the RPM sensor condition and clearance to the compressor wheel: it should be 0.20-0.25 mm. Refer to the Corrective maintenance paragraph in this chapter if the sensor needs adjustment or replacement.
7. Rotate the engine briefly by hand or compressed air and let it come to a complete stop. Check that rotation decreases slowly and evenly: any hesitation points indicate ball bearing wear which requires further inspection by the factory. Also listen for abnormal sounds which may indicate wear of the ball bearings.
8. Check the fuel system for visible signs of fuel leaks.
9. Check and if needed change the fuel filter in the vehicle and in your external fuel container at least every 4000 litres of fuel. AMT Netherlands recommends replacing the filters every 2000 litres of fuel, or sooner if they are contaminated.
10. Re-install the engine.

Remove front cap.

figure 9.1

9.2 Corrective maintenance

9.2.1 Introduction

User performed corrective maintenance is limited to:

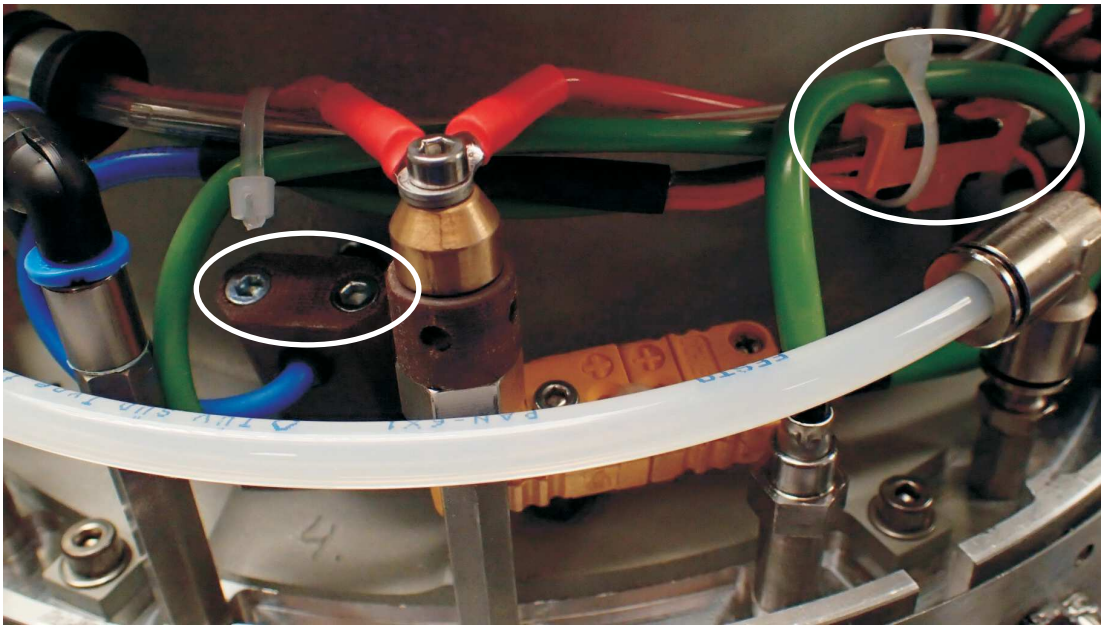
- Replacing Festo connectors and tubing on the engine.
- Adjusting or replacing the RPM sensor.

Any other corrective maintenance must be performed by AMT-Netherlands.

9.2.2 Replacing Engine Festo connectors and tubing

1. Remove the engine and drain all fuel.
2. Loosen 7 of the 8 M4 bolts which hold the outer casing to the engine by a 1/2 turn. Do not loosen the bolt with the lead seal, as this will void the warranty (figure 9.1).
3. Remove the 8 M3 bolts that hold the engine inlet cowling.
4. Remove the engine inlet cowling. If the cowling is jammed, place an 8 mm wooden stick at an angle in the slot and gently tap it loose.
5. Locate the faulty Festo connector or engine tubing and replace by an identical part; use Loctite 243 on metal-to-metal threaded connections only.
6. Use pressurised air ,maximum 10 bar or 145 psi, to test for leaks.
7. Install the engine cowling.
8. Apply Loctite 243 to the 8 M3 socket head screws and fasten the engine cowling with these screws and washers.
9. Apply Loctite 243 to the 7 M4 socket head screws and fasten the outer casing to the engine with these screws and washers.

RPM sensor replacement figure 9.2



RPM sensor adjustment figure 9.3

9.2.3 Adjusting or replacing RPM sensor

Note: If the downloaded last engine run shows a 'Blade Failure' without this actually happening, the RPM sensor may be loose or faulty. Replace the sensor if it has any damage.

1. Loosen 7 of the 8 M4 bolts which hold the outer casing to the engine by a 1/2 turn. Do not loosen the bolt with the lead seal, as this will void the warranty.
2. Remove the 8 M3 bolts that hold the engine inlet cowling.
3. Remove the engine inlet cowling. If the cowling is jammed, place an 8 mm wooden stick at an angle in the slot and gently tap it loose.
4. In order to re-adjust the sensor, only remove the 2 Philips head screws. If the sensor needs to be replaced, cut the tie-wraps, disconnect the JR-connector, remove the two Philips head screws and pull the sensor out of the mounting block (see fig. 9.2).
5. Apply Loctite 222 to the 2 Philips head screws and complete steps 5 through 8 before the Loctite has cured.
6. Re-adjust the sensor / insert the new sensor so that the sensor surface feels is flush to the inlet (see fig. 9.3).
7. Tighten the 2 Philips head screws a little so that the sensor can be moved with light force.
8. Use a 0.20 mm feeler gauge to adjust the clearance between sensor an compressor blades to 0.20 mm (+0.05 -0.00 mm). This must be a tight fit and must be checked for each compressor blade.

   CAUTION: do not damage the sensor surface.

9. When the clearance is correct, fully tighten the 2 Philips head screws.
10. Connect the sensor JR connector and secure the cable with 3 Nylon tie-wraps.
11. Install the engine cowling.
12. Apply Loctite 243 to the 8 M3 socket head screws and fasten the engine cowling with these screws and washers.
13. Apply Loctite 243 to the 7 M4 socket head screws and fasten the outer casing to the engine with these screws and washers.

After the engine has been re-installed, perform a static maximum power run for at least 10 seconds and shut down the engine. Using the TMC software, download the last engine run data and check for 'Blade Failure' errors.

front view Lynx, frontcap not mounted.

figure 9.4

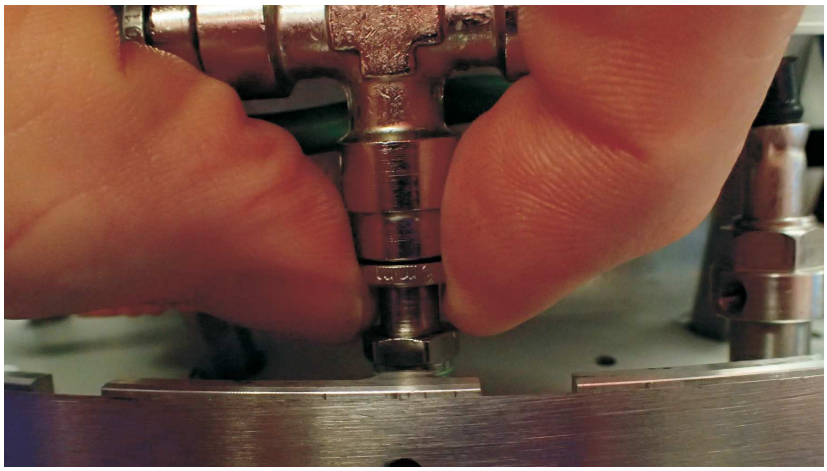


figure 9.5

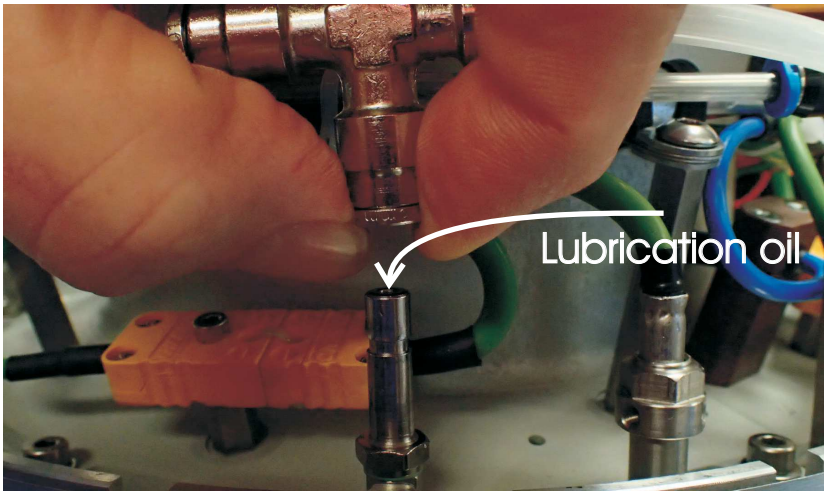
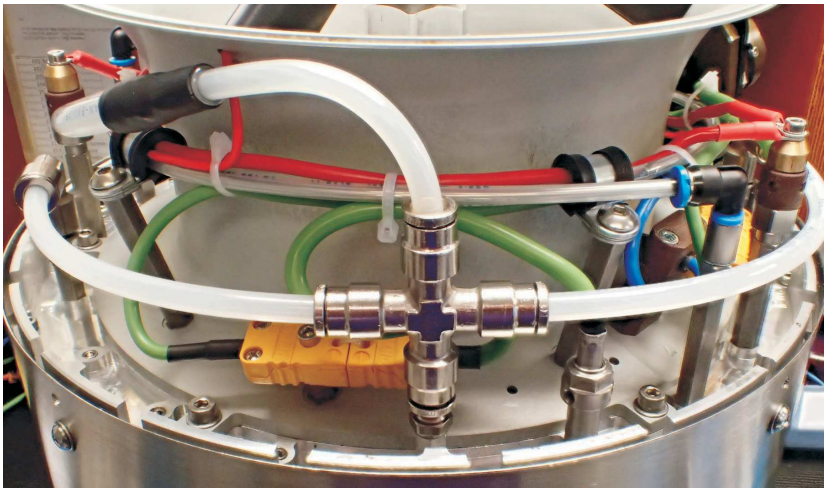


figure 9.6



9.3 Storage procedure

If the engine will not be used for 3 months or longer, perform the following procedure.

1. Loosen 7 of the 8 M4 bolts which hold the outer casing to the engine by a 1/2 turn. Do not loosen the bolt with the lead seal, as this will void the warranty.
2. Remove the 8 M3 bolts that hold the engine inlet cowling.
3. Remove the engine inlet cowling. If the cowling is jammed, place an 8 mm wooden stick at an angle in the slot and gently tap it loose.
4. Unlock cross tube connection by pushing the lower metal ring part upwards as shown in figure 9.4 and 9.5
5. Prepare 15 ml of storage fluid: a mixture of kerosene with 20% engine oil.
6. Use a syringe to inject 10 - 15 ml storage fluid into the lubrication pipe.
7. Install cross tube connection on to lubrication pipe (figure 9.6).
8. Install the engine inlet cowling.
9. Apply Loctite 243 to the 8 M3 socket head screws and fasten the engine cowling with these screws and washers.
10. Apply Loctite 243 to the 7 M4 socket head screws and fasten the outer casing to the engine with these screws and washers.
11. Using compressed, spin the turbine for about 10 seconds to distribute the storage fluid in the engine.
12. Position the engine in a vertical position with the nozzle down on a piece of cloth to drain and absorb excess storage fluid.
13. Seal the fuel and gas inputs with a short piece of tube of which the outer end has been molten closed.
14. Seal the engine inlet and exhaust with the plastic caps provided and store the engine in a vertical position with the nozzle facing down in a dry room.

9.4 Post-storage procedure

If storage is longer than 6 months, perform the following procedure before re-installing the engine.

1. Remove the plastic caps from the engine inlet.
2. Loosen 7 of the 8 M4 bolts which hold the outer casing to the engine by a 1/2 turn. Do not loosen the bolt with the lead seal, as this will void the warranty.
3. Remove the 8 M3 bolts that hold the engine inlet cowling.
4. Remove the engine inlet cowling. If the cowling is jammed, place an 8 mm wooden stick at an angle in the slot and gently tap it loose.
5. Unlock cross tube connection by pushing the lower metal ring part upwards as shown in figure 9.4 and 9.5
6. Prepare 15 ml of storage fluid: a mixture of kerosene with 20% engine oil.
7. Use a syringe to inject 10 - 15 ml storage fluid into the lubrication pipe.
8. Install cross tube connection on to lubrication pipe (figure 9.6).
9. Install the engine inlet cowling.
10. Apply Loctite 243 to the 8 M3 socket head screws and fasten the engine cowling with these screws and washers.

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.

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		
❑	LiPo battery	❑	_____
❑	Solenoid fuel	❑	Solenoid igniter
❑	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		
❑	LiPo battery	❑	_____
❑	Solenoid fuel	❑	Solenoid igniter
❑	Solenoid gas		
❑	C.T.F. switch		
❑	Thermo sensor		
❑	EDT		
❑	Glow plug lead		
❑	Fuel filter		
❑	Kerosene igniter		
❑	_____		

Incomming checked by:

Outgoing checked by:

11. Apply Loctite 243 to the 7 M4 socket head screws and fasten the outer casing to the engine with these screws and washers.
12. Using compressed, spin the turbine for about 10 seconds to distribute the storage fluid in the engine.
13. Position the engine in a vertical position with the nozzle down on a piece of cloth to drain and absorb excess storage fluid.
14. Re-install the engine.

9.5 Factory service or repair

Send only those items which need checking, service or repair.
If possible, use the original packaging.
Seal the engine as described in the storage procedure.
The EPV fuel input and outputs must be sealed in a similar manner.
Use the inspection form (see Download page of our website http://www.amtjets.com) to provide a detailed report on the required checking, service or repair. Provide a copy of the Engine Log if available. Without a clear error description it may take more time to find and solve any problems.

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 AMT Netherlands or, if present, by the AMT service centre in your own country. In case of replacement, AMT Netherlands becomes the owner of the replaced components.

This warranty excludes insufficient maintenance, misuse, accidental damage, alteration, normal wear and tear, sale to third parties, the use of corrosive or abrasive cleaning agents or other causes beyond the control of AMT Netherlands, this to the sole discretion of AMT Netherlands.

When AMT Netherlands discovers that the Warranty seals have been broken, or that the EPV or other accessories have been dissassembled or modified in any way, the warranty is voided.

10.2 Completing the warranty card

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

In case of a possible Warranty claim, please send the engine together with a detailed description of the complaint, the EPV and the Engine Log to AMT Netherlands. Please use the original packaging material for this.

Notes:

Engine log

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

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

Notes: