

Interactive Installation Manual Turbo

M0260-NC Beta version 1.3

[Click or scroll to the next page to continue](#)



Welcome to the ULPower Interactive Installation Manual Beta 1.3

Thank you for choosing ULPower Aero engines to power your aircraft. This manual will provide you with basic information on correct engine installation which is a requirement for safe engine operation / safe flights. We recommend to study this manual carefully.

This manual is an interactive support document, best viewed in Adobe Acrobat reader, with links and references to outside sources. Much as it can be used 'off-line', read like an on-line book or printed and bound as a manual, some of the links will not work without an active internet connection (your network connection charges may apply for external linking).

You may simply 'scroll' through the manual. If you are using this manual on a mobile phone or tablet you may need to download the Adobe Acrobat Reader to enable the links. Using the links will make use easier. Each page has a reference on the top right of the page, making reference when speaking to another manual user easier

You may also always return to the 'Contents Page' for installation ? by clicking on the ULPower logo on the top right of each page.

Please verify that you use the latest manuals available from ULPower - <http://ulpower.com>

Regards

The ULPower Team (email info@ulpower.com)



E&OE May 2023

How to get the most out of this manual

Each section has up to three levels... **Quick guide**, **Detailed guide** and **Technical guide** – with a corresponding icon (see right). The quick-guide pages are aimed at the experienced ULPower installation technician who is looking for a memory jogger. However, we recommend reading through to the more detailed guide contents for all installations. Where applicable there are links to ULPower.news, the ULPower YouTube channel and various other outside resources, for those interested in finding out even more. These links and the external content may be updated and extended at any time.

Reading the full installation manual and using the wide range of other resources available from ULPower, increases your knowledge and should help you both enjoy and succeed in your ULPower Aero Engine installation.

This manual is provided to assist/inform and does not replace reference to experienced engineers nor compliance with local or OEM requirements. We advise full compliance with industry good practice and as a default compliance with standard documents such as the FAA Maintenance Technician Handbook ([FAA-H-8083-30](#)), Aircraft Wiring and Bonding ([AC 21-99](#)) and Acceptable Methods, Techniques and Practices – Aircraft inspection and Repair ([AC 43.13](#)). Enjoy your ULPower installation.



Quick
Guide



Detailed
Guide



Technical
Guide

Wherever you see the ULPower.news button, you may click on it to open a browser window and access more details/guidance via the ULPower.news website.

An active internet connection and data service will be required.

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ULPOWER
AERO ENGINES **NEWS**

ULPOWER
AERO ENGINES

Our Video Channel



Safety information

- The engine should only be installed and placed into operation by persons familiar with the use of the engine and informed with regard to possible hazards.
- This non-certified engine is designed for possible application on aircraft used in VFR conditions which have the capabilities of controlled gliding without engine power.
- It should be clear that the choice, selection and use of this particular engine on any aircraft is at the sole discretion and responsibility of the aircraft manufacturer, assembler and owner/user. ULPower makes no warranty or representation on the suitability of its engine's use on any particular aircraft. Furthermore, ULPower makes no warranty or representation of this engine's suitability with any other part, component or system which may be selected by the aircraft manufacturer, assembler or user for aircraft application.
- Use the appropriate tooling when installing the engine.
- Engine is delivered in "dry" condition (without oil). Before putting engine in operation it must be filled with oil according to specifications in the operating handbook.
- Never (test)run the engine without a propeller or flywheel as this will inevitably cause engine damage and present a hazard of explosion.
- Propeller/flywheel and its attachment with a moment of inertia in excess of the specified value must not be used and releases engine manufacturer from any liability.
- Improper engine installation and use of unsuitable piping for fuel-, cooling- and lubrication system releases engine manufacturer from any liability.
- Unauthorized modifications of engine or aircraft will automatically exclude any liability of the manufacturer for sequential damage.
- Do not use a protective device (e.g. a fuse) essential for the engine, to protect any other circuit
- Do not install unnecessary protective devices for the alternator and the regulator rectifier
- Install protective caps to protect switches essential to flight safety such as ECU switch, master switch, ...



Before we start...

Your new engine has been bench run before being preserved at ULPower, thus warranting proper protection against corrosion for at least 12 months from date of delivery from ULPower.

This warranty is subject to the following conditions:

- the engine must be stored in the original packaging as supplied by ULPower.
- the coverings on various openings must not be removed (see picture)
- the engine must be stored in a suitable dry and condensation free place, between 5 and 60°C (41-140°F).



If the engine is stored for longer than 12 months, the following tasks have to be performed every three months:

- crank the engine by hand two complete turns
- spin the compressor wheel (by hand) a few times: it should spin freely. If not, contact your ULPower dealer or servicepoint.
- inspect for corrosion (e.g. prop shaft). At detection of corrosion, send the engine to your nearest overhaul center without delay.
- repack engine into original packaging and seal properly.

ULPower offer a factory revision service for stored engines which are outside warranty. Such engines are then released with a fresh ONE year warranty.



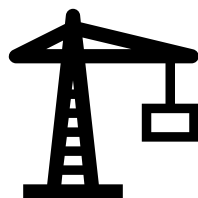
Once uncrated we recommend entry to service as soon as possible and in the meantime ensure that the engine is kept clean and dry with openings covered i.a.w. good engineering practices.

Contents / Quick Links

You can work through the pages of this manual sequentially, or use this page to select section by section to suit your installation needs.



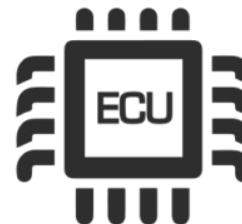
Unboxing



Hanging the
engine



Exhaust/
Muffler



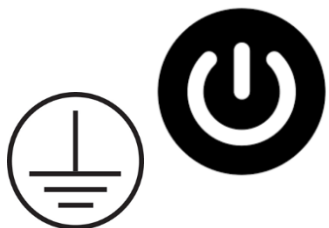
ECU, Boost control
&
Cockpit wiring



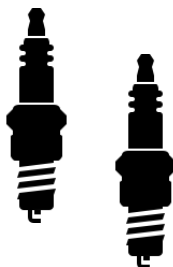
Electrical
System



Rectifier/
Regulator



Grounding and
Starter



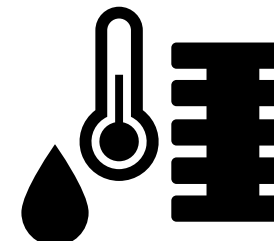
Ignition
System



Battery &
Capacitor



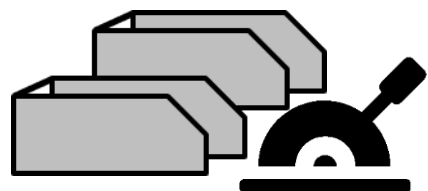
Fuel System/
Fuel Pumps



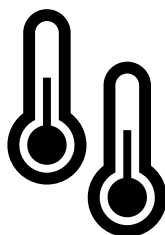
Oil Thermostat
& Cooler



Oil / Air
Separator



Baffles, Air Filter
and Throttle



EGT/CHT/MAP
/senders



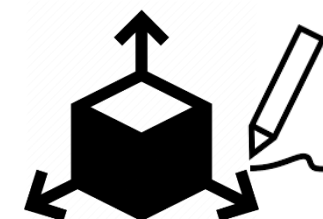
Propellers



Preparing for
First Flight



Fluids, Limits,
ranges, etc.

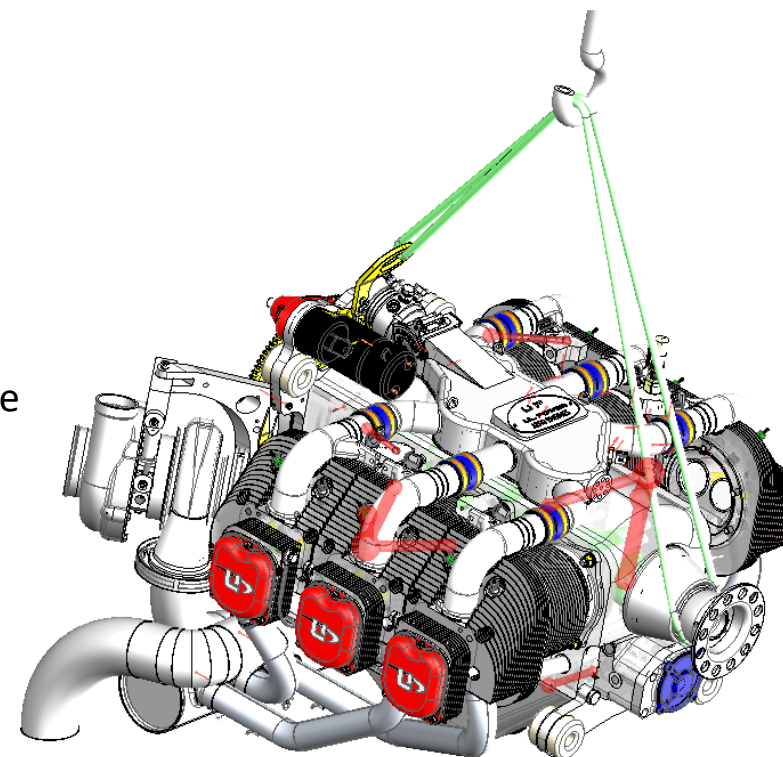


Dimensions &
Diagrams

Unboxing



1. Release the metal tabs on the top of the box.
2. Gently tap to lift the top lid only.
3. Remove accessories and put to one side.
4. Using an engine hoist, fit a suitable lifting strap between the yellow lifting hook and the prop shaft.
5. Take up the load, without lifting the engine/box
6. Release the securing wood beams by removing the retaining screws on the side of the box.
7. Loosen the bolts/nuts from the steel shipping plates attached to the bottom of the box.
8. Raise the engine out of the box, avoiding knocking any parts of the engine.
9. Remove the shipping plates from the engine



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HANDLING TECHNIQUES: It is important to consider safety at all times during engine handling and installation. Ensure that your engine hoist is suitable for the task (both in lift capacity and lift height) as well as that your lifting strap is suitable for the weight to be lifted, and is in good condition. At all times keep your fingers and body clear of crush points during the installation process.

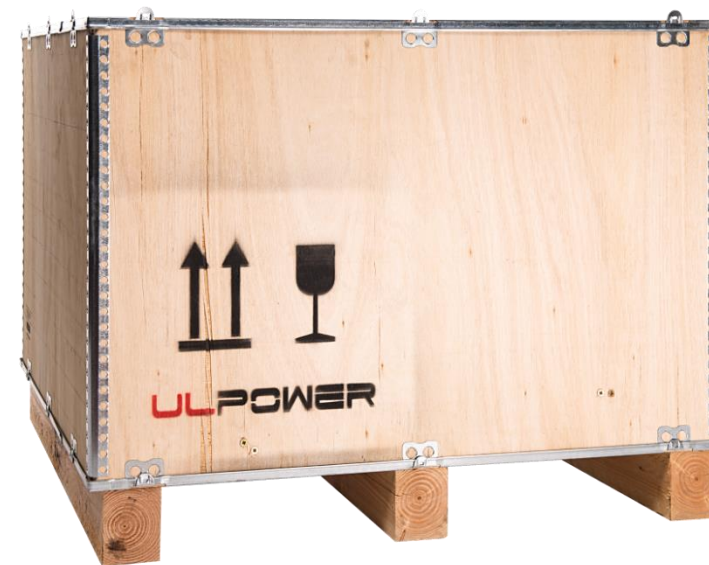




Unboxing

To open the tabs on the box you are best to use a medium sized flat head screwdriver and, if necessary, pliers and a soft mallet. Lift the tabs to make sure that the lid of the box can be removed easily. Keep the box lid to hand. You may use masking tape to cover the sticking up tabs to reduce the risks of scratching yourself or items. Caution is advised.

Unpack the items around the engine and place them carefully to one side. Depending on your order, you may have a variety of parts in boxes/bags and also coils of hoses.



DO NOT undo from the bottom tabs because the engine is attached via the sides of the box.

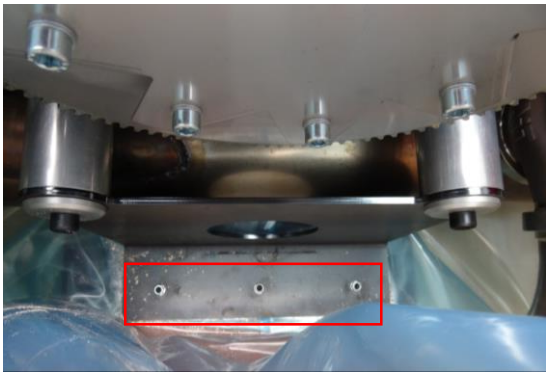
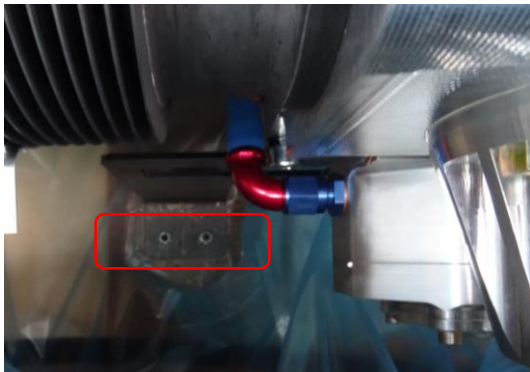








Unboxing

Once you have the engine alone in the box, you will see that the engine has two steel shipping plates (on the back and in front of engine) that are attached to the bottom of the box.

Loosen the bolts/nuts (7 in total) from the steel shipping plates attached to the bottom of the box.

	Back of the engine (side starter ring gear)	Front of the engine (propeller side) LEFT	Front of the engine (propeller side) RIGHT
Top view			
Bottom view (box)			



Unboxing

Now you are ready to remove the engine. The engine must first be secured using the pre-installed yellow lifting hook and prop shaft, using a suitably rated lifting strap and engine hoist.

If there are wires attached to the lifting hook, carefully remove the tie wraps and ensure that your lifting strap can enter the hook without fouling any wires

Once secured and the weight of the engine 'just taken up' by the engine hoist (all safety protocols respected) you can remove the screws holding the wooden engine securing blocks in place.

The screws are fitted from the outside of the box into securing wood sections (these may vary depending on the engine). Once removed the box will drop away and you can hoist the engine to the required height to install.

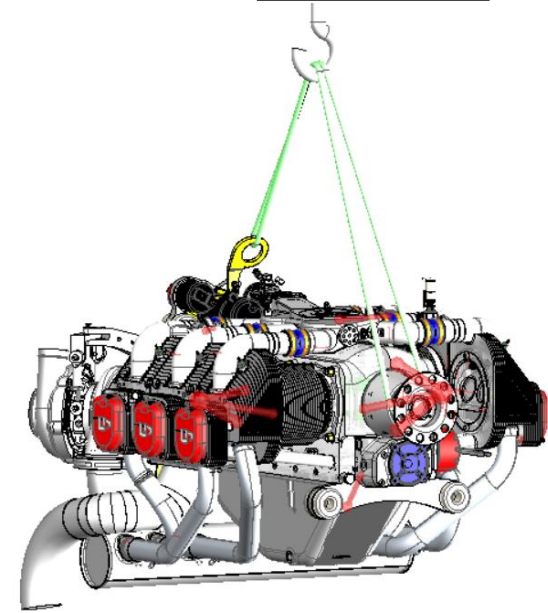
You may need to adjust the position of the lifting strap. To support the weight of the engine, you may manoeuvre the engine by supporting the cylinder heads, just behind the rocker covers – BUT make sure you do not damage the oil lines installed to the lower part of the head, or any other parts of the engine.

You will also need to remove the steel shipping plate at the front and the back of the engine, by simply removing the two bolts holding it in place with an appropriate Allen key. The back steel shipping plate has to be removed before mounting the engine on the engine mount, the front steel shipping plate can be removed after the engine is securely bolted to the airframe.



Hanging the engine

1. Offer up the engine to the airframe
2. Ensure that the rubber anti-vibration mounts and aluminium washers are fitted securely
3. Insert the mounting bolt
4. Fit washer and lock nut (DO NOT USE NYLOCKS IN THE HOT ZONE)
5. Torque the nut (25Nm)
6. Gently release the engine hoist, ensuring that the engine is secure before removing the lifting strap
7. Remove the yellow lifting ring and store securely





Hanging the engine on the plane

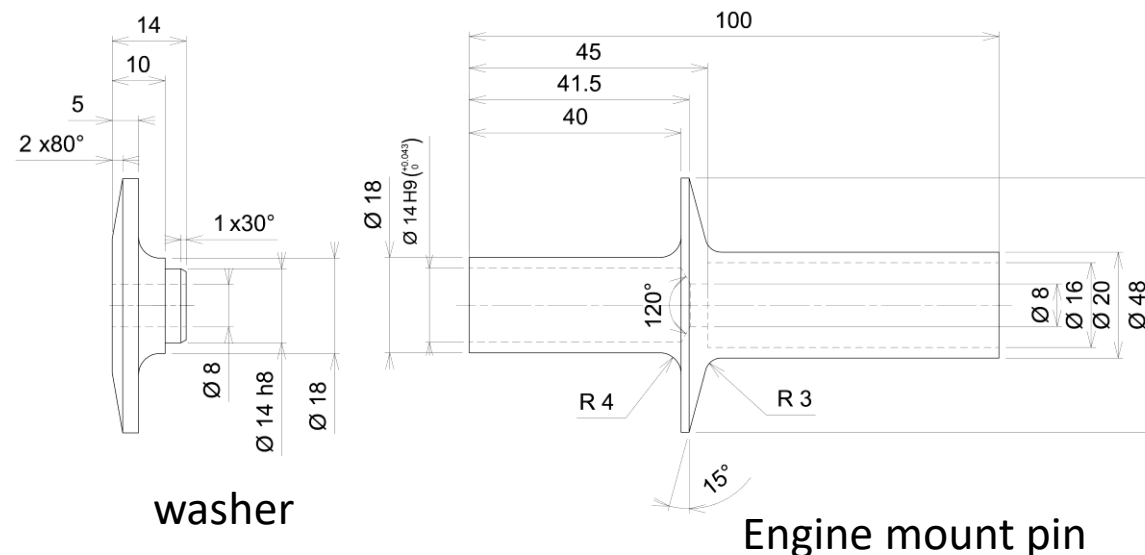
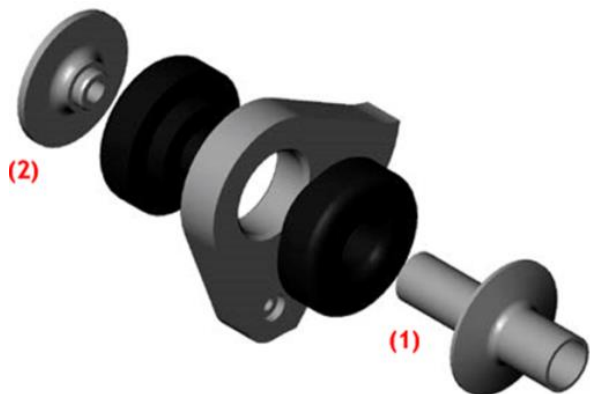
Engine Mounts and mounting pins:

Always use a suitable engine mount either from your aircraft supplier or an experienced engine mount manufacturer. ULPower also offers a design, construction and test service with industry standard report on strength attached. Several FWF kits and adaptor mounts are already available, contact your ULPower dealer for more details.

Engine mount bolts, lock nuts, rubbers and washers come as standard with your new ULPower engine. Engine mounts pins (E013504) are available as spare parts (**bolt M8x70: ULP Part n° F0208070 / Lock nut: ULP Part n° F5103080**)

We suggest the steel Engine Mount Pin (1) and aluminium Engine mount Washer (2) to be dimensioned as below.

Engine mount pins should be tightened together with the M8x70 cap screw (8.8 Steel/Din 912) and lock nut between two flanges with the correct distance and torque (45mm / 25Nm).

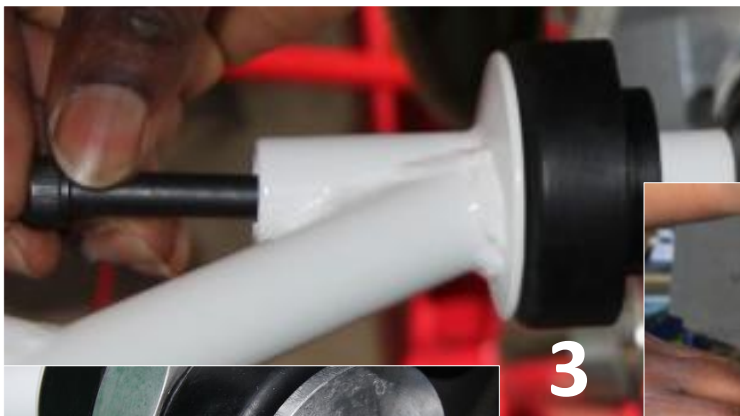
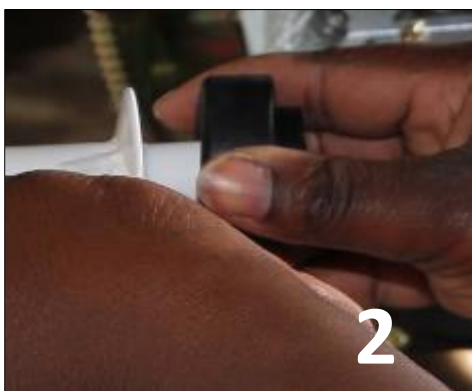




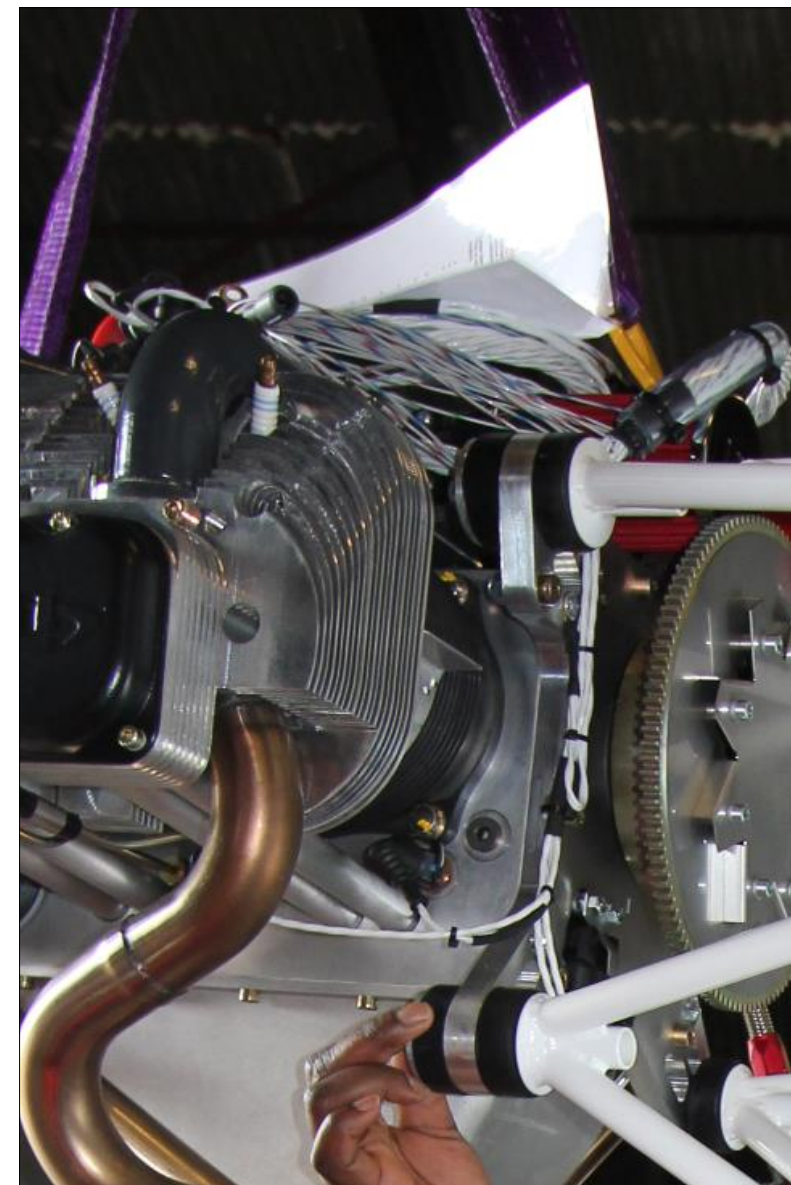
Hanging the engine

Before mounting the engine to the airframe, apply some silicone lubricant to the engine mount (1), this will allow the rubber vibration mounts to slide on easily (2). Insert suitable engine bolts and nuts (either those provided by ULPower or your airframe supplier) (3/4). Torque to 25Nm.

Once the engine is securely mounted, gently lower the engine hoist, checking for any issues, and if all is as it should be, remove the lifting strap and the yellow lifting hook (5) (keep the hook and its bolts safe in case you need to remove the engine in the future).

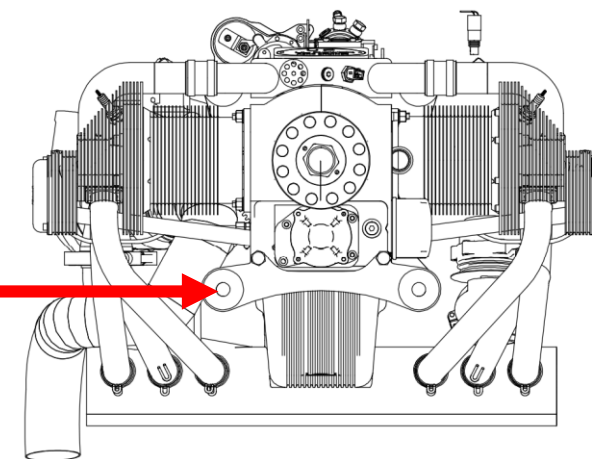
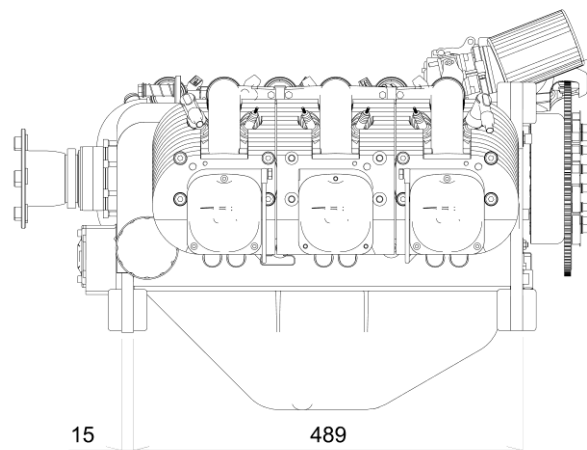
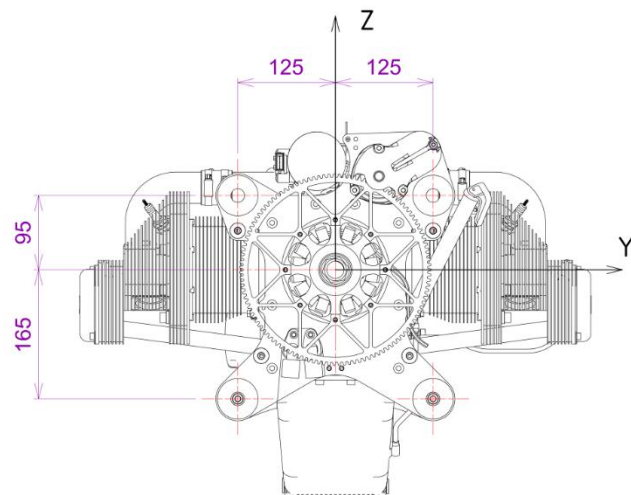


Do not work 'under the engine' at any time until secured.



Optional mounting points

Most installations occur using the four rear mount points, however, it is possible to order a front engine mounting plate as shown here to suit specific installations.



[For more information consult our technical documentation and / or contact your local ULPower dealer.](#)

Exhaust/Muffler



The UL520T is standard delivered with the exhaust system pre-installed. The exhaust system consists of : exhaust tubes (6), exhaust muffler, turbocharger, wastegate and (2) tailpipes (wastegate and turbo exhaust).

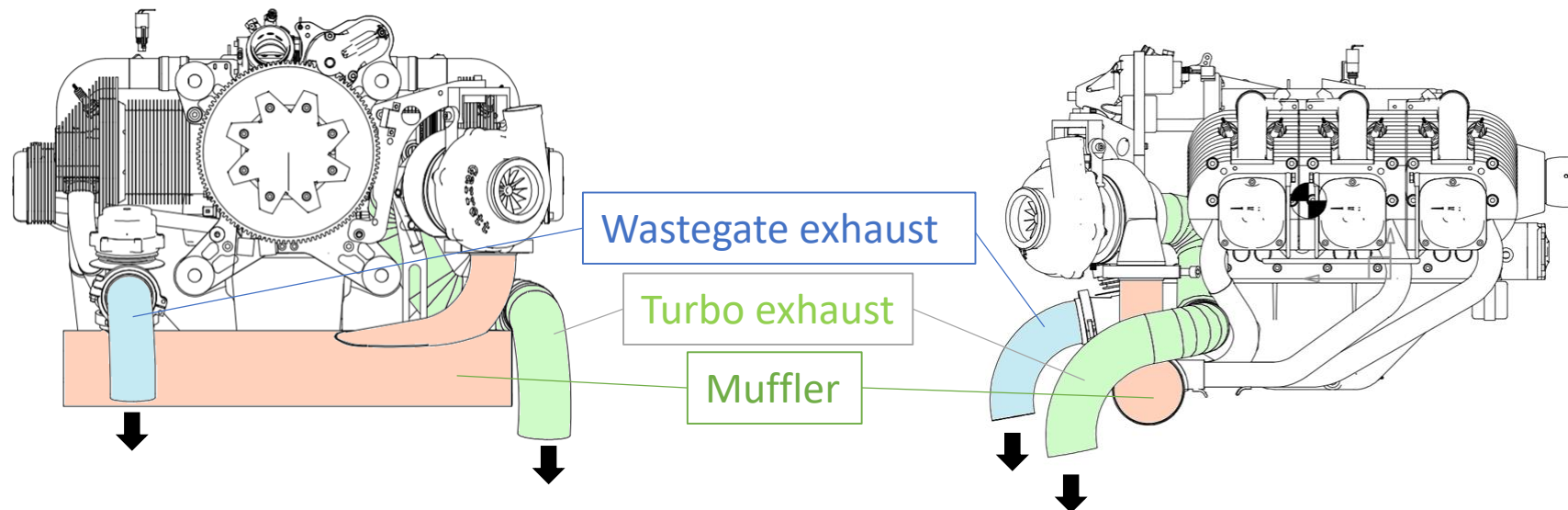
Unlike the naturally aspirated ULPower engines, there is **no** need to remove the gaskets and install new ones.

NOTE : If these need to be replaced, they must be replaced with **stainless steel** gaskets (NOT copper ones).

There are 2 exhaust pipes (one from the wastegate and another one from the turbo).

- When extending these pipes, provide a suspension point to avoid stresses at the wastegate and/or turbo outlet.

Install heat-shields as appropriate to protect engine mount rubbers/sensors/wires/etc from excessive radiant heat from the muffler/tubes/turbo as may be applicable.



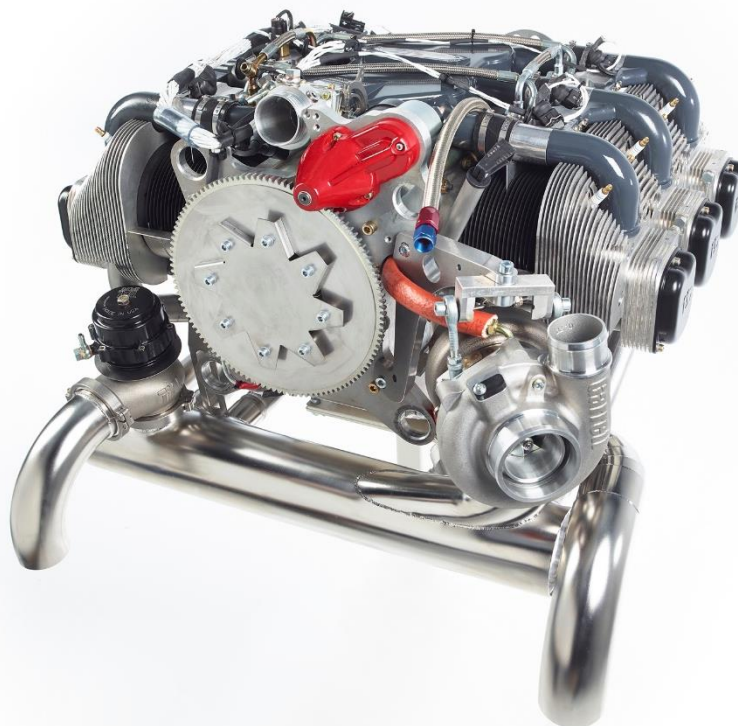
Exhaust

Your ULPower Aero Engine will be delivered with the UL power exhaust system. The system is designed to match the engine and the ECU and to reduce the noise to an acceptable level without losing power.

The design of the exhaust system is related to the ECU software program. Any changes may result in decreased performance of your engine. Only use an exhaust system that is **MATCHED** to the ECU software you have installed.

Any modification to the ULPower exhaust system, without specific approval , in writing , by ULPower will void engine warranty !

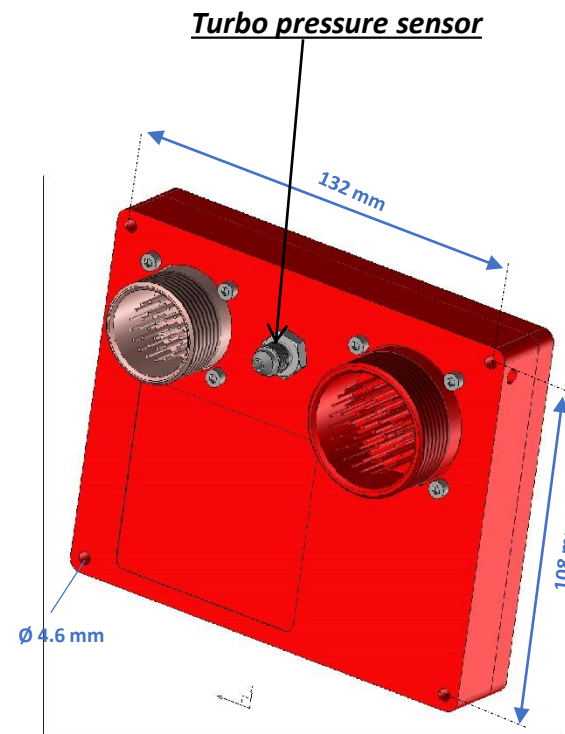
If you need an alternative exhaust for the turbo engine, please contact your ULPower dealer for further information



Installing the ECU



1. Install the ECU on a place clear of heat (max 65°C) and vibration at least 100mm from the ignition coils using the supplied rubber anti-vibration mounts. (eg firewall engine side or cockpit side)
2. Route the larger ENGINE loom connector to the ECU and connect (from the same loom connect the coil and ground connectors securely)
3. Install Fuel Pump Control Relays (FPCRs) as required.
4. Wire the smaller 'COCKPIT' Loom connector to your instrument panel and connect fully to the ECU/Panel switches/breakers/fuses as required.
5. Connect CAN or RS232 cable to cockpit loom as required.
6. Connect the ECU turbo pressure sensor with the turbo pressure measurement location (stainless steel braided hose)
7. Connect the ECU with the boost controller (via the smaller 'COCKPIT' loom connection and boost controller wiring loom).



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Always use good quality switches and connectors rated for at least 20amps operation. As a minimum you will need an ECU switch (20amp), two ignition switches and fuel pump switch(es) each with 15amp breakers/fuses.

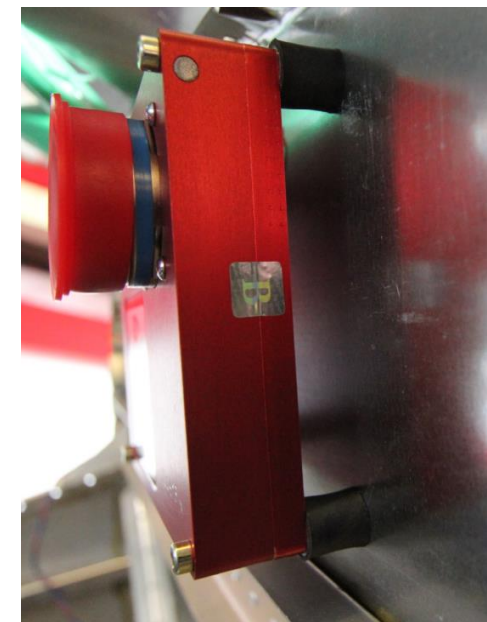
NOTE: Engine start button is NOT routed through the ECU.





Installing the ECU

1. Locate the ECU behind the firewall OR firewall forward in a suitable zone clear of heat (max 65°C), vibration and at least 100mm from the ignition coils. If installed behind the firewall please remember to drill a hole to pass the connector and the turbo pressure hose (do not cut the wiring loom).
2. Lay out the mounting holes and drill to 5mm. Deburr as required.
3. Install ECU using the supplied rubber anti-vibration mounts.
4. Route the larger ENGINE loom connector to the ECU, with a suitable protection for wires, and thread onto the ECU until fully home (red line on ECU side must be hidden).
5. Connect coils and grounding points from the Engine loom as required.
6. Wire the smaller COCKPIT loom connector to your instrument panel, power supply, EFIS,... and boost control valve :



Thread the cockpit- and engine-wiringloom onto the ECU until fully home (red line on ECU side must be hidden).

DO NOT cut or modify the wiring looms and DO NOT open or tamper with the ECU itself. Doing so may result in engine failure and personal injury and will invalidate your warranty.



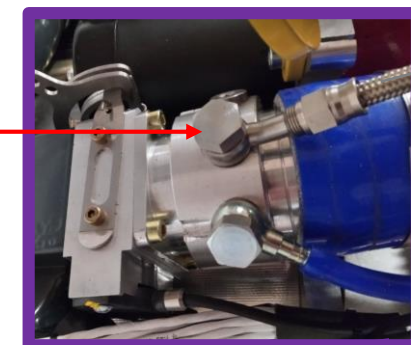


Installing the ECU

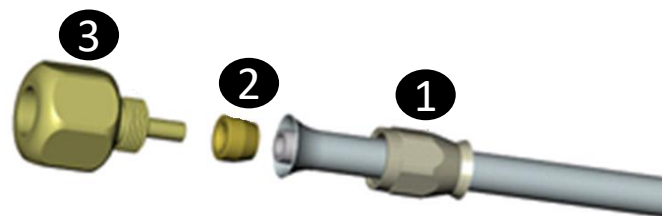
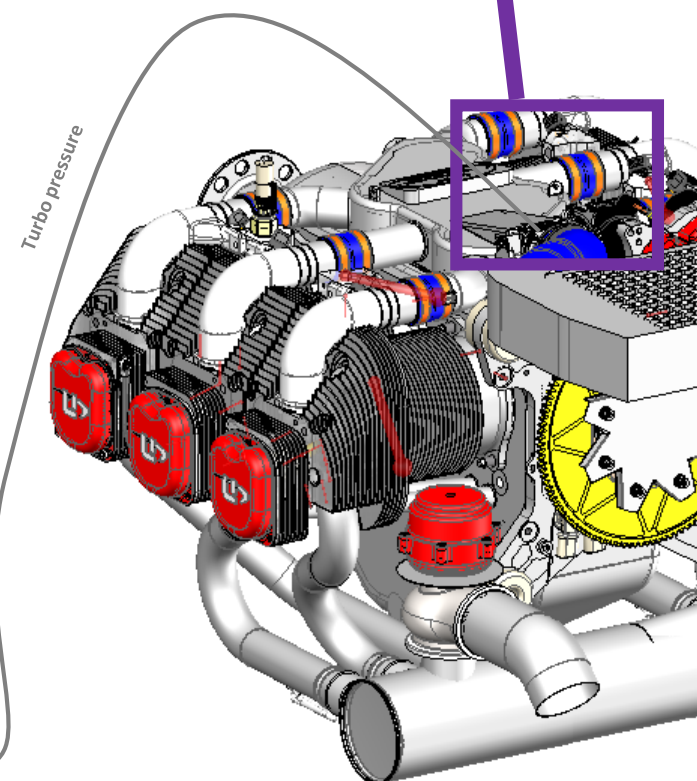
Keep away from heat !
Avoid short bends !

7. Connect the ECU turbo pressure sensor with the turbo pressure measurement location (stainless steel braided hose)

- The length of the line will depend on where you would like to install the ECU. Determine the length and assemble the line as follows:
 - Determine the length : make sure that the hose is not stretched when installed.
 - Apply tape around the hose at the point you wish to cut it to length .This way the stainless steel braid will stay in position and doesn't unravel; a cleaner cut is obtained.
 - Cut hose with a metal saw or grinding disc in such a manner that a nice straight end is obtained.
 - Unscrew the socket screw (1) of the fitting (3). Be careful not to loose the brass cone (2) that sits inside. Before removing the tape, slide the socket screw over the hose including the stainless steel braid.
 - Remove the tape.
 - Open the stainless steel braid towards the outside to free the end of the inner plastic tube. As shown on the image below. Do not unravel the braid too much.
 - Slide/push the brass cone (2) over the plastic tube all the way to the end.
 - Push the fitting (3) into the tube.
 - Pull back the socket screw towards the fitting and screw onto the fitting as far as possible. Make sure the steel braid does not go in between the thread. Use two spanners - one to hold the fitting, the other to tighten the lock screw.
 - Repeat on the other side.
 - **Clean the line thoroughly to ensure no metal, rubber or other particles are inside before connecting the line.**
- Connect the turbo pressure line with the connection near the throttle (torque value, see IPC)
- Connect the turbo pressure line with the ECU. **Attention ! Use one wrench to hold the ECU sensor connection in place and another (torque value, see IPC) to secure the turbo pressure line.**



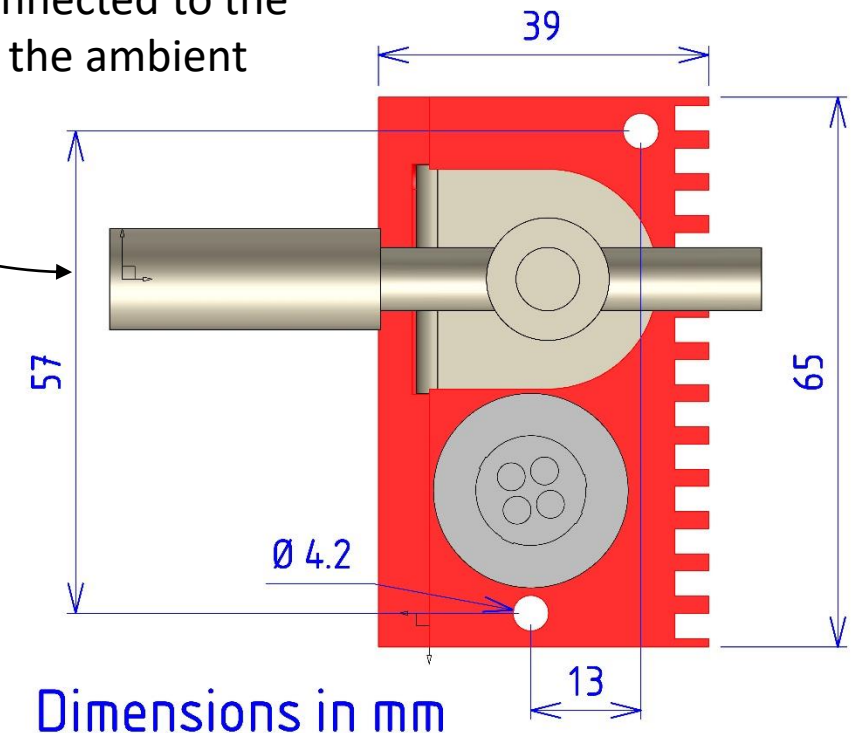
To ECU





Installing the boost controller

1. Install the boost controller on a place clear of heat (max 65°C/150°F) and at least 100mm from the ignition coils (no need to use silent blocks). Two holes are provided in the boost controller housing to fix it with M4 bolts
2. Preferred installation : firewall engine side
3. Connect the pneumatic hoses. If the boost controller is installed on the cockpit side (or in a pressurized cabin), make sure that the 'Ambient pressure port' is connected to the ambient air. If necessary, remove the pre mounted filter and connect to the ambient pressure (eg static port).
4. Connect the boost controller (electrical) with the ECU
5. Supply voltage (+12V and ground) to the boost controller





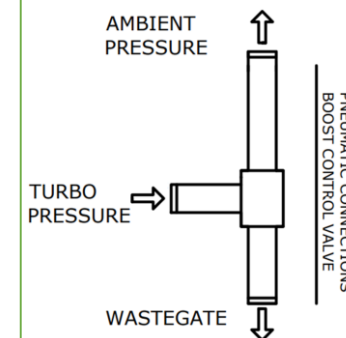
Installing the boost controller



Pneumatic connections ([click here](#))

3 Ports :

1. From turbo pressure (at throttle)
2. To wastegate (controlled pressure).
3. Venting port (filter installed). **If the boost control is not located in ambient pressure area: a connection must be made between the boost controller and ambient air (for example the air filter).**



Electric connections ([click here](#))

Use the original ULPower high grade silicone hoses and electrical connections. Longer lengths of the hoses/wiring are available on request. Standard length is 1000 mm.

The boost control wiring contains 3 cables*:

- Cable 1 : +12 V (RED) and Ground
- Cable 2 : ECU A/B connection (grey heat shrink)
- Cable 3*: ECU A/B connection (grey heat shrink)

* Engines with serial number below 220101 may have only one ECU connector (grey heat shrink)



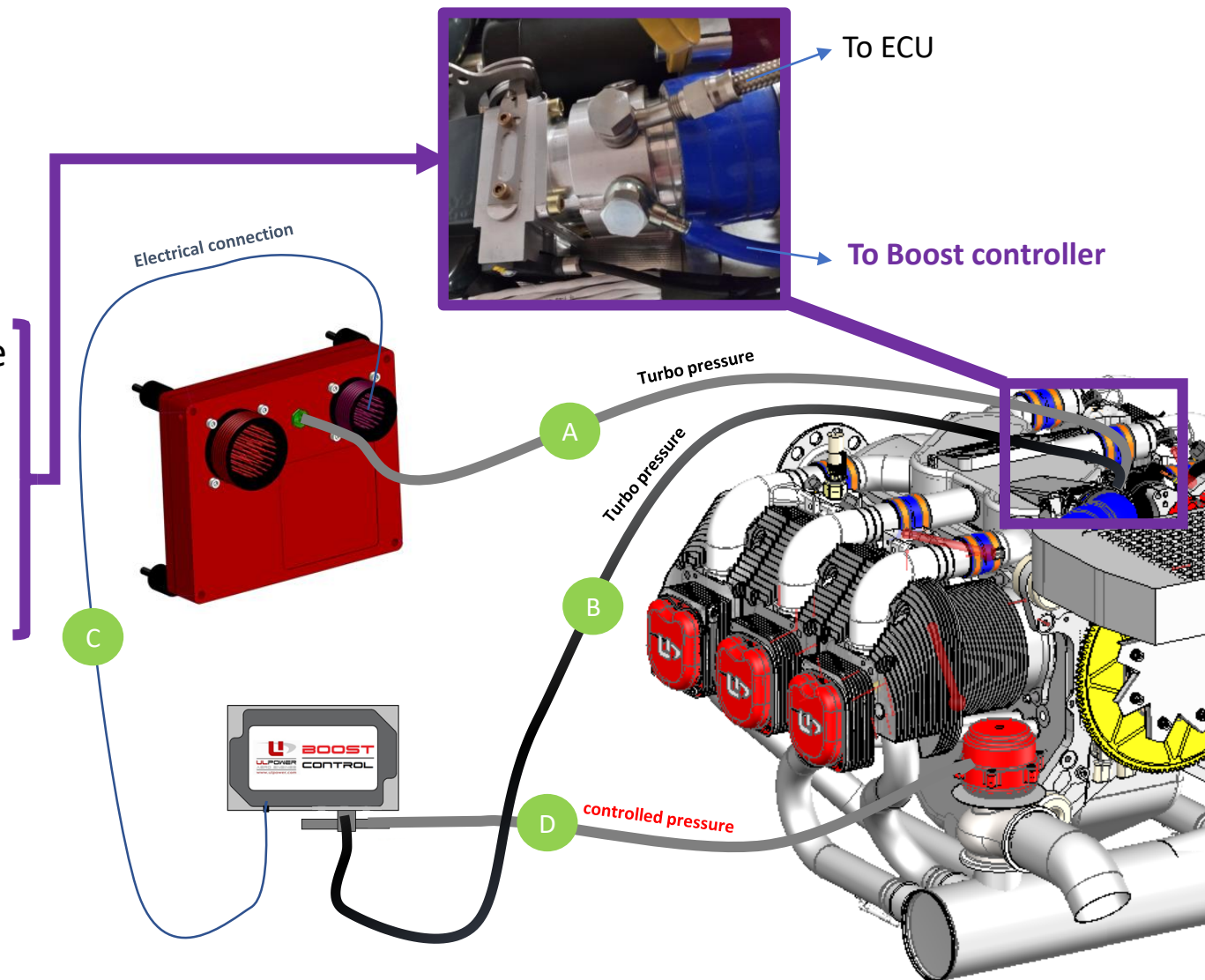


Installing the boost controller

The boost control valve must be installed close to the engine (e.g. on firewall), but away from heat and at least 10 cm away from the coils.

Boost controller

- A Connect the ECU turbo pressure sensor with the turbo pressure (stainless steel braided hose). [\[Click here\]](#)
- B Connect the reinforced silicone hose between the turbo pressure and the boost controller*
- C Connect the cable from the ECU with the boost controller [\[Click here\]](#)
- D Connect the reinforced silicone hose between the boost controller and wastegate*

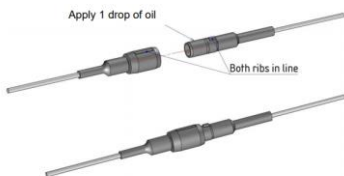


* Use reusable hose clamps on both ends. These are supplied with the engine.



Installing the ECU – Boost controller

The ECU controls the boost controller. Locate the cockpit wiring loom. Connect the grey heat shrink cable to one of the connectors (**doesn't matter which of the 2**) on the boost controller wiring.*



*Engines with serial number below 220101 may have only one ECU connector (grey heat shrink)

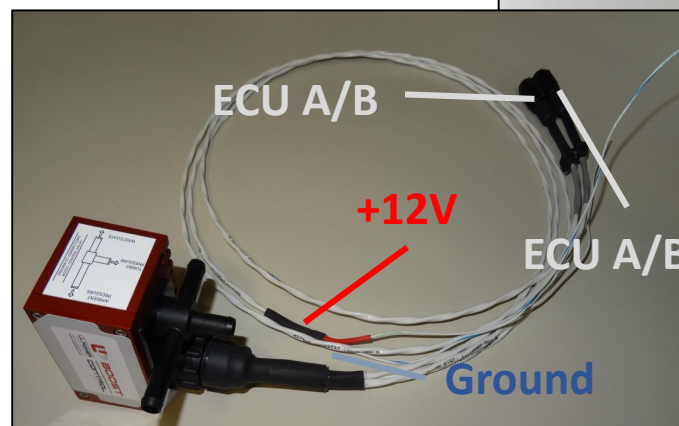
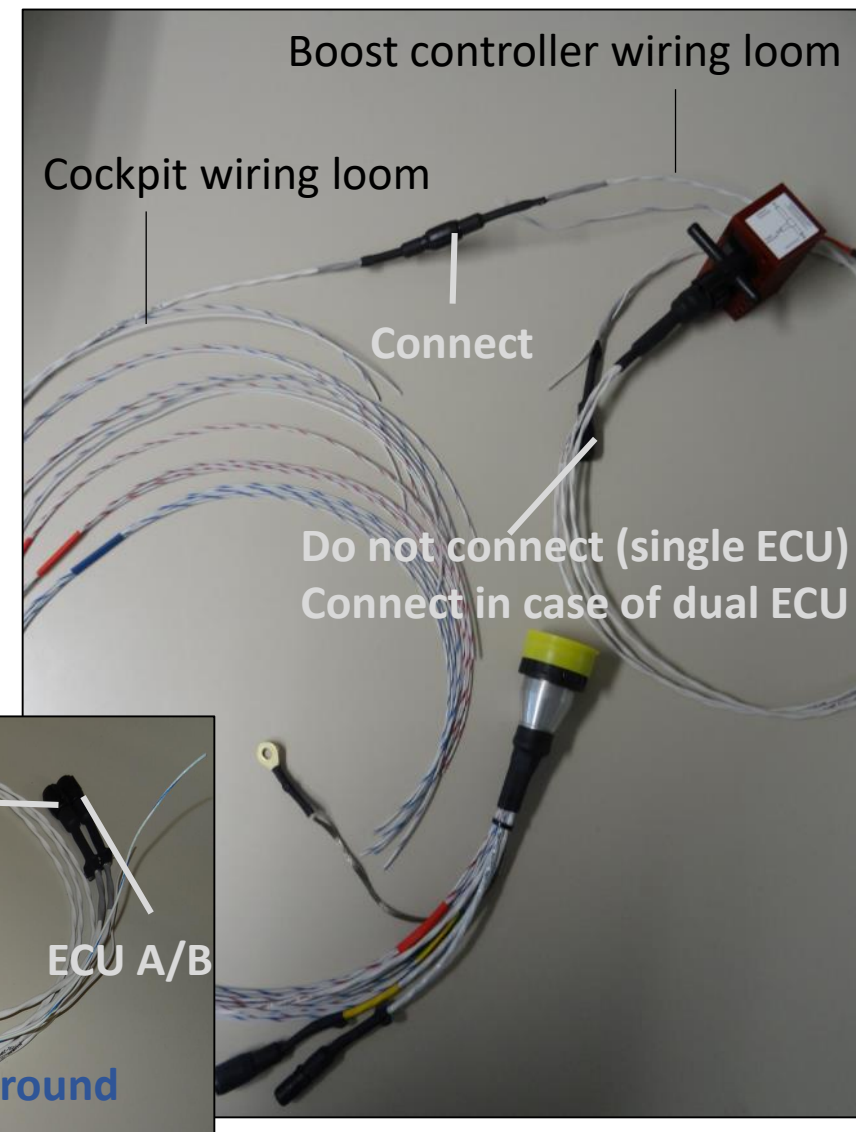
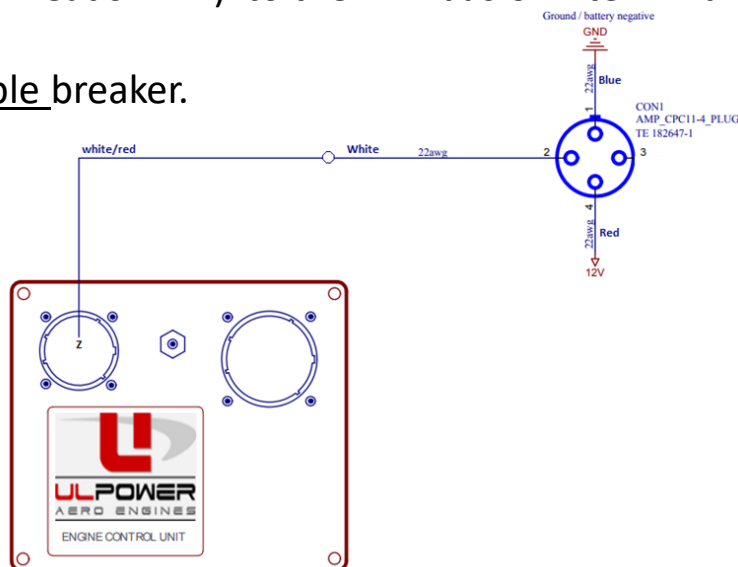
The boost controller must be powered independent

Use min. 22AWG wiring, depending on length wiring.

Route the blue wire to the airframe bus or battery minus.

Route the red wire (red heat shrink) to the 12V bus or + terminal battery.

Install a 1 amp resettable breaker.

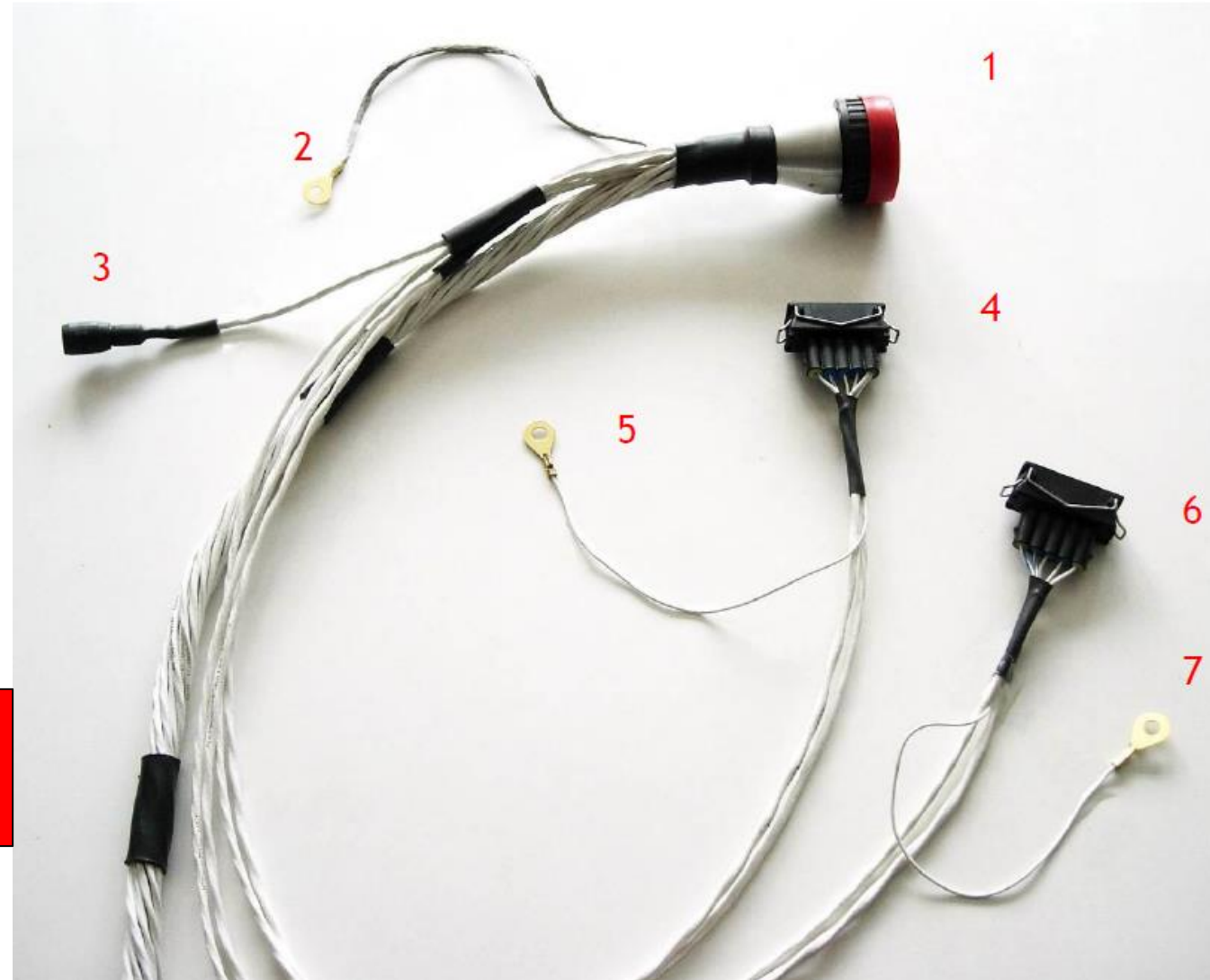




Installing the ECU – Engine Loom

The engine loom has the larger of the two connectors going to the ECU. Most of the wires are already connected to the engine sensors, coil triggers and injectors, however, you will need to route the loom through the firewall and also connect the coil connectors, earths and other connectors as required

1. Connect to ECU (thread on fully)
2. Ground for cable shielding – to airframe ground (green marker)
3. Connector for Aux box
4. Connector for coil 1 – must be securely connected
5. Ground for coil 1 - to airframe ground
6. Connector for coil 2 – must be securely connected
7. Ground for coil 2 - to airframe ground



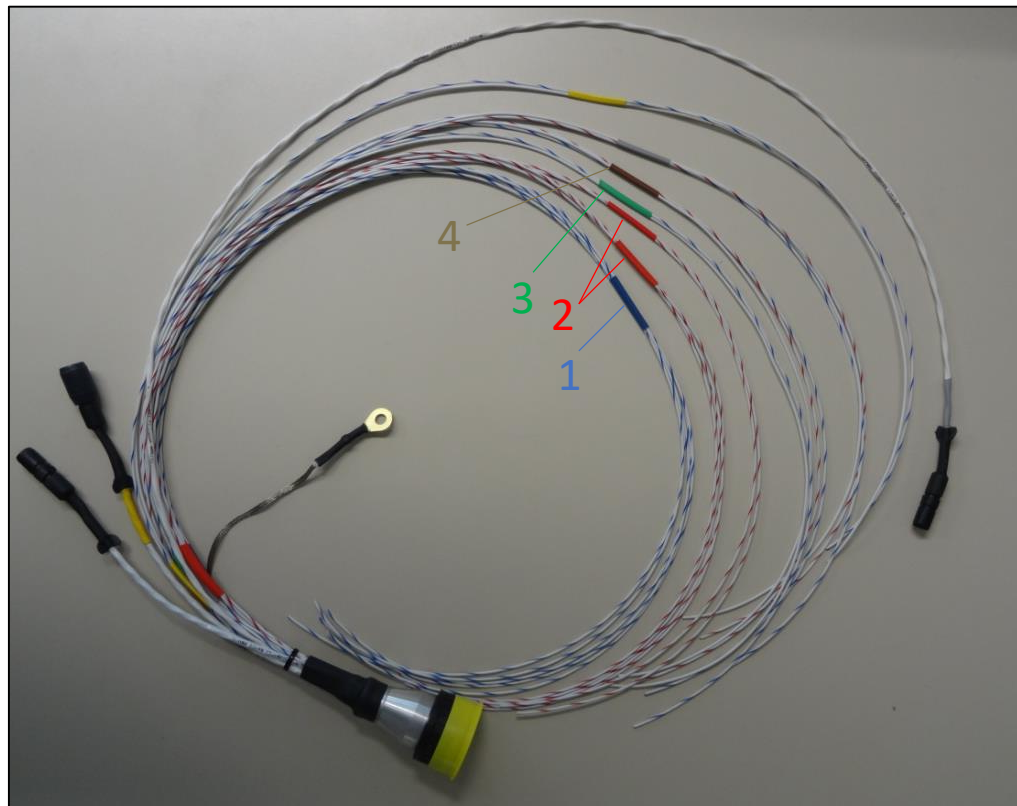
The standard engine loom is 1000 mm long. If you wish to install the ECU further than 900mm from the rear of the engine a longer wiring loom may be ordered.





Installing the single ECU – Cockpit loom

The wiring of the cockpit Loom is best done section by section, using colour coded wires on the pre-wired, factory tested loom.



1. **Blue shrink sleeve** = -ve wires for ECU: route all 5 wires together to the airframe bus or battery –ve terminal. You may crimp all together or use individual terminals, i.a.w. acceptable practices.

2. **Red shrink sleeves** (x2) = +ve wires for ECU: route all 6 wires together to a switch, You may crimp all together or use individual terminals, i.a.w. acceptable practices.

Install a 20A **resettable** breaker between the switch and the +ve bus or battery +ve terminal. Wire between switch and breaker and +ve point must be a minimum 14AWG (2.5mm²) of suitable wire i.a.w. acceptable practices.

3. **Green shrink sleeve** = FPCR (Fuel Pump Control Relay) trigger wires route to one or two FPCR as shown (see later)

4. **Brown shrink sleeve *** = Ignition coil grounding wires (the approximate equivalent of a mag switch)

white/blue wire and white wire to ignition switch coil 1

white/blue wire and white/red wire to ignition switch coil 2

Remember: CLOSED circuit = OFF for these wires. See more (see later)

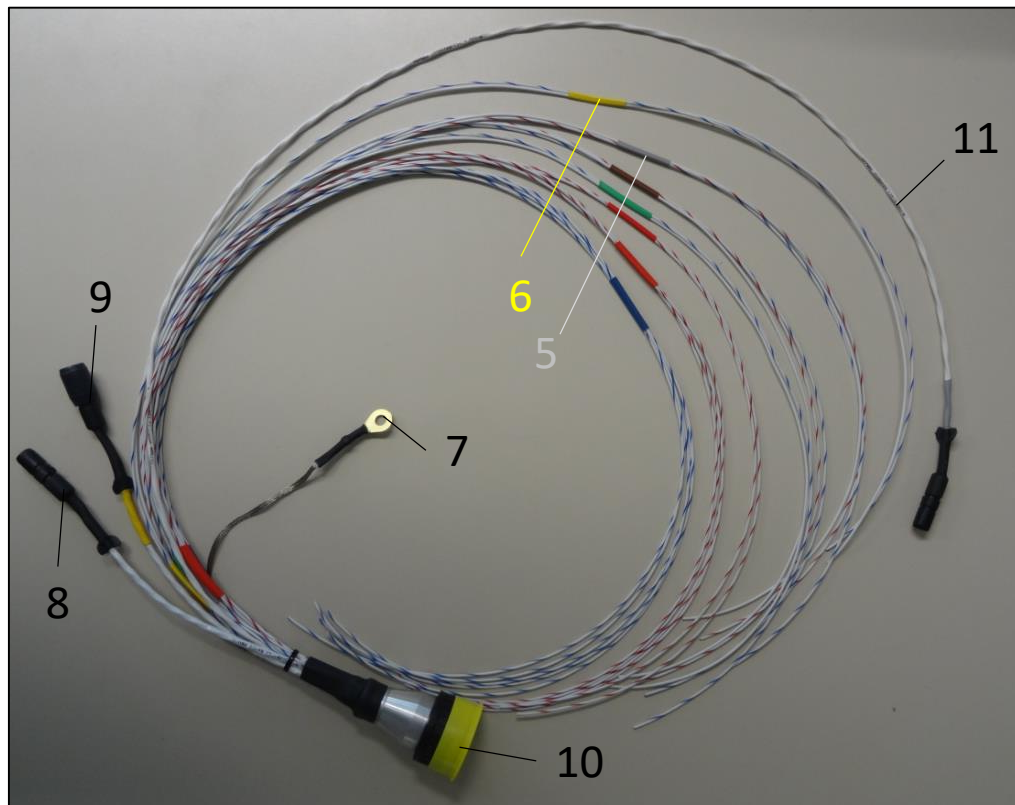
* For dual ECU systems click [HERE](#)

Continued on next page....





Installing the ECU – wiring Cockpit loom



5. Grey shrink sleeve = data lines – connection needed when not using an EFIS

white : RPM signal (2 pulses/ rev. 0 – 9V)

white/blue : Fuel consumption (Injector pulse). Output is a duty cycle
100% is equal to 72l/hr

white/red : fuel consumption (pulses/litre)

72l/hr = 170Hz

WHEN USING AN EFIS THESE DO NOT NEED TO BE CONNECTED - IF NOT USED THEY MUST BE BLIND TERMINATED/INSULATED.

6. Yellow shrink sleeve :

white/blue : -ve connection for warning signal in case of battery low (<12.7V)

white : -ve connection for engine check light : (see [later](#))

7. Ground for cable shielding (Run to airframe ground/-ve bus)

8. PC Connector for RS232 data transmission, UL Read (Male)

9. PC Connects for CANBUS data transmission (Female) (**yellow** heat shrink marker on cable)

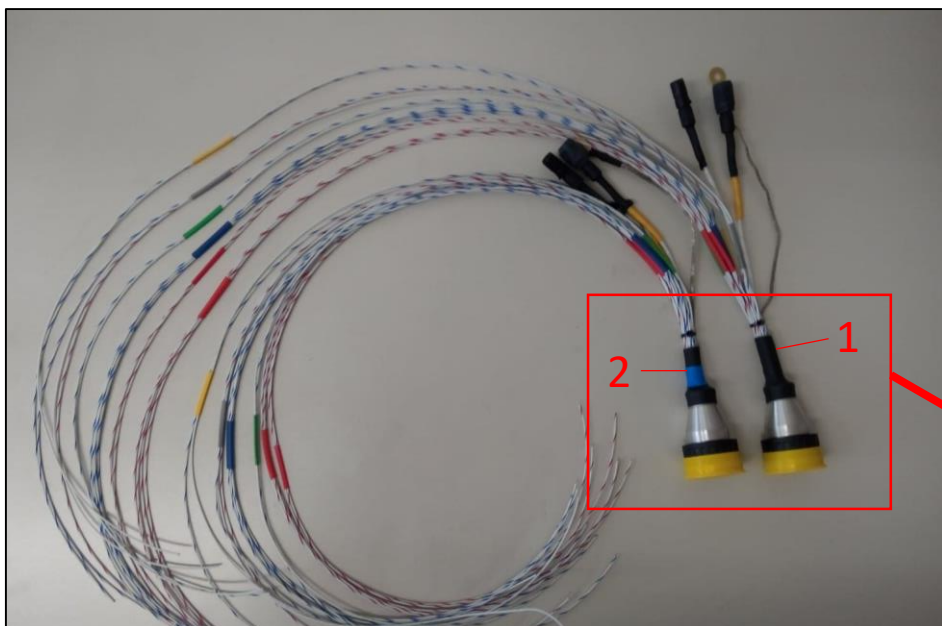
10. ECU Connector

11. Boost controller connection (**grey** heat shrink marker on cable)





Installing the dual ECU – Cockpit loom



When using 2 ECU's, there are 2 different cockpit wiring looms :

1. Black heat shrink = ECU A
2. Blue heat shrink = ECU B



The only difference between these 2 wiring looms is internal in the ECU connector, **so both wiring looms must be connected the same way.**

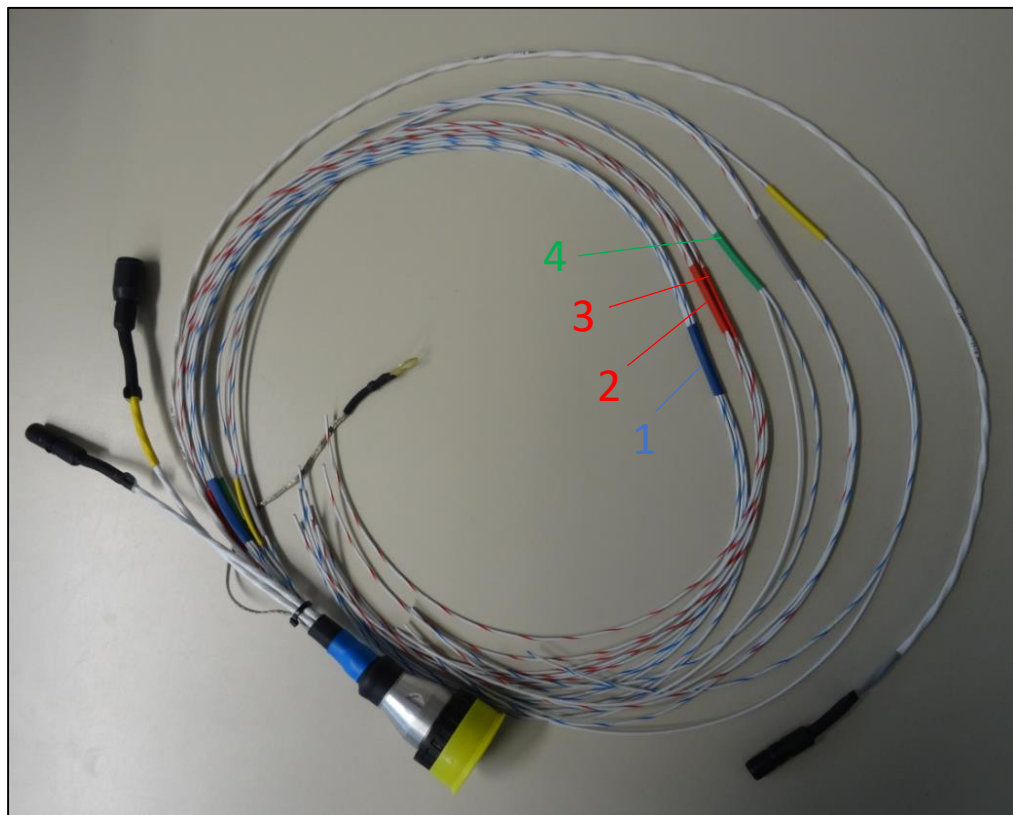
It does not matter which ECU you connect to wiring loom ECU A (1: black heat shrink) or wiring loom ECU B (2: blue heat shrink). The reason for using two different wiring looms is that the EFIS can recognize ECU A and B (the wiring loom determines this).

Tip : Once the connection is made, mark on the ECU which is A and which is B.



Installing the dual ECU – Cockpit loom

The wiring of the cockpit loom is best done section by section, using colour coded wires on the pre-wired, factory tested loom.



1. **Blue shrink sleeve** = -ve wires for ECU: route all 5 wires together to the airframe bus or battery -ve terminal. You may crimp all together or use individual terminals, i.a.w. acceptable practices.

2. **Red shrink sleeves** = +ve wires for ECU: route 4 wires together to a switch, You may crimp all together or use individual terminals, i.a.w. acceptable practices.

Install a 20A breaker between the switch and the +ve bus or battery +ve terminal. Wire between switch and breaker and +ve point must be a minimum 14AWG (2.5mm²) of suitable wire i.a.w. acceptable practices.

3. **Red shrink sleeve** = +ve wires for injection : route 2 wires together to battery + terminal

**Do not connect 2 en 3 together to the same +12V !
Use separate switches!**

4. **Green shrink sleeve** = FPCR (Fuel Pump Control Relay) trigger wires route to one or two FPCR as shown (see later)

Continued on previous page....click [HERE](#)



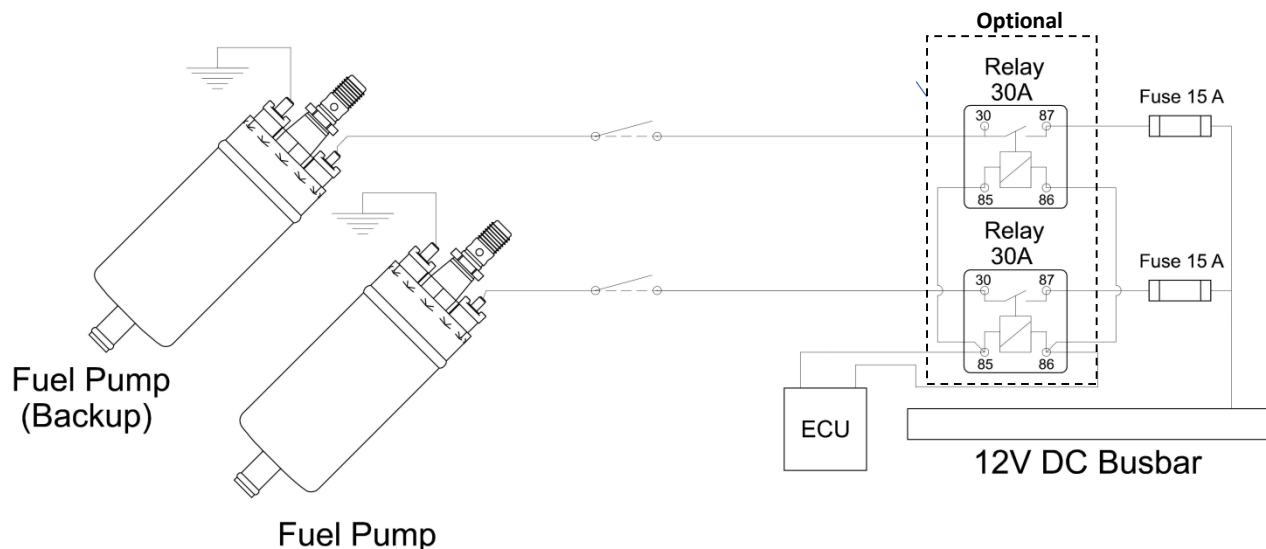
Installing the ECU – wiring the FPCR



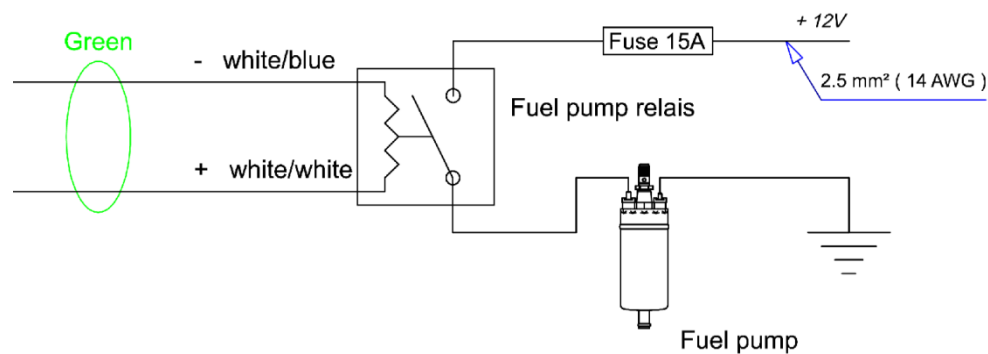
3. **Green shrink sleeve** = FPCR (Fuel Pump Control Relay) trigger wires route to one or two optional FPCR units as shown here

The Green shrink sleeve contains two wires which are used to trigger the FPCR (Fuel Pump Control Relay). Connect one wire to position '85' on the FPCR and the other to '86' on the relay.

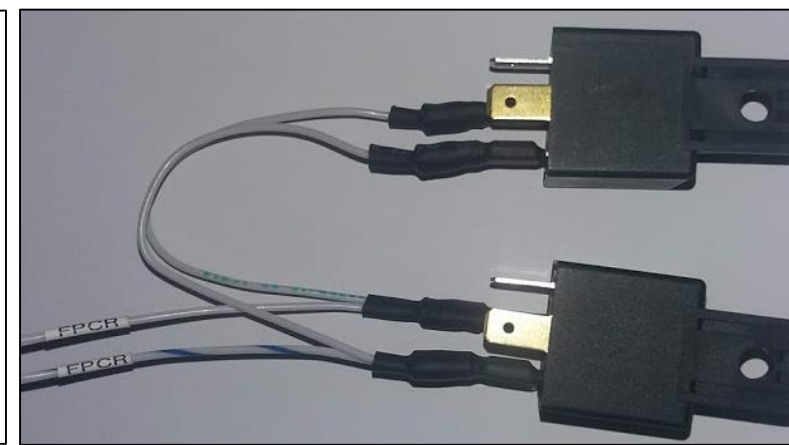
Run a wire from '87' to the 12V bus via a 15A breaker/fuse. Run a wire from '30' to the switch and then to the fuel pump positive connection.



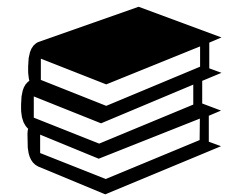
Wire the fuel pump –ve connection to airframe ground



Use one FPCR per pump. 'Cascade' the wires from the ECU to '85' and '86' on each relay as shown right.



You may install one or two fuel pumps, with or without FPCR but may only operate BOTH pumps at once for a maximum of 15 - 20 minutes (for example during take off/landing or during fuel tank selection)



Installing the ECU – wiring the FPCR

If installed correctly, when the engine is running the ECU will latch the FPCR to enable fuel pump(s) operation. In the event of the engine stopping, the ECU will 'un-latch' the FPCR's and stop the fuel pumps operations (after 15 seconds). This is a safety device.

When first powered the ECU will latch the fuel pump for around fifteen seconds to pressurise the fuel system and check the relay operation, whilst waiting for the engine to 'run'. In the event that the engine has not been started, the FPCR is then un-latched to prevent unnecessary power drain, until the crankshaft starts to turn – from the starter being activated. If the engine starts within the 15 seconds, the pumps run continuously.

This system ensures the pumps do not drain the battery unnecessarily and is a way to check to that the FPCR emergency cut-off is functional too.

There are several wiring solutions that may be used (in combination from the following), depending on local approvals :

1. Wire the pump(s) INDEPENDENTLY of the ECU, noting that the ECU cannot shut the pumps off without the FPCR installed.
2. Wire BOTH pumps via TWO ECU triggered FPCRs
3. Wire one pump via the ECU triggered FPCR and, if required, one pump independently
4. Wire pumps so that ONLY one pump can be on at a time using a DPDT (Dual Pole Dual Throw) switch that switches from one to the other without the option of both pumps at once.
5. You may install an 'over-ride' switch to bypass the FPCR if required, in accordance with standard practice methodologies.





Installing the ECU – wiring the Coil Switches

4. **Brown shrink sleeve*** contains the Ignition coil grounding wires (the approximate equivalent of a mag switch). There is a 'common' grounding wire which is blue/white and then the two Ignition switch wires.

Use a good quality , SPST (single pole, Single Throw) switches and wire the white/ blue 'common grounding wire' wire to a terminal on both switches (you will need to create a suitable connection).

-
Then, connect the white wire to the other terminal on 'Ignition Switch 1' and
The white/red wire to the other terminal on 'Ignition switch 2'.

* For dual ECU systems there are no brown shrink sleeve wires



Brown

white/white (ign. 1)

white/blue (common)

white/red (ign. 2)

Ignition 1 (On/Off)

Ignition 2 (On/Off)

(Open contact = on)



It is important to note that IGNITION switches are actually 'ON' only when the circuit is OPEN. When the circuit is 'closed' the Ignition coils are 'grounded' and the engine will stop – exactly the same as a magneto switch.

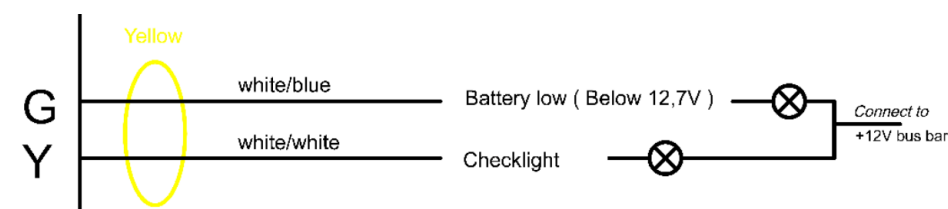


Installing the ECU – wiring Warning Lights

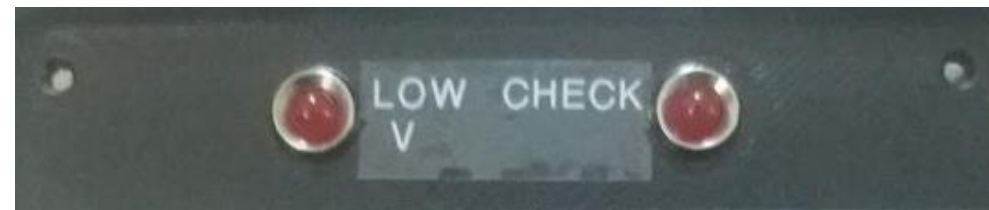
The ECU provides output for two standard warning lights. These can be incandescent lamps or a 12V LED panel mount indicator. Convention is that warning lights are red.

6. Yellow shrink sleeve :

- white/blue : to the negative side of the lamp/LED (max 2w) in use: illuminates in case of battery low (<12.7V) as sensed at the ECU
- white : to the negative side of the lamp/LED (max 2W) in use: illuminates in the case of a sensor error on the engine and is often referred to as the Engine Check or simply Check Light
- Bring a positive wire to the other side of the warning lamp/LED with a 1Amp fuse or breaker in line.



These lights will illuminate for a few seconds on start up of the ECU. In some cases you may choose to wire these signals into your EFIS system as a digital signal for an on screen warning. Refer to your EFIS installation manual for more details.



There are many different lamp solutions available commercially, both incandescent and LED based.
WARNING: It is recommend to use a 12V LED which usually have an integrated resistor (circa 400 ohm)



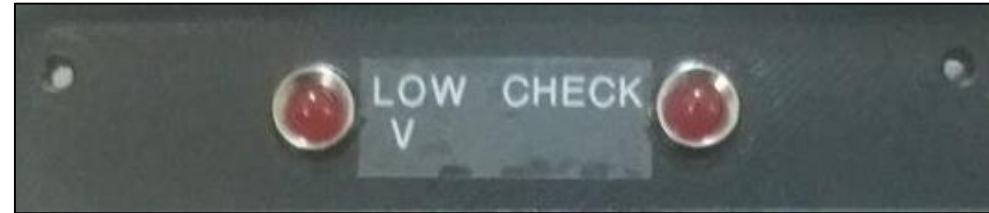
Installing the ECU – wiring Warning Lights

When the battery voltage at the ECU and the engine is running correctly, the lights are off.

If the voltage at the ECU drops below 12.7 volts, the LOW VOLTS LED will come on. It will disappear again when 13V is reached.

When there is a problem with one of the following sensors, the CHECK light will come on

- Oil temperature sensor
- Inlet air temperature sensor
- Throttle position sensor
- Altitude sensor (Integrated in ECU)
- Hall sensor engine start (Sync/CPS)



In the event of the check light coming on due to a sensor failure the engine will continue to run – however, it may not be running optimally due to the use of default values in the ECU-map. Resolve the issue before next flight.

If the check light flashes, the overboost limiter is activated. The power output of the engine is strongly reduced. Reducing the throttle will deactivate the overboost limiter. Important to land as soon as possible.

If the check light is (steady) on AND the indicated boost pressure (on instruments) equals ambient pressure, then the engine power output will be slightly reduced (10-20%) and the fuel burn might increase. Continue the flight and resolve the issue before next flight.

This indicates that the ECU is not measuring the correct pressure, see troubleshooting manual





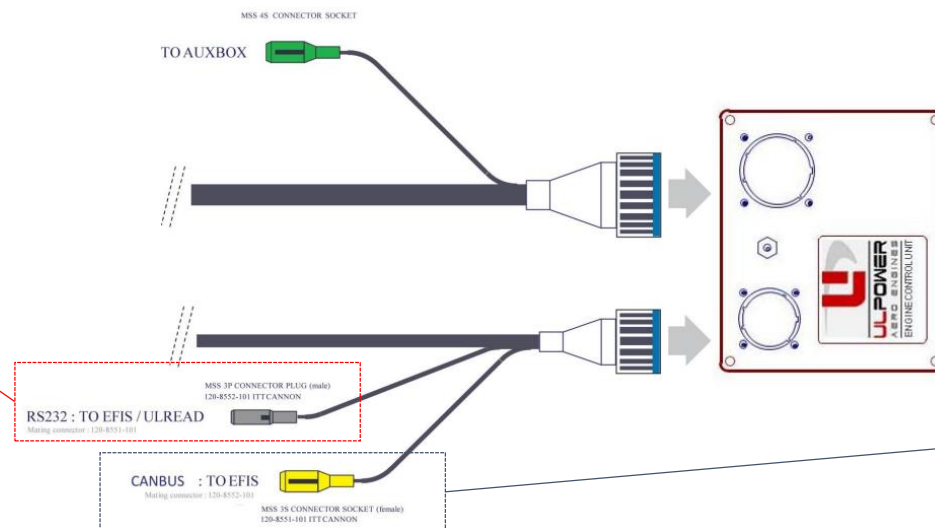
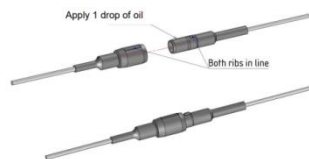
Installing the ECU – RS232/Canbus

ULPower engines have a number of [factory installed sensors](#). The ECU transfers data from these sensors per RS232 and Canbus (for engines with a serial number above 173301. Below that serial number data are transferred by RS2332 only). This [data output](#) can be displayed on your EFIS (verify compatibility with supplier) by using 1 single cable.

RS232/ULRead

An RS232-EFIS cable (l=1m) is available. (E080305)

This output is also used for the [ULRead](#) diagnostic software (optional E080511 ULRead cable)

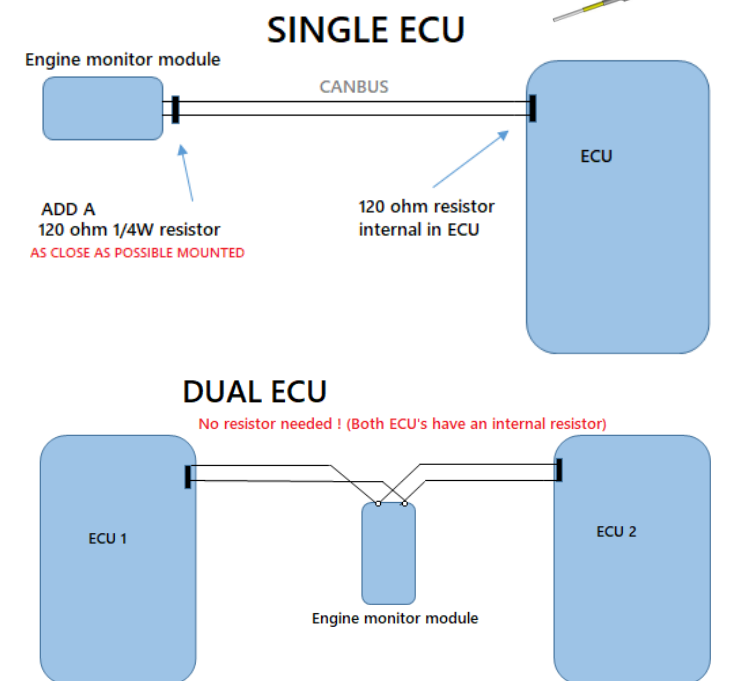


For canbus compatibility, most avionics systems require a 120ohm resistor . The ULP ECU already has a built-in resistor

ULPower RS232 and Canbus protocol available on request

Canbus

A CANBUS-EFIS cable (l=1m) is available. (E080303)

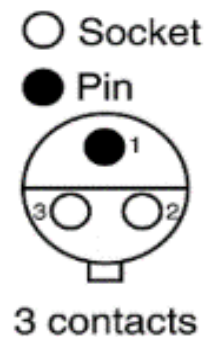




Installing the ECU – RS232/Canbus

RS232 connection (MALE)

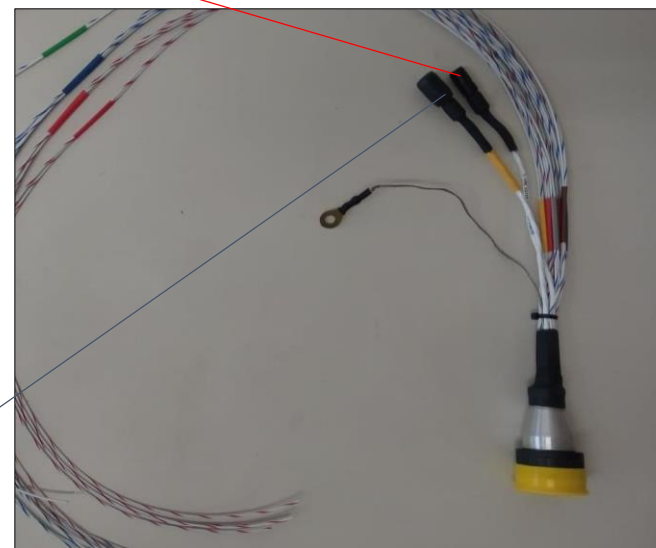
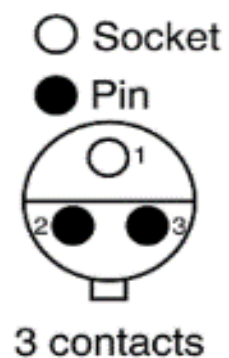
Eng data RX232*	2 female
Eng data TX232	3 female
Eng data common	1 male



*Do not connect RX (pin 2), the ECU is only sending data !

Canbus connection (FEMALE)

CAN H	3 male
Common -	1 female
CAN L	2 male



Electrical Overview...

The electrical system for the ULPower engines is straightforward and aimed at easy installation with reliable operations.... However, there are a few things to watch...


- Read the full electrical section before starting installation...
- Use appropriate wire gauge
- Check regulator correctly connected
- Make sure engine is suitably grounded
- Install a suitable starter button
- Ensure suitable Ah on battery
- Install the capacitor for protection
- Install a suitable fuse/breaker for the Engine side of the installation
- Install a suitably sized fuse for the aircraft side of the installation, taking into account your total power requirements and availability.


On some installations the starter button is powered from the airframe side to inhibit accidental starting without the master relay activated.

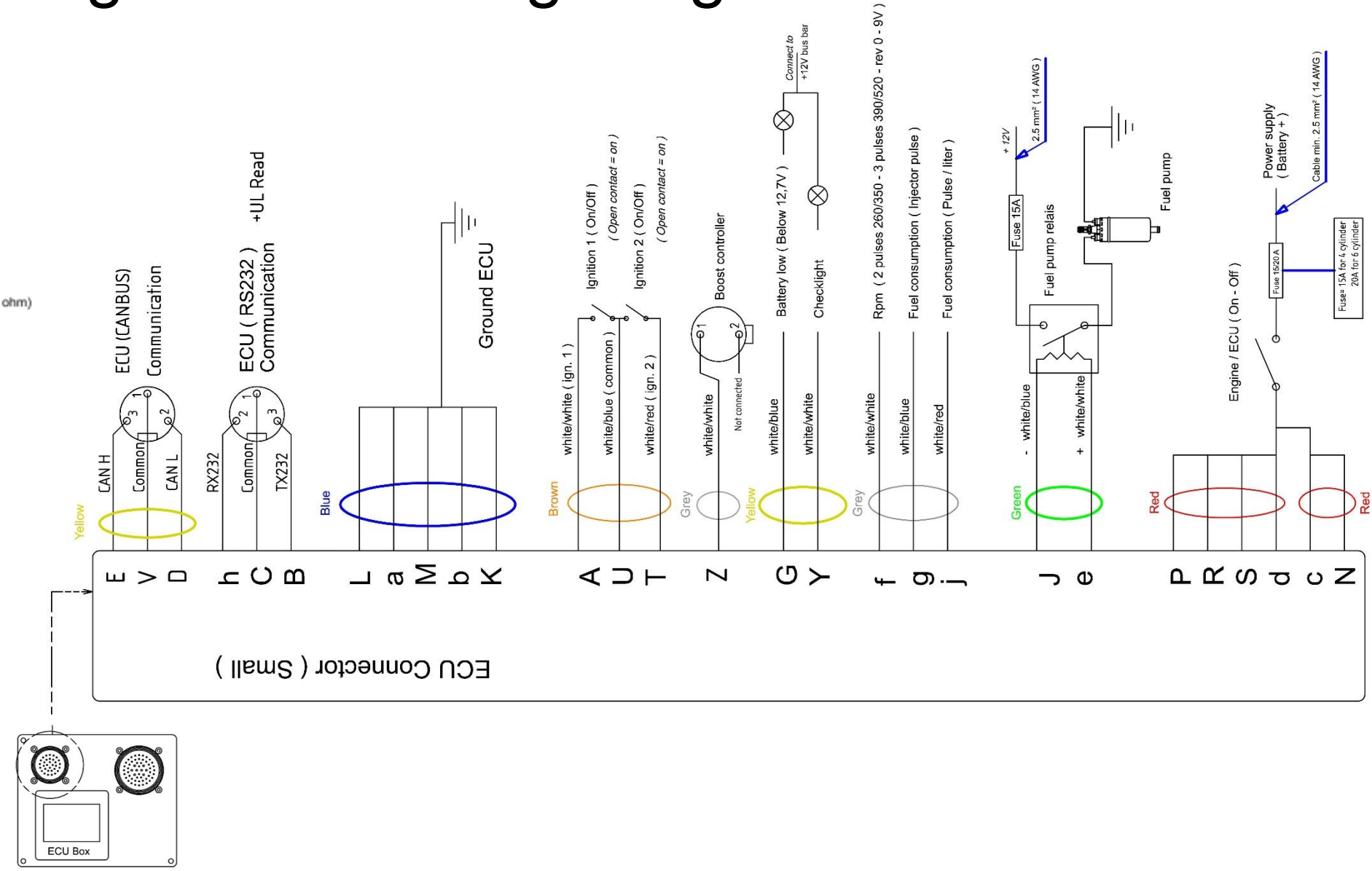


Single ECU Wiring Diagram

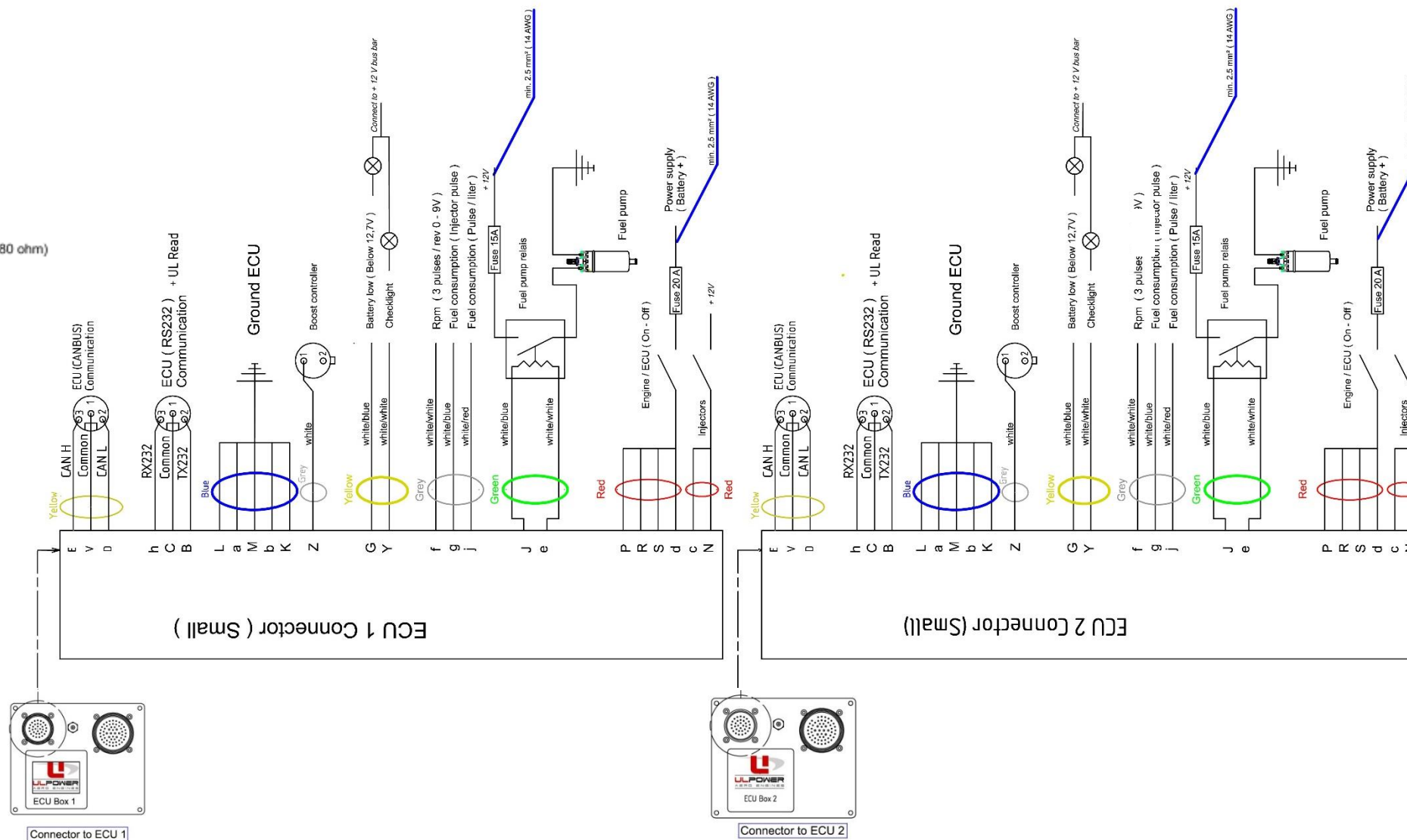


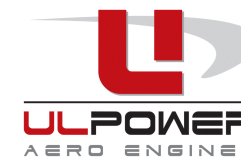
 = Shrink sleeve around the wires

 = Led (Max 2 W / 680 ohm)

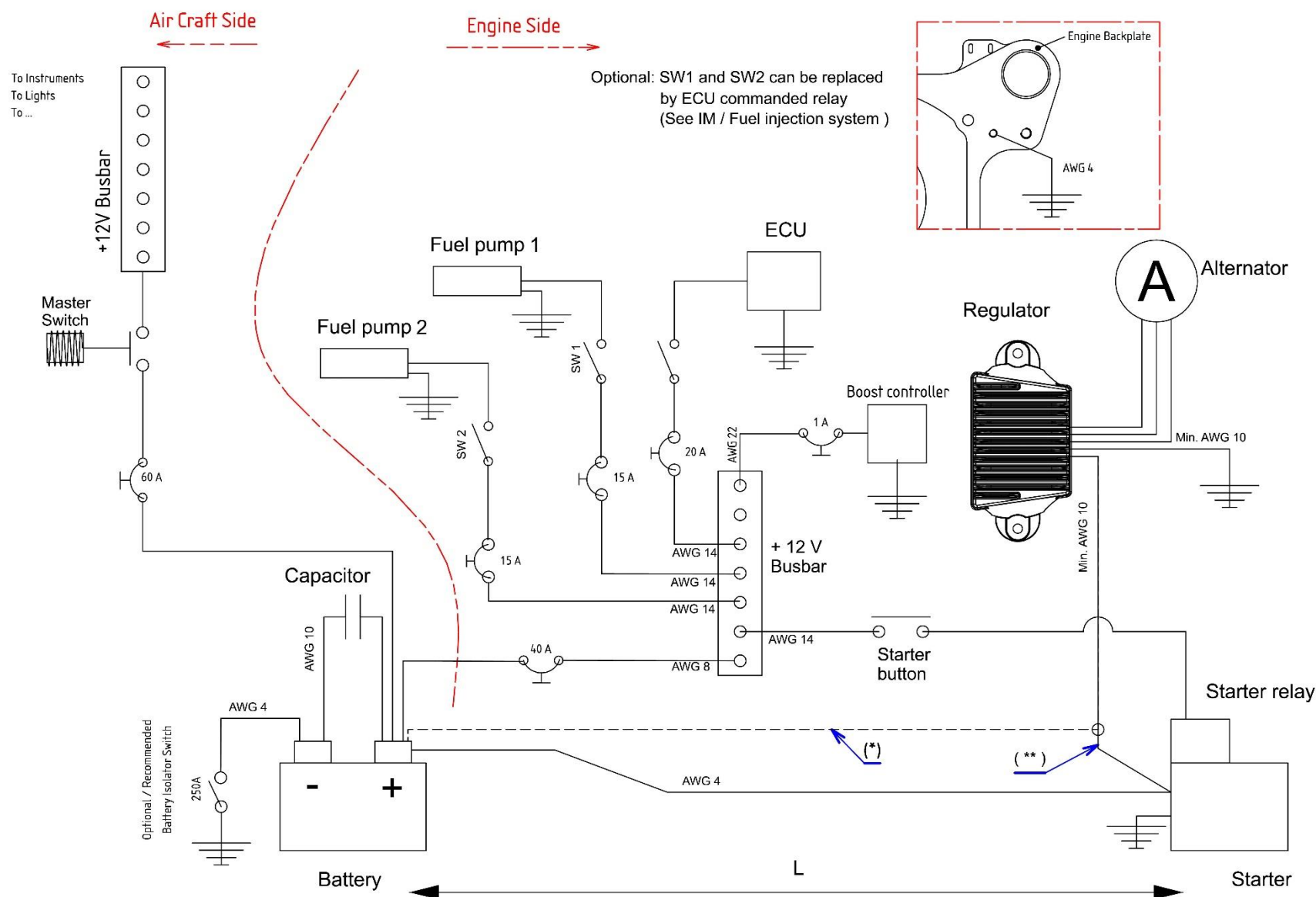


Dual ECU Wiring Diagram





Electrical Overview: sample installation diagram



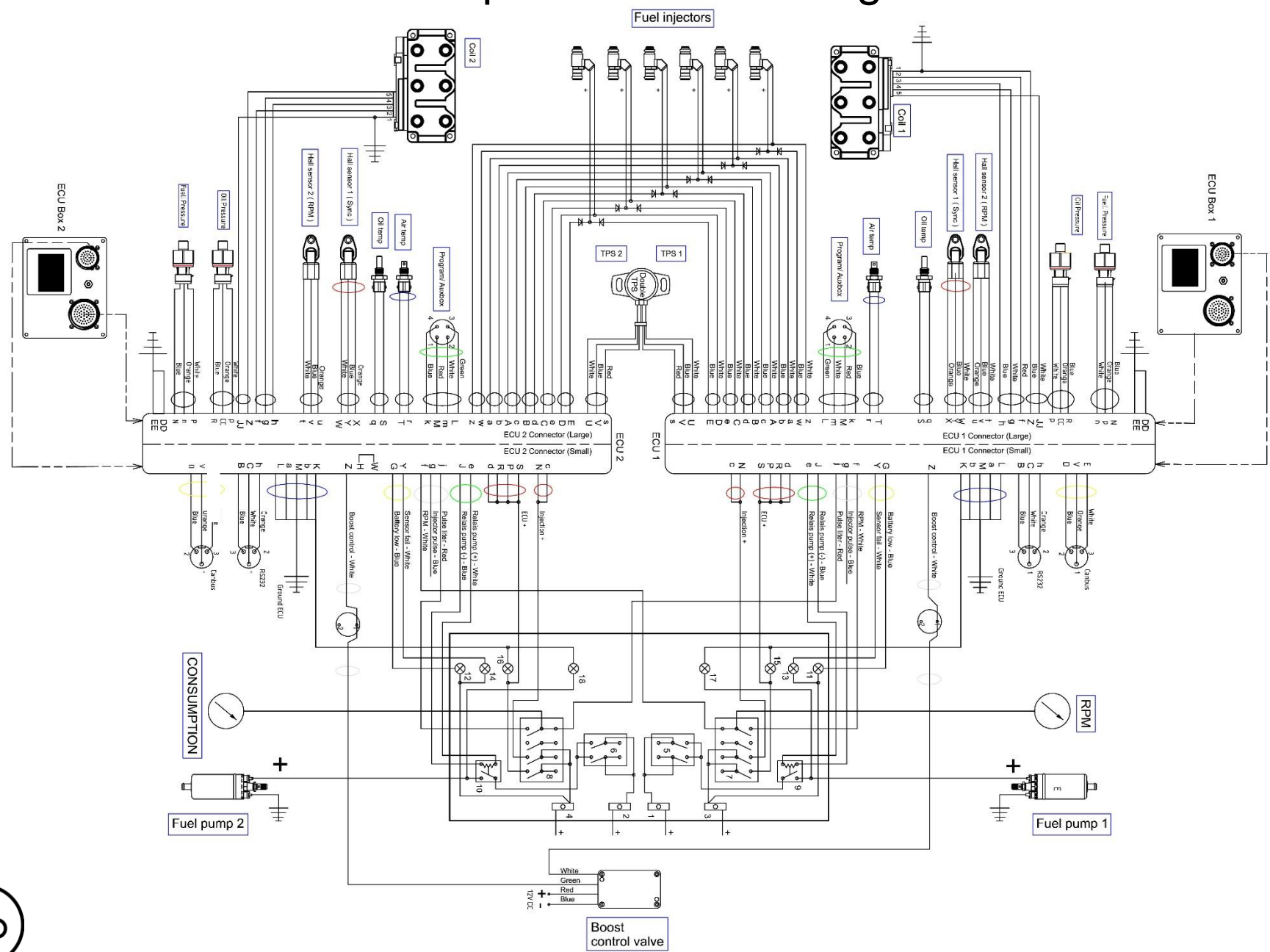
(*) : Engine close to battery ($L < 1$ meter)
Connect regulator + output directly to battery

(**): Engine far away from battery (for example battery in the back of the plane ($L > 1$ meter))
Connect regulator "+" output to the starter





Electrical Overview: sample installation diagram dual ECU



ECU Specification



The ULPower development team have over 17 years trouble free experience with this ECU architecture.

The FADEC ECU ensures easy start and optimal fuel burn without the need for choke, primer, carb heat or mixture controls. The only control required is a throttle cable !

The ULPower ECU is encased in a compact, aluminium body ECU, is RTCA/DO 160G compliant and features high-quality MIL-DTL-38999 connectors. The ECU is electrically robust, allowing it to share a common electrical system with the airframe. Although, recommended to be installed behind the firewall, it may, where necessary, be fitted FWF (ensure temps <65°C). The ECU connectors are rated for up to 500 mating cycles. We do not recommend removing the ECU Engine and Cockpit loom connectors once the engine is commissioned, unless required for a software update.

The ECU map will use default values for oil temp, air temp, etc in the event of a sensor failure, and keep the engine running, although less efficiently than with actual values. Consequently, fuel burn MAY increase in such an event. The ECU does NOT raise signal warnings for values outside of ranges – that should be managed by your EFIS system.



Dual ECU Installation



For those who require additional redundancy for their missions, ULPower offers a genuine dual ECU option, with discrete ECUs, duplicated looms and sensors.

Each can take over complete control retaining optimum ecu-map operations

When choosing the dual ECU option, each ECU is linked to one fuel pump and one ignition coil.

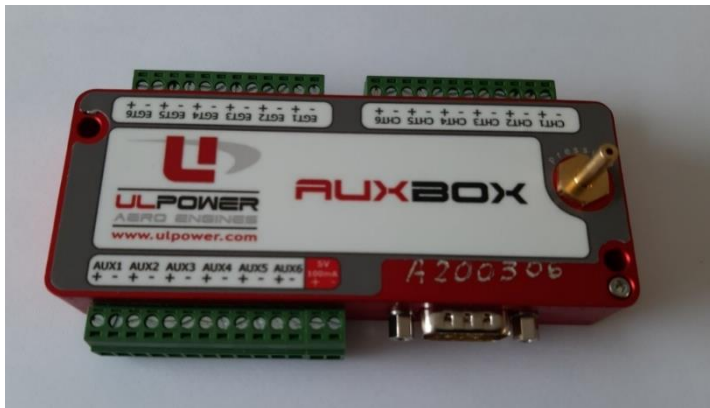
ASTM F2339 engines are standard provided with a dual ECU system.

READ MORE @  **ULPOWER** **NEWS**



Aux Box integration to the ECU

The turbo engine is standard equipped with an AUX BOX.



EGT,CHT sensors and ambient pressure sensor connection parts can be supplied additionally. In addition there are 6 AUX 0-5V channels available for customized read out. Contact your ULP dealer for more info or [click here](#)

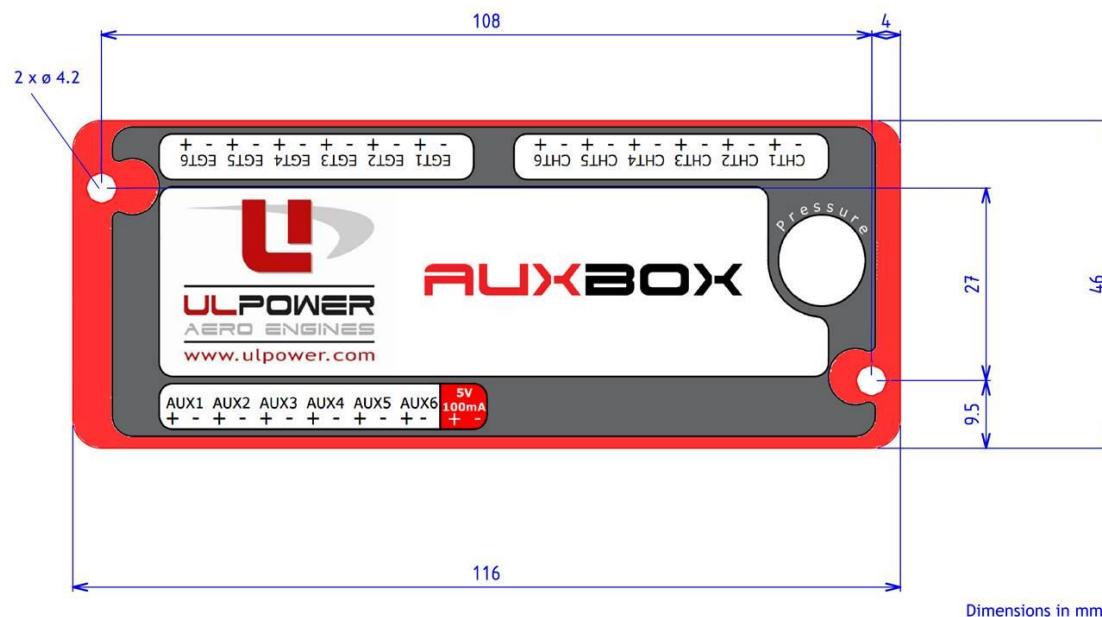
**MEASURE THE AMBIENT AIR PRESSURE WITH THE AUXBOX (connect to static system or near the air filter)
DO NOT CONNECT THE AUXBOX PRESSURE SENSOR TO THE MANIFOLD PRESSURE !!**

Aux Box mounting

Mount the auxiliary box in a location free from vibration and heat (same conditions as for instruments/ECU). There are two holes provided in the aux box for mounting

The data from the AUXBOX (Ambient air pressure, 6 x CHT and 6 X EGT – if the EGT/CHT are installed - and 6 Auxiliary inputs) can be monitored via Canbus or RS232 on your EFIS.

Please contact your EMS supplier to verify that the EMS is fully compatible with the AUXBOX.





Aux Box inputs

1. (Ambient air) Pressure sensor

- Route a small air hose from the brass air pressure sensor to a suitable location (e.g. near the air filter or into the static system – depending on installation.)
- The ambient air pressure is (temporarily) stored in the internal memory of the ECU and is displayed with the ULRead diagnostic software

2. EGT and CHT

- Up to 6 EGT and 6 CHT inputs available
- EGT and CHT sensor kit available from ULPower



ULPower thermocouple extension
type : ANSI

3. AUX Inputs / 5V 100mA

- The AUX sensor input voltage is 0-5 V
- A 5V 100mA power supply is provided on the AUXBOX
- On the right side an example of a typical installation



Connect to static
system / Ambient air

The ground (-) is not connected internally. Use a cable bridge.

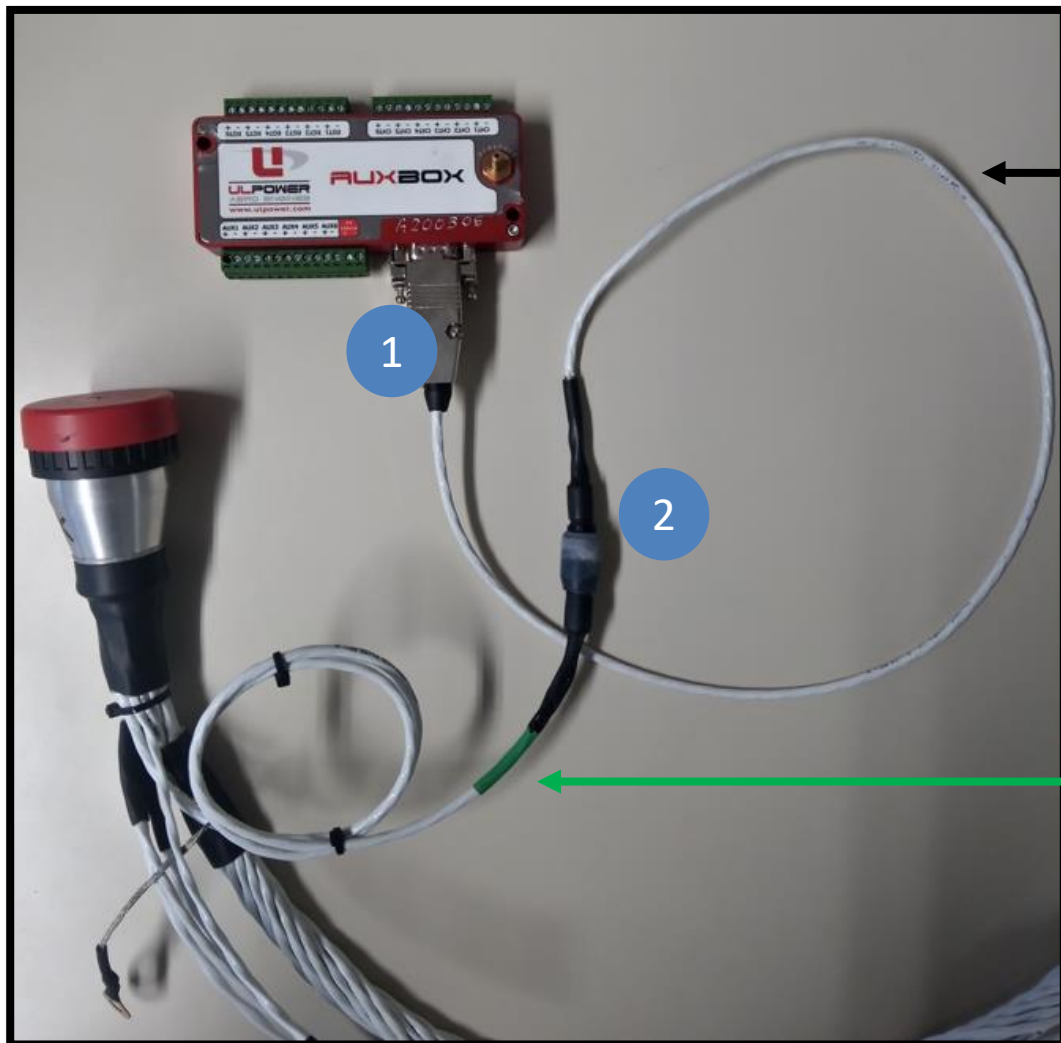
Sensor signal

Temperature sensor



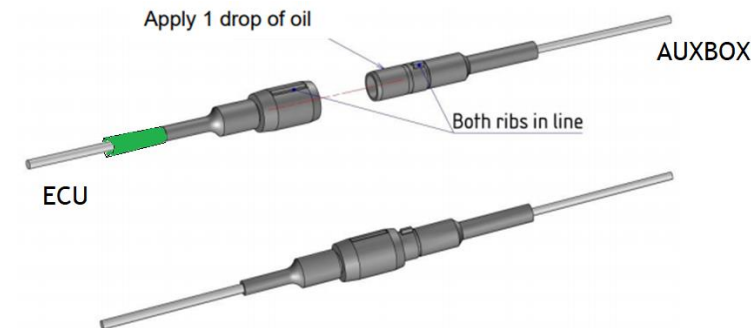


Aux Box connection to the ECU



The auxbox is supplied with a connection cable.

Connect this cable to the AUXBOX **1** (DB9 side) and connect the other end of this cable* **2** (sure seal) to the sureseal connector of the engine wiring loom (large ECU connector) which has a **green heat shrink**



* In case of a dual ECU setup : The AUXBOX connection cable has 2 sureseal connectors, connect one to ECU A and the other to ECU B.

Electrical Systems

GUIDELINES: Before you begin installing your electrical system, here are some guidelines on standards and quality of parts required:

Wire: Always use a good quality wire for your installation. Generally, Aircraft hook-up wire has a low smoke sleeving and is more resistant to heat and 'installation twists n turns' than other wires. We strongly recommend using appropriate aircraft approved wiring in your installation. This manual specifies various wire gauges (cross sectional area of wire), however, where wire runs get longer you may need to increase the wire gauge/section to ensure trouble free operations. Remember, as wires get longer they consume more current themselves, and then they get warm – for reference, the resistance of copper increases by approximately 25 % between 20°C and 85°C (68°F and 185°F) – this may result in operational issues over time on installations with limit or undersized wire sections.

Connectors/terminals/BUSBARS: These must be of a type that does not 'shake loose' with vibration and capable of carrying the load of all the circuits connected to it

EXAMPLE: the starter relay requires a minimum of at least 25mm² (4 AWG) to and from the airframe power plus a 'trigger wire' from the starter button of at least 2.5mm² (14AWG). Much as the engine will start with SMALLER wire sections when the engine is cold, once it get warm in the engine compartment the WIRE itself will consume some of the electrical energy needed to start the engine – and hence hot starting may be difficult – simply due to undersized wiring.

Ideally you should calculate your wire length and section to meet electrical current needs and add a safety margin for every circuit.

Standard wiring practice, as may be applicable, is covered in FAA Maintenance Technician Handbook ([FAA-H-8083-30](#)), Aircraft Wiring and Bonding ([AC 21-99](#)) and Acceptable Methods, Techniques and Practices – Aircraft inspection and Repair ([AC 43.13](#)).



Electrical Systems

There are several ways to monitor your electrical system's robustness and health.

Battery Voltage:

Monitoring the battery voltage will indicate a) if you have sufficient charge to start the engine (more than 12.8 V normally) and b) once the engine is running, it will indicate if the alternator and/or rectifier/regulator is working properly. If the battery is charging, the voltage should be above 14 V. If you are consuming more power than the alternator can deliver or in the rare event the alternator or regulator/rectifier has failed, the battery voltage will drop. If in flight the voltage drops below 12.7 V you should land as soon as possible. (if your battery is fully charged, and you have regulator/alternator failure, you will still be able to fly 45 minutes) In the event of a low voltage situation developing, it is generally good practice to switch off unnecessary electronics and restrict radio transmissions to preserve battery life (check the procedure in your aircraft POH (Pilot Operating Handbook) as applicable).

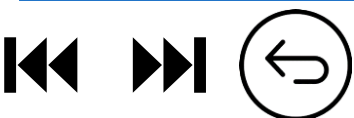
ECU Voltage:

The ECU Low Voltage warning light will only come on when the voltage **at the ECU** has dropped below 12.7 V. The voltage at the ECU MAY vary from the voltage on the main bus, depending on your electrical installation. Adding a voltmeter (or wiring to a port on your EFIS) in parallel to the ECU supply may provide an additional health check in some installations. If the voltage drops below 10 V, the ECU will no longer function, and the engine will stop.

Electrical Current (amps):

An amp meter can also be installed to precisely measure the amount of electrical current the alternator is delivering – the higher the amperage the more electricity is being consumed. There is a limited amount from your alternator (15, 30 or 50 amps depending on your configuration) and you must not exceed that amount. Likewise, in the event of an alternator failure, reducing the current draw will extend battery life.

[Click here to see the alternator performance.](#)



Electrical Systems



Before you begin installing your electrical system, here are some guidelines on standards and quality of parts required:

SWITCHES: all switches should be of a good quality, robust and suitable for at least 15V DC operations. Check for a high number of mechanical operations rating and/or MTBF (Mean Time Between Failures). It is important that your switches and their installation are reliable as they are your interface to the engine. Always check local installation standards



Toggle Switches, used for ECU, Ignition circuits, Fuel Pumps, etc: SPST (Single Pole Single Throw), latching (remain on when put on) and in most circumstances a 20A current rating will meet the requirements of an installation.

Push button switches, (used for triggering the starter relay): SPST momentary/non-latching (only closes the circuit when pushed and opens when released). This should be suitably sized to enable easy activation in an emergency, but not able to be activated by accident. In many cases, a good quality 5A rated switch may last many years, however, we recommend a minimum rating of 35A for the start button to avoid the risk of overloading and burning out over time due to momentary current loads of over 30A. There are various styles from the 'industrial' to more 'discrete', at your discretion – local 'racing car' outlets generally carry some suitable buttons. If using a low amperage rated switch you may opt to use an intermediary relay to protect your circuit.



Key switches: 'Master type' key switches SHOULD NOT carry the full electrical system through themselves.

If you are using a key switch to control your electrical system you should install a suitably rated Master Relay capable of handling the current demands of the installation. Check the master relay trigger current before selecting your key switch.



Key Switched 'On/Off/Left/Right/Start' key switches may NOT be suitable for ULPower installations without the use of suitable relays due to their low amperage limits. Ensure such switches are rated appropriately or consult a qualified aircraft engineer.

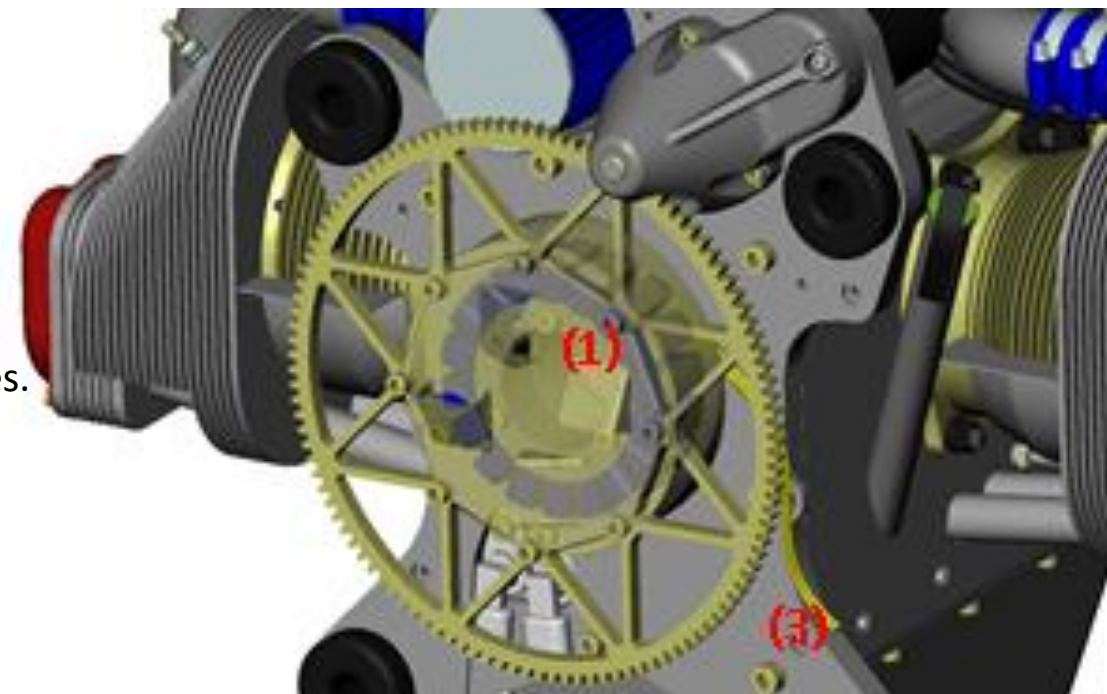




Regulator...

Install the Rectifier Regulator (RR) :

- Away from vibrations and heat with heat transfer paste where applicable
- Ensure cooling air is vented over the fins if required.
- Connect the three wires from the alternator (1)/(3) to the RR
- Connect the two wires from the RR to the power supply (+ve/-ve)
- Cross check all connections are well made and connectors clear of heat sources.
- Secure wires to prevent vibration.
- Only use the RR relevant to the alternator Amp output on your engine.



50 Amp RR

If the engine is CLOSE to the battery (i.e. less than 1m of cable) connect the +ve output from the RR to the battery / +ve bus.

Where the engine is further away from the battery (i.e. more than 1m of cable) connect the +ve to the +ve on the starter (to share the higher gauge wire for battery charging.)

Do not start your engine when the regulator is disconnected from the battery as this will destroy the regulator. We recommend the installation of a 68000 μ F capacitor (ULP n° E053010) in parallel to the battery to ensure power to the +12V bus in case of open contact in the battery. The capacitor will provide additional protection to the ECU and other circuits in the event of a battery or rectifier regulator failure.





Regulator...



Install the Rectifier regulator (RR) :

- Away from **VIBRATIONS** (the firewall is probably the 'least vibration' zone) using appropriate hardware (nuts/washers and bolts).
- Away from **HEAT** (the firewall is often the furthest point from heat)
- It is highly recommended to provide cooling air vented over the fins of the 50A RR (this can be bled off the baffles/plenums).
- Where possible, mount so that the connector is horizontal or 'at the bottom' to avoid moisture entering the connector
- Make sure that the connectors are properly inserted and connected AND routed away from sources of heat and mechanical damage.
- 3 wires come from the alternator and 2 wires go to the aircraft power system (battery). The positive wire (+ve) has a RED heat shrink on it
- When making up connections ENSURE all connections are secure to reduce electrical resistance and heat at the connection.
- Secure all wires to prevent vibration, ensuring sufficient slack to allow for normal engine movement.

Due to the strong magnets, ENSURE that no magnetic items (e.g. bolts, washers, nuts, ...) are inadvertently dropped and 'stuck' to the magnetic areas (alternator rotor).

This can irreversibly damage the alternator (rotor and/or stator) when running the engine/turning the crankshaft.

TIP : cover the alternator during the entire installation (e.g. with a clean rag).





Regulator – installation 50Amp

Installing the 50amp Regulator: The alternator output wires from the engine are pre-wired with a 3-pin connector for the rear of the 50Amp RR. The stabilised DC supply wires are pre-wired with a 2-pin connector for the rear of the RR, and with two tails, one with a red heat shrink (+ve) and one without (-ve).

Pre connect the alternator and supply lines to the RR before mounting.

The 50Amp output is standard on the six-cylinder range of engines and optional on the 4 cylinder range. NOTE: In the event of 'insufficient current draw' RRs tend to heat up. However, this RR is a **MOSFET type**, and will switch off charging in the event of a full battery and insufficient amperage draw to ensure temperature regulation, and return to providing current as soon as required by the aircraft electrical supply.

Cooling:

It is highly recommended to provide cooling air vented over the fins of the 50A RR (this can be bled off the baffles/plenums).



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The 50Amp RR uses 10AWG wire – respect the wire sections if extending wiring.

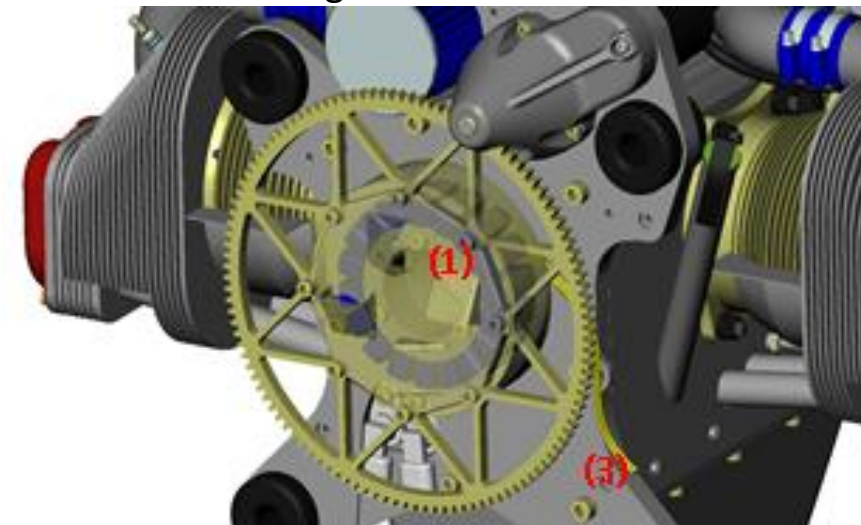
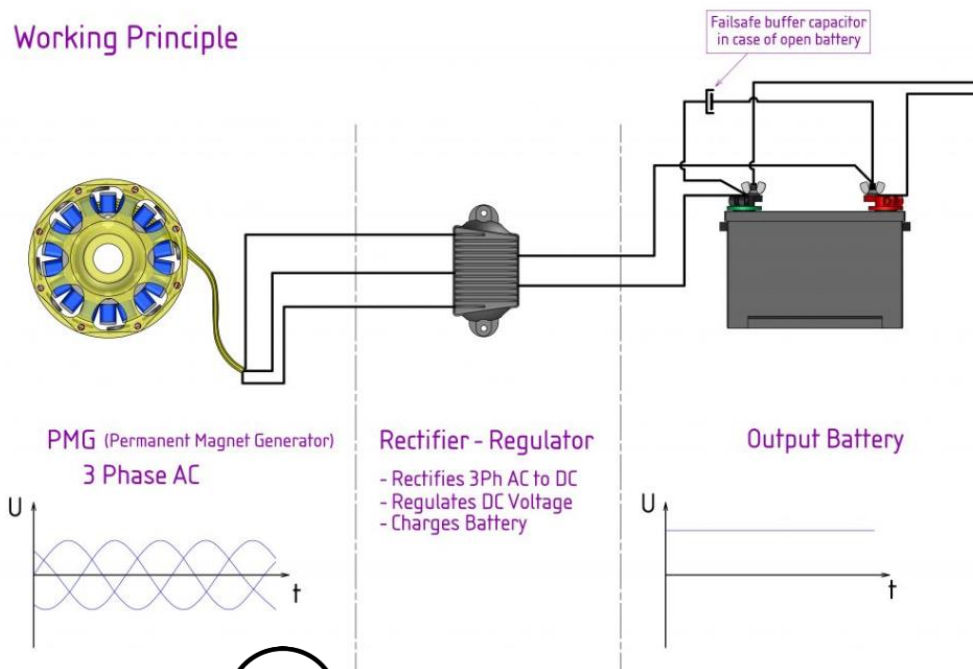


Regulator...

ULPower Engines are equipped with a permanent magnet 3-phase alternator (1) integrated at the back of the engine.

The regulator/rectifier (RR) converts the 3phase AC output into a unstable DC between 12 and 15.5 V. The battery buffers this unstable DC output and converts it into a stable DC output. It is very important to never disconnect the regulator from the battery when the engine is running. Doing so would destroy the regulator. When the maximum voltage is reached, the rectifier/regulator will stop feeding DC output into the battery. Depending on the type of battery, the rectifier will shut down the DC output to the battery when the voltage level is between 14 and 15.5 V.

Working Principle



The ECU needs a stable DC output . If the battery fails, or there is an open contact inside, the buffering characteristics from the battery fail also . Such a situation may result in an unstable power supply to the ECU. Therefore, we strongly recommend the installation of a genuine ULP capacitor (this capacitor is able to cover for the big amount of amps coming from the alternator/regulator) parallel on the battery.

Likewise, a failure of the RR may result in an erratic power output, which is buffered by the battery and capacitor.

Due to the strong magnets, ENSURE that no magnetic items are inadvertently dropped and 'stuck' to the magnetic areas.

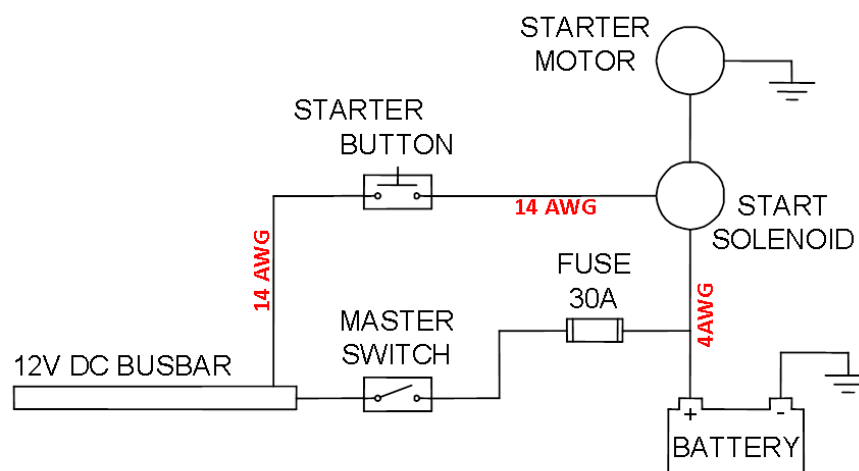


Grounding and Starter...

Ensure that the engine grounding and wiring to the starter is carried out using high quality wiring and connectors to the highest standards. Failure to do so may result in poor or non-starting.

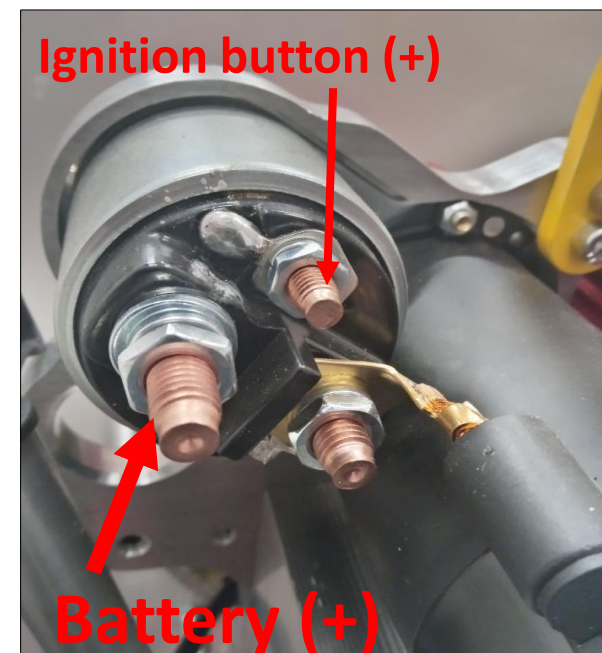
1. Using at least 4AWG (25mm²) wire, ground the engine block using an M6 bolt and washer at the threaded mounting point below the starter. Apply Loctite 243 to the thread of the bolt
2. Using at least 14AWG wire run the 'trigger' wire from the starter (ignition) button to the ¼" (6.35mm) tab on the starter solenoid
3. Using at least 4AWG (25mm²) wire, connect the battery positive to the starter solenoid.

The start button must be suitable for use with a momentary peak amperage of 30 amps or an intermediary solenoid may be required.



Undersized wires may result in poor hot condition starting due to increased resistance when hot.

Poorly mounted connectors may result in poor starting and excessive heat at the connector due to unnecessary resistance.



Ignition coils



- Install the coils on the firewall or engine mount. (avoid vibrations and heat)
- Minimum distance between the 2 coils is 50mm / 2 inch
- Keep coils and ignition cables well away from the ECU to avoid electrical interference. (Minimum distance 100mm/4in).
- Connect the wiring loom coil sockets to either of the 2 coils and ensure that the earthing lug from each wiring loom is connected to a nearby earthing point.
- Make up the HT (High Tension) ignition cables and install through the baffle cable grommets.
- The HT cable for cylinder 3 or 4 can go to either output on the 3-4 side, and the HT cable for cylinder 1 or 2 can go to either output on the 1-2 side of the coil and 5 or 6 to either side of the 5-6 side.



Make sure that each cylinder has one spark plug connected to each coil (two spark plugs per cylinder). When preparing for first run, run on ONE coil only at a time and check for smooth running before running on both ignition coils.



Ignition Cables...

To enable the ignition coils to be placed in the optimum position for each installation, ULPower provides a coil of HT cable and terminations. You must always use the ULPower HT cable and connectors as together they are matched to the electrical system.

Cut each HT cable to the required length and fit the ignition coil connector using the method shown on the ULPower news blog site

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- The provided copper clamps are used on one end of each lead and screw into the ignition coil cover. Strip only a few millimetres of the outer plastic of the ignition lead to unveil the inner core. It is advisable to solder the copper clamp onto the lead for good contact. The ignition lead is held and guided behind the point of soldering so no bending and as a result cracking should occur on the soldering.
- Push in the lead with the clamp all the way into the ignition coil cover and then **screw** on the cover with a couple of turns. Make sure the lead is fixed tightly and it cannot be pulled out by a small force.
- The ignition coil cover clicks onto the ignition coil. Make sure you get the correct leads going to the correct spark plugs.
- Cut the lead to the required length. Do not strip the plastic, but **screw** the spark plug cover into it. Do not forget to first slide the rubber sealing over the lead before attaching it to the spark plug cover (a little silicone spray may help). When attached pull back the rubber to cover the joint and make it moisture proof.
- Slide the bottom rubber over the spark plug cap and click the cap onto the corresponding spark plug.
- Give the cables a gentle tug to ensure that they are secure.



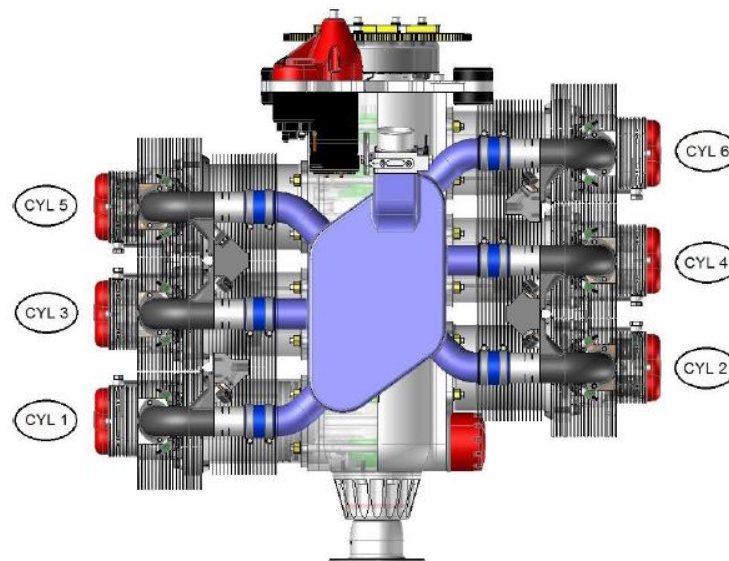


Ignition Cables...

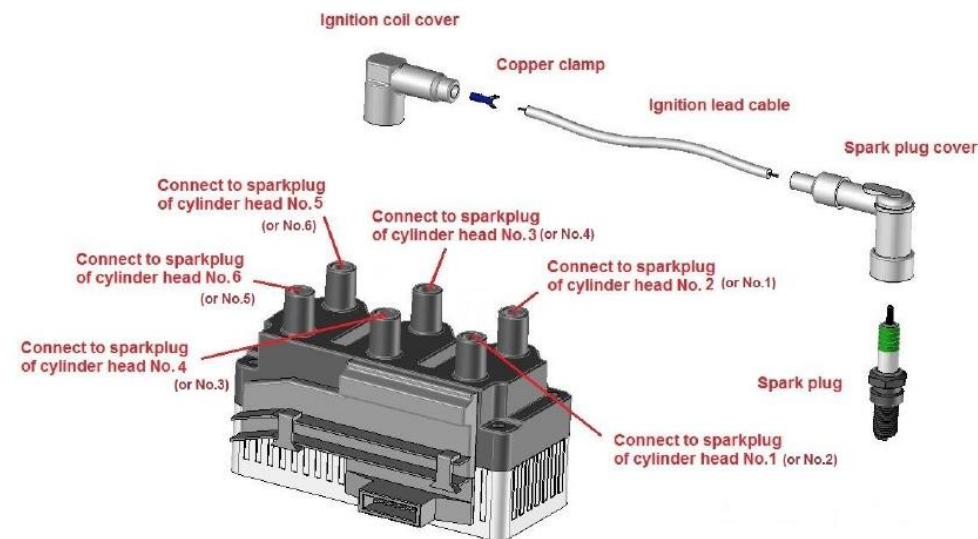
Because ULPower engines use a 'Lost Spark' ignition system, a well proven system, firing at the top of each 'upward stroke' it is possible to switch certain positions. Therefore cylinders 1 and 2 fire at the same time, as do 3 and 4 and 5 and 6.

The engines have their cylinders numbered from prop shaft to starter ring as shown.

Even numbered cylinders on one side and odd numbered cylinders on the other side.

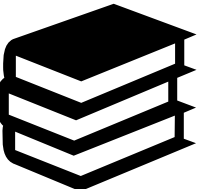


Firing Order: 1 – 4 – 5 – 2 – 3 – 6



See [AMC-20.3:13](#) for ASTM compliant engines

Battery and Capacitor



Your choice of battery is important for both starting the engine and ensuring sufficient flight time in the event of an alternator failure. The ECU requires a stable electrical supply for correct operation, and the installation of a battery and capacitor are an integral part of your electrical system. The starter will draw approximately 140Amps on start-up. To ensure easy starting the battery must have a suitable Cold Cranking Amp (CCA) capacity and the cable section between the battery and the engine must be at least 4AWG (25mm²) with high quality, well crimped, connectors at each end. Cable lengths should be kept to a minimum. The battery must have sufficient Amp Hour (Ah) capacity to provide at least 30 minutes operation in the event of an alternator failure. The Capacitor, installed in parallel to the battery, should have at least 10AWG wire between the battery and itself and be located close to the battery. Use terminal insulation boots i.a.w. good practice.

Recommended Minimum battery requirements

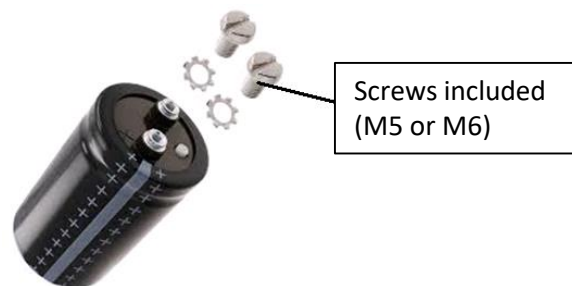
Lead/Acid: 12V, 160 CCA¹, 18Ah² (single ECU) 24Ah³ (Double ECU)

LiFePo : 12V, 320 CCA¹, 16 Ah² (single ECU) 20Ah³ (Double ECU) WITH a Battery Management System (BMS)



Recommended Capacitor

63V 68 000 µF (ULP part n° E053010)



NEVER use a “booster” (quick battery charger) to start the engine.

¹CCA is the ability to turn the starter. Ah is the amount of power stored. Lead Acid Batteries often require less CCA and more Ah than LiFePo batteries for the same in field performance due to the differences in behaviour of the two systems. LiFePo batteries MUST have a battery management system to protect the battery from overheating, over-discharge, etc.

²Single ECU WOT = 11.5 A/h consumption (Fuel pumps + ECU + ignition system)

³Double ECU WOT = 16 A/h consumption (Fuel pumps + 2 x (ECU + Ignition system))

Use Peukert's law to determine discharge current battery



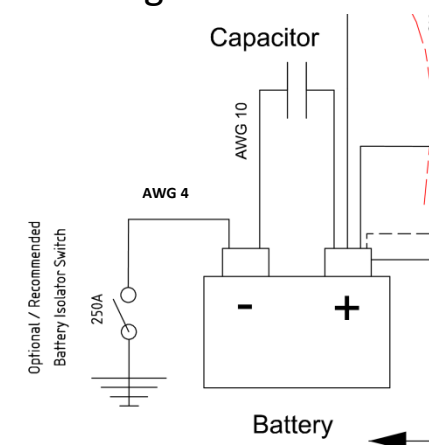
Battery and Capacitor

The 63V 68 000 Micro Farad capacitor is installed in parallel to the battery. The ULP capacitor (ULP part n° E053010) should be installed directly across the battery terminals. Once charged it will not drain the battery even if left connected permanently.

The battery and capacitor work together to smooth power output from the engine to ensure a stable and smooth power supply to the ECU and the airframe electrical systems. In the event of a battery failure, the capacitor ensures that the regulator continues to provide a stable power output to the ECU/aircraft and also provides a level of protection from voltage spikes that may occur in the event of a rectifier/regulator failure.

Multiple Batteries: You may choose to install a higher Ah battery or more than one battery in parallel or independent circuits to ensure a longer engine run time in the event of an alternator failure or as a back up in the event of a battery failure. Such designs are outside the scope of this manual and are at the discretion of the builder/OEM. Always ensure that your electrical system is fully tested and ensures continuous, stable 12V power to the ECU, and that all installations are i.a.w. good practice and are acceptable under your local regulations.

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CAUTION: The capacitor may hold up to a 14 volt charge and should not be shorted at any time.

Fuel System



Key points to remember with your Fuel System

- Use good quality fuel lines and connectors designed for a your fuel choice and suitable for aircraft installation.
- Fuel lines and connections must be suitable, with appropriate safety margins, for at least a constant 3bar fuel system with a 120 litre/hour fuel flow rate.
- Fuel lines and connectors must be protected from excessive heat (e.g. exhaust) and mechanical damage.
- Fuel lines must be fire proof.
- We recommend to install fuel pumps FWF shielded from heat and mechanical damage.
- Fuel **must** return to the tank from which it is drawn (you may use a duplex fuel selector or header tank if required).
- Return line must have a non-return valve (where possible behind the firewall).
- NEVER shut down the return line (it allows pressure out of the system post shutdown and must be left open)
- Make sure no air can enter the fuel system !
- If using a gascolator, use one with a screw lock.
- Certain flying manoeuvres may create unporting of the main tanks. Consider using a header tank to vent the fuel system.
- Use the correct fuel filters. Using the wrong filters can lead to engine failure!

If using a duplex fuel selector, be aware that it may close both the supply and the return lines when in the 'OFF' position. **If so, DO NOT SWITCH TO THE OFF POSITION** unless for maintenance or in the event of an emergency. Failure to comply may result in over-pressure in the fuel system and possible damage to fuel pumps and other components of your fuel system. Such fuel selectors must be placarded accordingly. For example "DO NOT SELECT OFF UNLESS EMERGENCY OR FOR MAINTENANCE".



Standard installation practice, as may be applicable, is covered in FAA Maintenance Technician Handbook ([FAA-H-8083-30](#)).

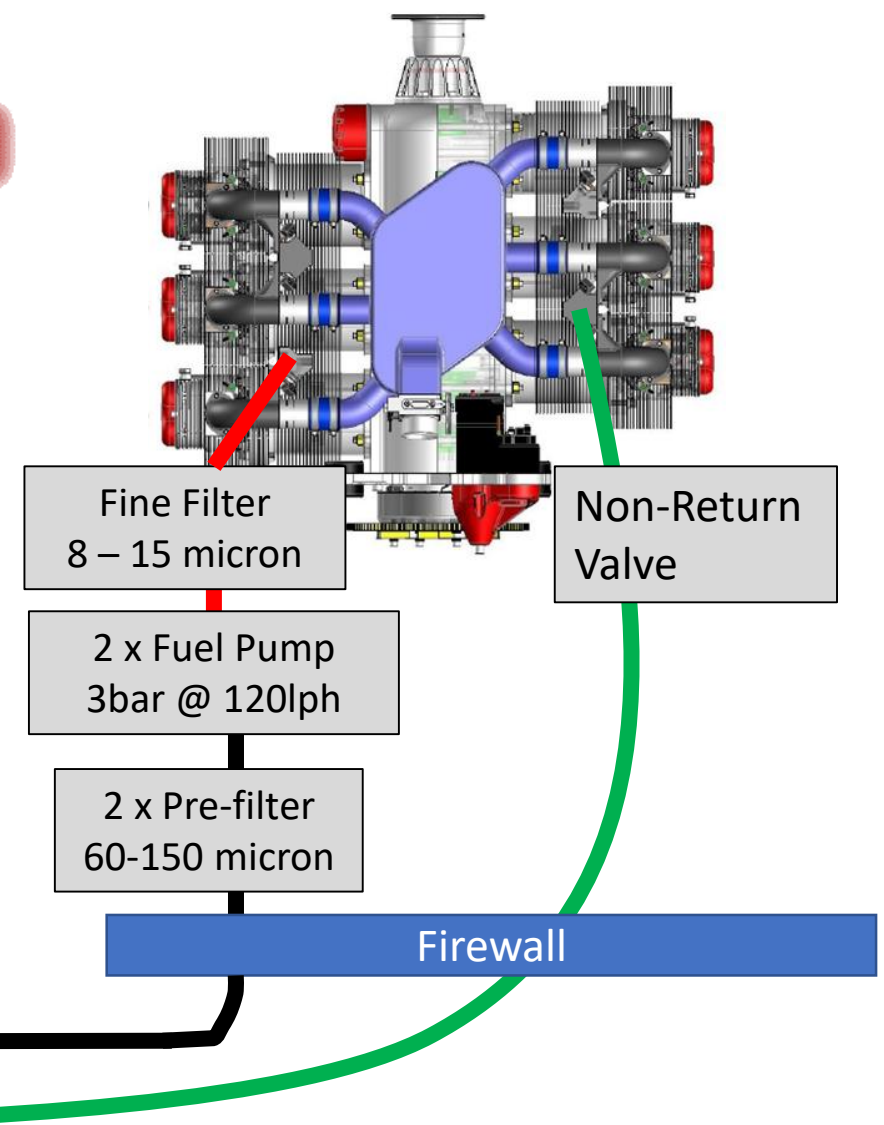
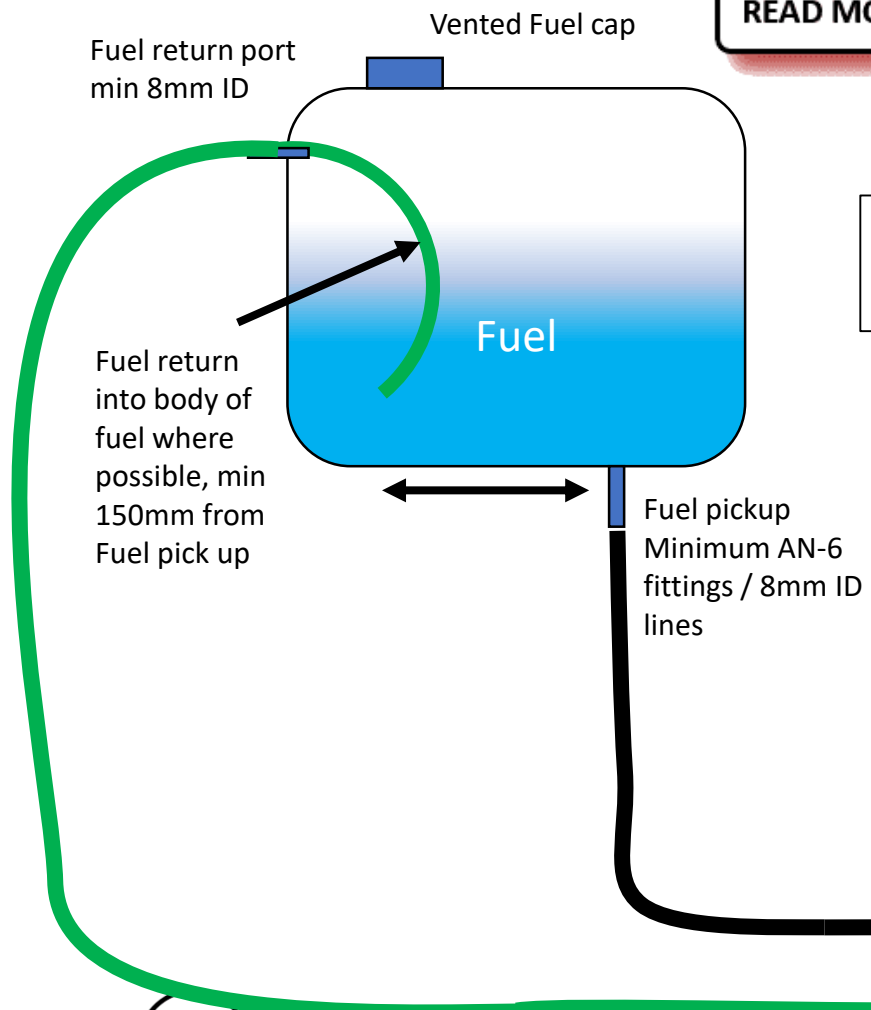


Fuel System

Overview (based on a single tank system):-

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Click on the sub parts of the system for more info



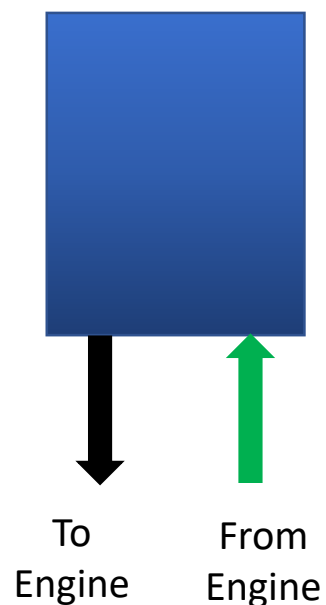
— Min 8mm ID fuel suction line — JIC-/AN-6 fittings/ 8 mm ID fuel line with working pressure of 3bar @ 120l/hr — JIC-/AN-6 fittings/fuel return line



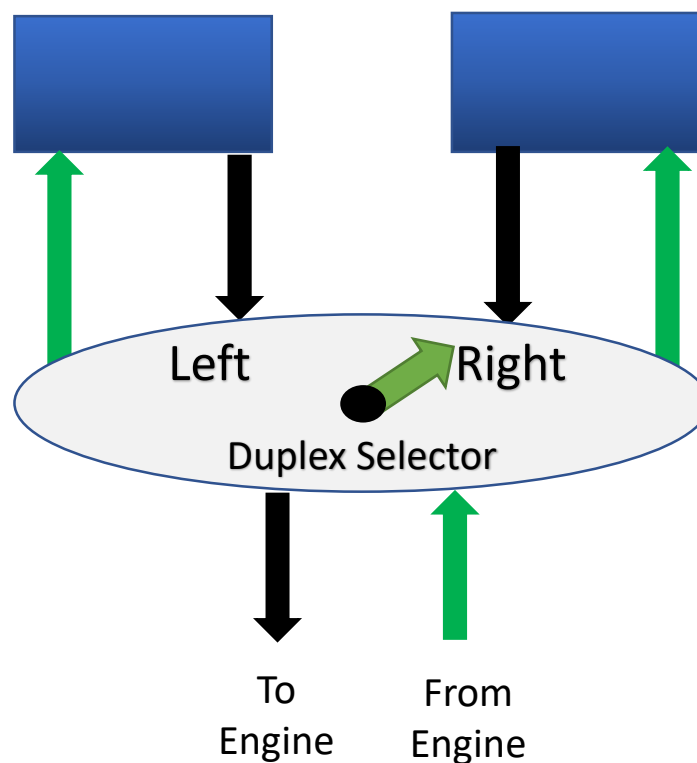
Example Fuel System options

A robust fuel system is essential for continuous operation of your engine. Ensure that air cannot enter the fuel system by failure to change tanks before running out of fuel or unporting fuel tank pickups during manoeuvres. Air entering the fuel system may result in engine stoppage.

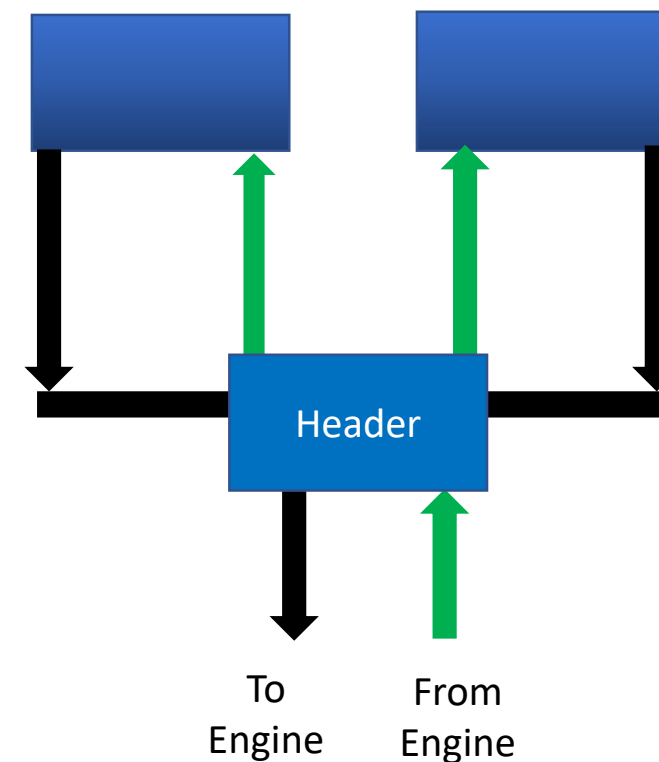
Single Tank



Dual Tanks – with duplex selector
feed tank = return tank



Dual (multiple) Tanks – with header
Multiple feeds into header tank
Header breathing line(s) to tank(s)



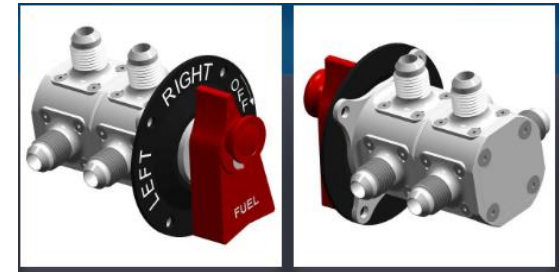
With 120 litres per hour of fuel flow there will be a large volume of fuel returning to the tank from which fuel is drawn.



Fuel System

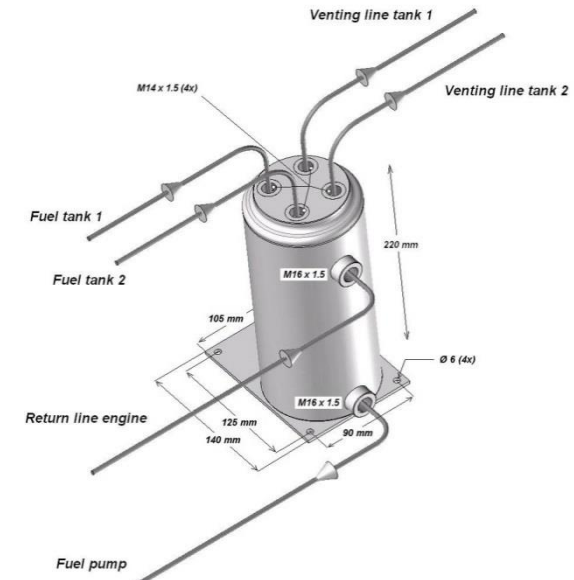
If using dual tanks, try to ensure the following:

1. Duplex fuel selector MUST not completely shut off the return line when in the 'OFF' position, failing this install a placard warning "DO NOT SELECT OFF UNLESS EMERGENCY OR FOR MAINTENANCE".
2. Fuel returns should avoid cascading fuel (i.e. return where possible into the body of fuel to avoid foaming and vapour in the fuel tanks)
3. Fuel returns must be at least 150mm from fuel pick ups to avoid picking up warm fuel and/or vapor lock



If using a header tank, as is often used on high wing aircraft, try to ensure the following:

1. Fuel return from engine to the header tank at least 150mm (6in) from the fuel pick up, directed away from the pickup, to avoid warm fuel being picked up by the feed to the engine.
2. Vent line(s) to the wing tanks should be at the top of the header tank
3. Fuel from wing tanks to the header tank should enter lower than the vent line(s) to avoid vapour entering the supply lines.
4. Sufficient volume of fuel in the header tank for the installation. (ie if using as a 'reserve tank' consider how many minutes of fuel it should contain.)
5. Consider a low fuel warning light system in the header tank as a safety feature



Other installations, for example with low wing low dihedral or aerobatic aircraft, may benefit from clunk tubes, catch tanks or baffles in the wing tanks to reduce risk of unporting during manoeuvres.

It is the OEM/Builders responsibility to design and test a suitable fuel system before flight testing i.a.w. good practice and local regulations.

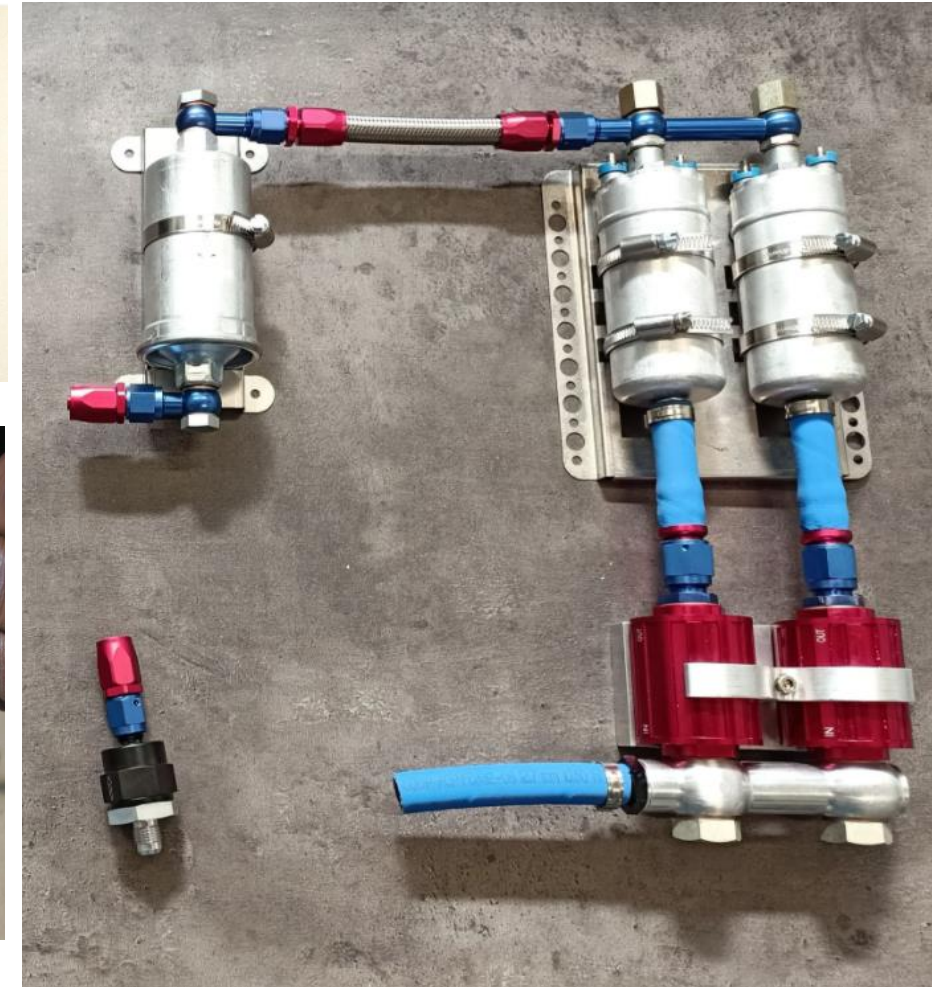
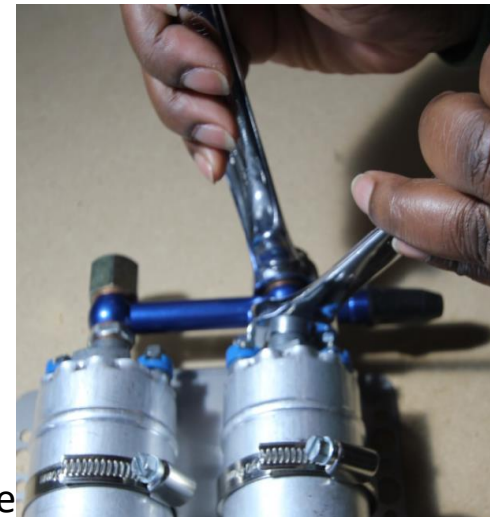
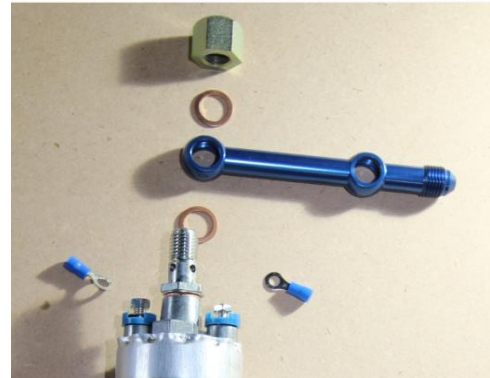




Installing the fuel pumps with the ULPower dual pump kit:

Fuel pumps and pre filters

1. Fit the fuel pumps to the mounting bracket using the hose clamps provided.
2. Fit the prefilters to the provided bracket.
3. Cut two lengths of the push on hose-08 1/2 to fit between the pumps and the pre-filter.
4. Check that the hose segments are clean prior to installation with the hose clamps (side pumps) and push on at the straight fitting (side filters).
5. At the output end of the pumps install the double fuel pump ramp (it can point in either direction) with copper washers and hex cap nut as shown (1). When tightening the banjo bolts, hold the nipple of the top of the fuel pump with a 17mm spanner to prevent damage (2).
6. At the inlet of the prefilters, add the collector with copper washers and banjo bolts.
7. Bolt the fuel pump bracket to the airframe ready for plumbing to the fuel tanks and engine.
8. Crimp electrical connectors with 14AWG wire tails for the fuel pumps to suit your chosen [fuel pump electrical configuration](#)



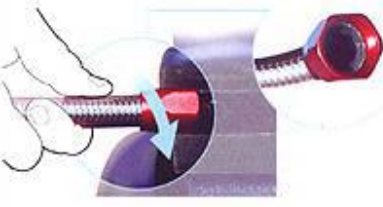
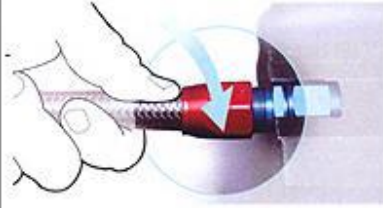
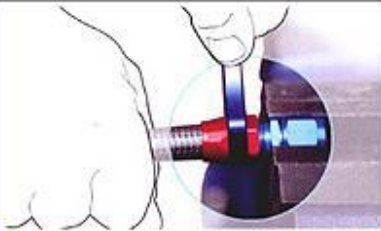
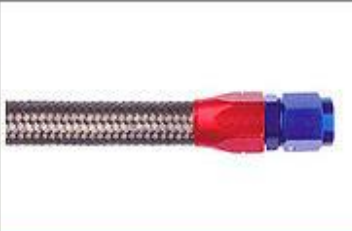




Installing the fuel pumps with the ULPower dual pump kit:

Connecting fuel lines

NB: In this description we are considering a SINGLE fuel tank installation, you will need to adapt to suit your particular requirements i.a.w. good practice and local regulations.

			
Step 1 Bind masking tape tightly around the hose at the required length and cut through using a fine-tooth saw blade or cut-off wheel, leaving tape on both ends so that it retains the braid. Clean any debris from both the cut ends and inside the hose.	Step 2 On a clean flat surface, disassemble the fitting. This consists of 2 parts; Socket (Red) Main Fitting Body (Blue)	Step 3 Hold the socket in a smooth jaw vice and feed one end of the hose into the socket by turning clockwise and pushing until the hose finishes just behind the socket threads.	Step 4 Holding the main body in the vice, lubricate the thread and push the hose and socket over the nipple end and start to thread the socket onto the fitting by hand.
			
Step 5 Finish tightening the socket onto the fitting using a good quality wrench until the socket is one full turn from the back of the fitting	Step 6 Pressure test.		

Make up fuel lines (for example using the reusable fuel line connectors from your ULPower supplier) to run from your fuel tank to the suction collector T joint at the entry to the fuel pump assembly.

Make up a fuel line from double fuel pump ramp to the fine filter.

Make up a fuel line to fit from the fine filter to the engine fuel inlet – BUT do not connect before flushing the system and carrying out a fuel flow check.

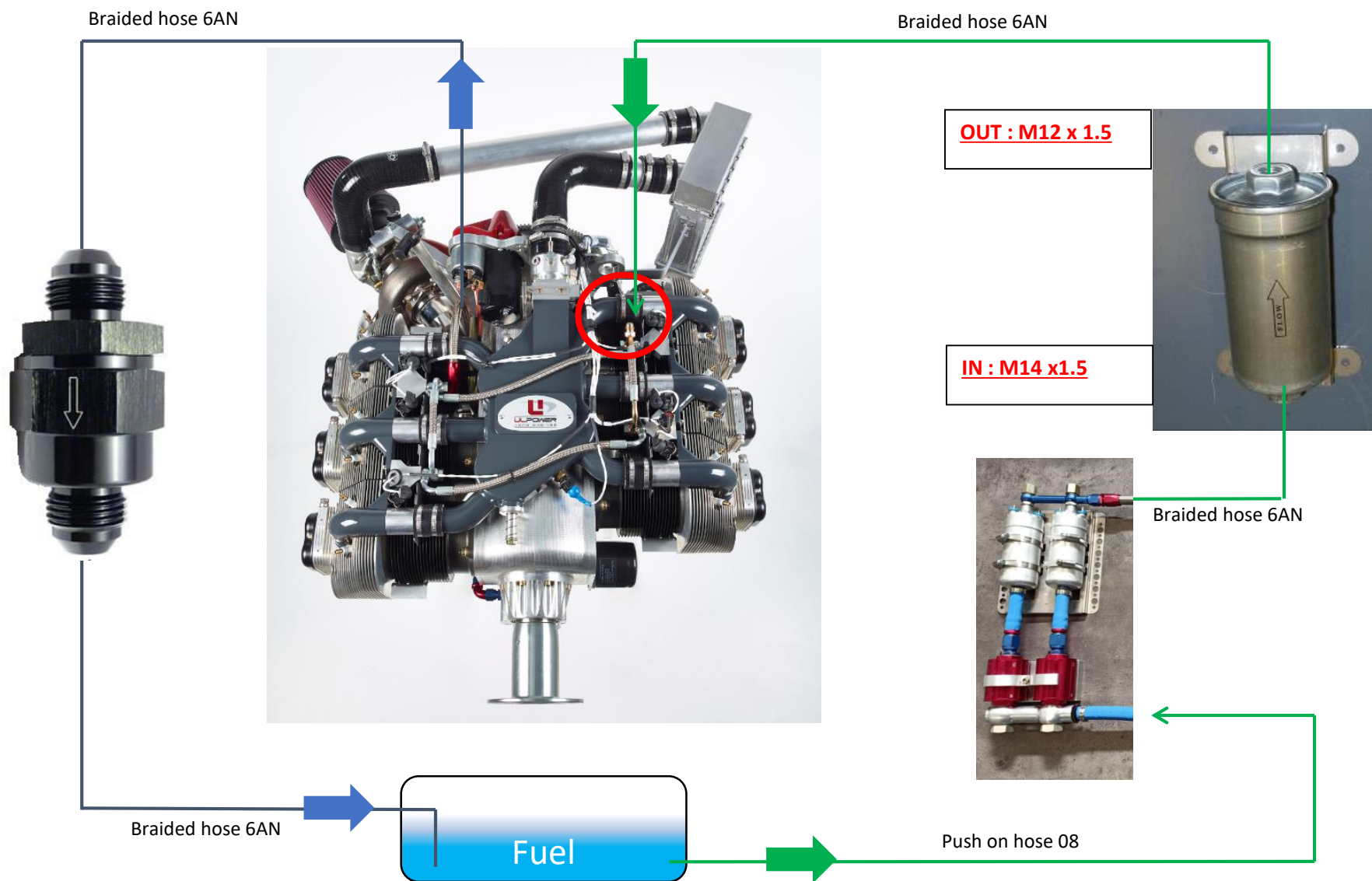
Make up fuel lines from the engine return line to your fuel tank.

Before installation clean the fuel hoses to ensure no metal, rubber or other particles are inside before connection. It is also recommended to run the fuel pump “before” you connect the fuel line to the engine both to confirm fuel low levels AND to flush out any debris that may be in the lines – preventing it entering the fuel rail.





Installing the fuel pumps with the ULPower dual pump kit:

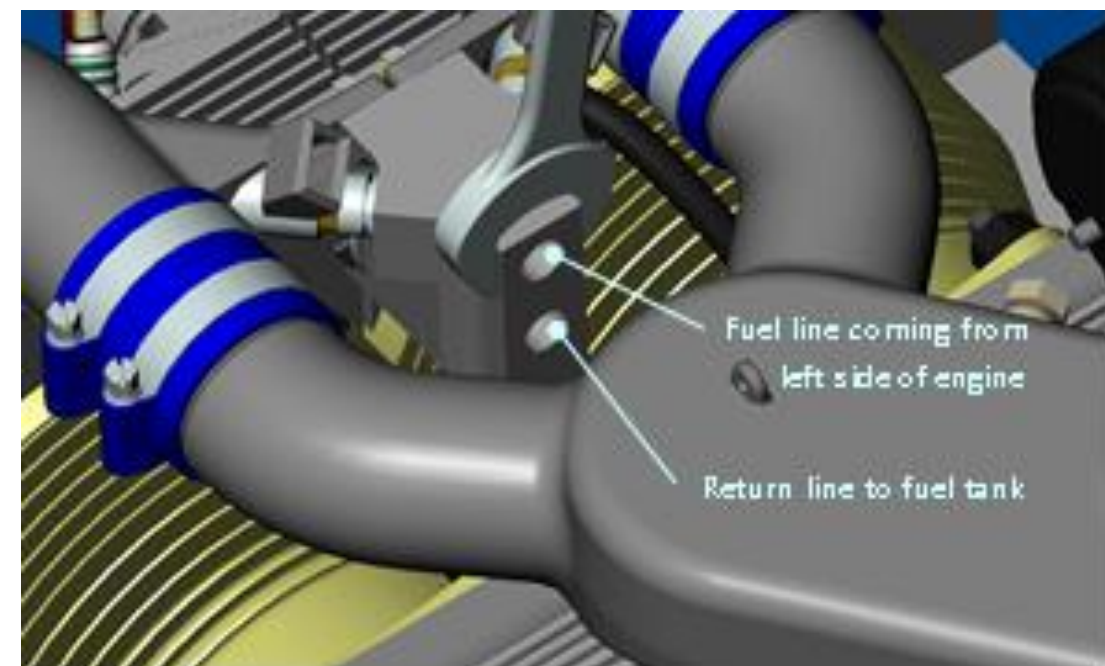


Fuel rail



Engines leave the factory with the fuel rail installed on the engine. During maintenance or in the case where you are making the connections on the engine, it is important to note that when tightening the banjo bolts that connect to the engine, you should use a spanner to hold the injector block in place. (The two screws on the other side holding the injector block in place are not designed to take the torque when connecting the banjo's!) Connect the fuel line coming from the left side of the engine (cylinders 2+4) to the top hole and the return line to the bottom hole.

A check valve (non return valve/NRV) is highly recommended in the return line. This is an extra safety measure in case of fire in the engine compartment. If not installed, fuel could run from tank to engine through a leaking fuel line even when fuel pump is switched off. In the event of an accident, the fuel lines may get severed in the FWF area, consequently it is essential to have an NRV 'behind the firewall'. Some installations have both an NRV in the engine compartment and also one in the fuselage area. These NRVs should open at very low pressure so as not to result in a pressurized return line.



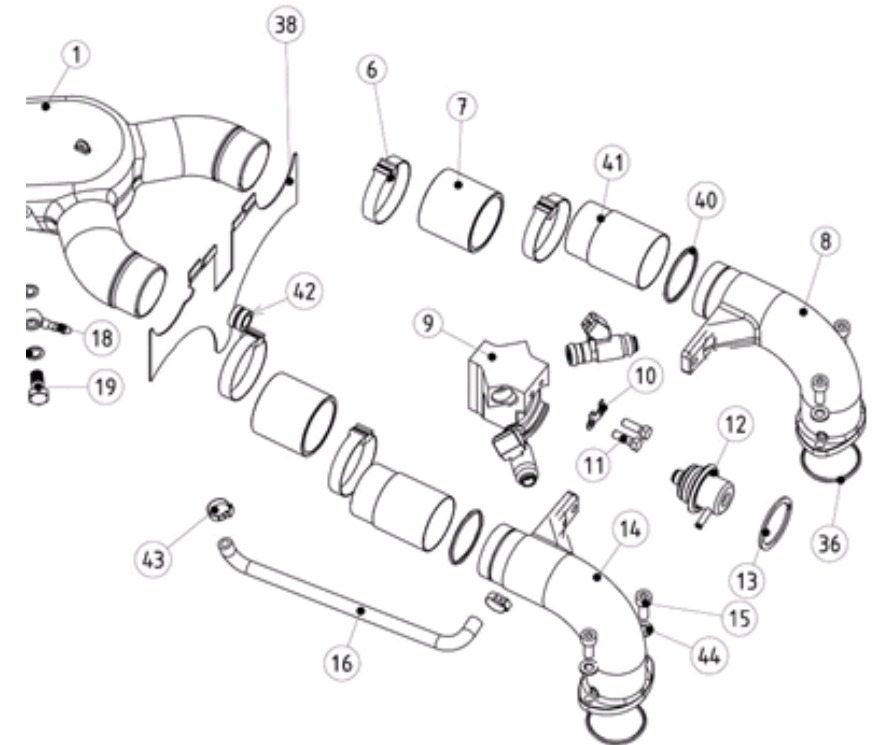
Check all fuel lines and connections before each flight !



Fuel pressure regulator

The fuel pressure regulator (item 12 in picture on the right) is integrated in the right fuel block (between cylinders 3 and 5). It is connected to the inlet manifold with a cloth braided rubber hose (item 16 in picture on the right) and a small banjo (in front of starter motor) in order to regulate fuel pressure ± 3 bar above inlet manifold pressure.

Regularly check for wear (particularly on the parts where it might rub against the casing or inlet tubes) of this hose because if it has worn through, not only can the fuel pressure regulator not do its intended work, (regulating the fuel pressure to 3bar above the manifold pressure) but also the fuel mixture may become (too) lean and the idle speed may also increase because air could enter the manifold through another route instead of only through the throttle plate.





Cooling system of ULPower engines

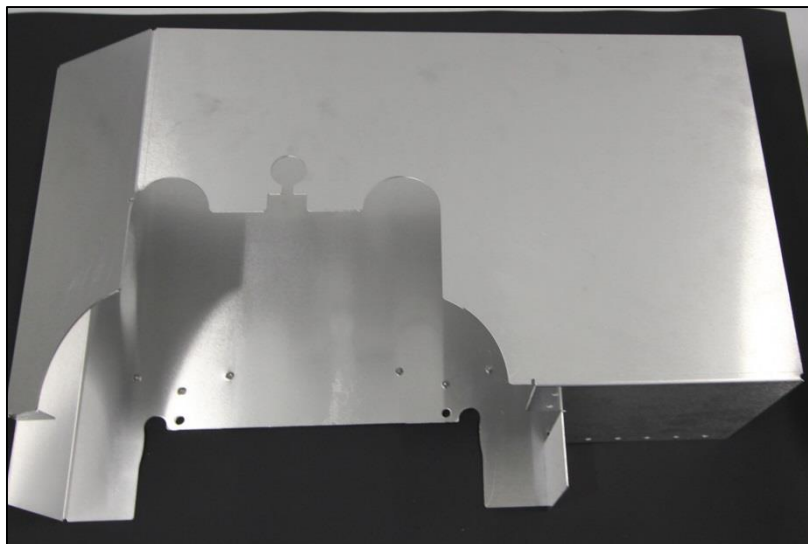
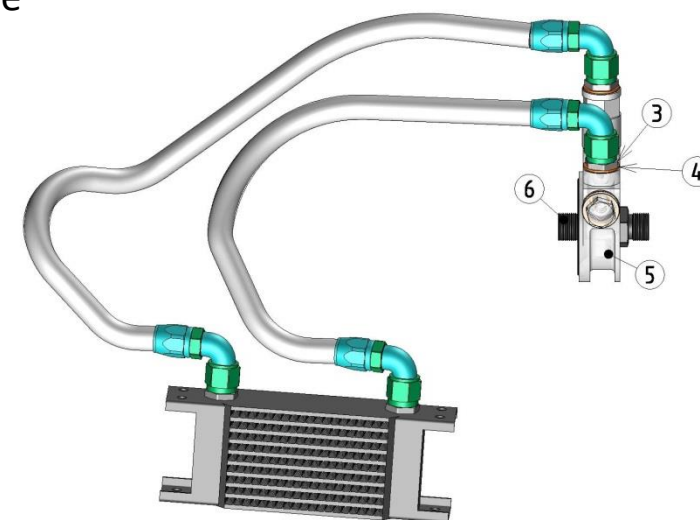
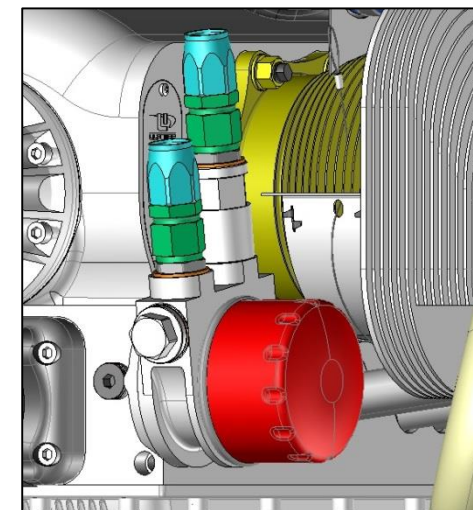
ULPower engines are oil and air cooled.

Each cylinder head has an integrated, pressurised oil line, taken from the main oil gallery, to provide enhanced cooling of vital components, increasing lubrication of push rods and valve guides for cooler running and longer life.

Pistons receive additional oil to their underside through dynamic oil dispersion from customised con-rods.

Oil cooler and oil thermostat are mandatory. A complete kit is available from your local ULPower dealer

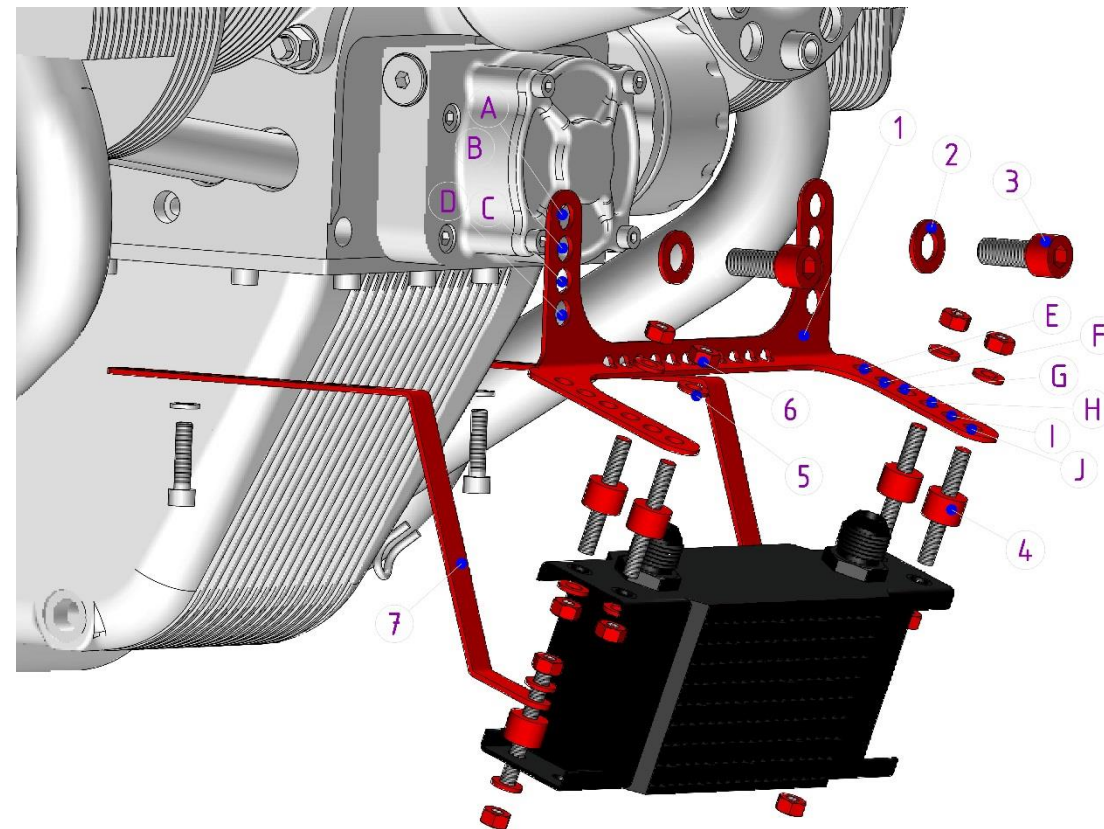
Furthermore the cylinder heads and cylinders have massive cooling fins for heat dissipation. CNC produced baffles, through which air is forced over the large fin areas, are included with the engine





Oil system

- A suitable oil cooler must be installed. ULPower offer a range of oil coolers and fittings.
- It may be installed using the ULPower oil cooler mount or remotely mounted in a suitable location for your airframe.
- Oil cooler locations MUST ensure sufficient fresh air being forced through the cooler at all angles of attack and during all phases of flight.
- Installing the oil cooler as low as possible under the engine line will prevent that the incoming air is not deviated by the propeller
- Where appropriate ducting and or baffling may assist with cooling.
- Always use appropriate shock absorbers and mounting systems.
- When using the ULPower oil cooler brackets, the position of the cooler can be changed by fixing the bolts (3) into different holes (a,b,c,d,e,f,g,h)
- Use appropriate oil lines (an oil cooler kit including lines and connectors is available)



1	Bracket	1 Pcs	5	Washer	12 Pcs
2	Locking disc springs M10	2 Pcs	6	Prevailing Hexagon nut M6	12 Pcs
3	Bolt M10x25	2 Pcs	7	Support	2 Pcs
4	Shock absorber	6 Pcs			



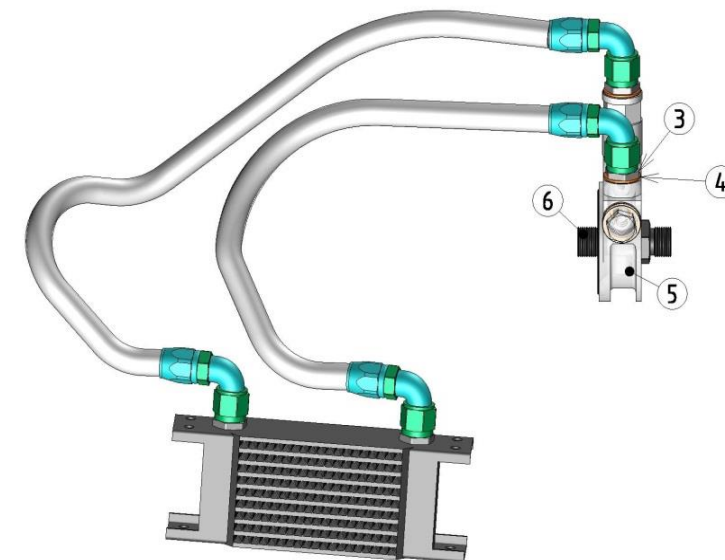
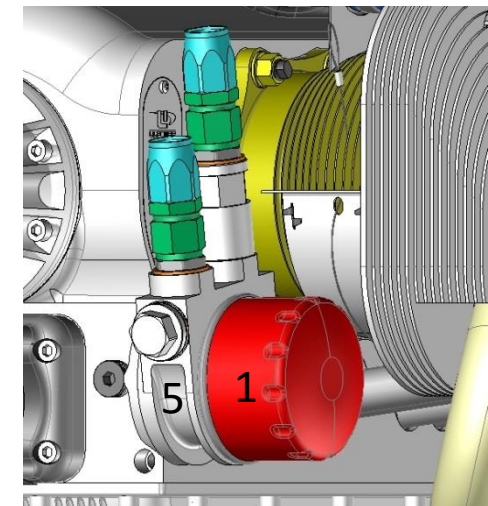
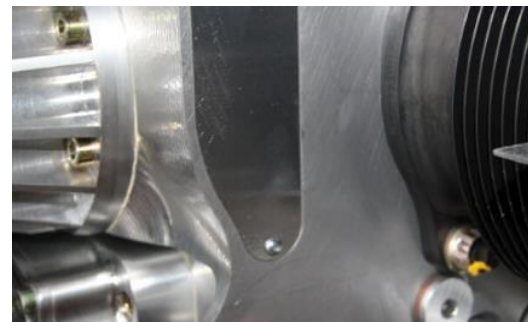


Oil Thermostat

The ULPower Oil Thermostat is integrated into a sandwich plate that sits between the crank case and oil filter (5). It is designed to ensure appropriate engine warming and effective engine cooling, when installed correctly with an appropriate oil cooler.

Follow the instructions for the ULPower supplied thermostat below:

1. Remove the oil filter (1) using an oil filter wrench.
2. Remove the oil filter screw (2). Wipe excess oil away.
3. Insert the male adaptor bits (3) together with a copper sealing ring (4) into the oil filter sandwich plate with integrated thermostat (5) and gently tighten. (max.25Nm).
This should be completed before fixing to the engine.
4. Put the sandwich plate (5) at the place of the oil filter; with the rubber seal facing towards the engine casing.
5. Insert the oil filter adaptor screw (6) in engine casing through the sandwich plate – note the orientation.
6. Rotate sandwich plate to desired position and tighten the adapter screw with socket/torque wrench (max. 20Nm).
7. Lubricate the oil seal of a new oil filter a little and screw filter onto the sandwich plate. **The oil filter should be torqued to 15Nm**





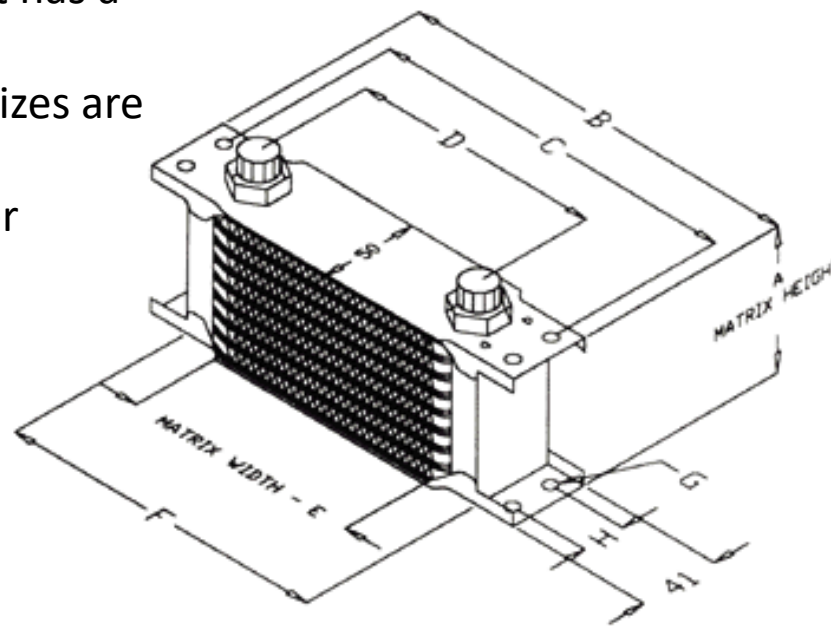
Oil Cooler – connecting oil lines and fittings

The standard oil cooler provided with the oil cooler kit has a matrix width of 115mm/ 16 rows .(UL260/UL350) and 235 mm /16 rows for UL390/520. If necessary, other sizes are available from ULPower upon request.

When installing the ULPower cooler with the ULPower supplied re-usable oil lines/connectors, please follow the instructions as shown before . [Click here](#)



Whenever fitting a connector to an oil cooler it is essential that you support the oil cooler fitting with a suitable spanner to prevent damage to the oil cooler.



Dimensions

E	B	C	D	F	G	H
235mm	330	308	248.5	295	7.1 DIA	22.2
115mm	210	188	132	165	7.0 DIA	22.0

Matrix Width Dim (E)	Row	Dim (A) (mm)	Dry Weight (kg)	Capacity (litre)	Matrix Face Area (M²)
235mm	7	53	0.53	0.14	0.012
	10	77	0.71	0.20	0.018
	13	100	0.88	0.26	0.024
	16	124	1.06	0.32	0.029
	19	147	1.24	0.38	0.035
	25	194	1.60	0.50	0.046
	34	265	2.14	0.68	0.062
	44	344	2.73	0.88	0.081
	50	390	3.09	1.00	0.092
115mm	7	53	0.32	0.09	0.006
	10	77	0.42	0.12	0.009
	13	100	0.52	0.16	0.012
	16	124	0.63	0.20	0.014
	19	147	0.73	0.24	0.017
	25	194	0.94	0.31	0.022
	34	265	1.26	0.42	0.030
	44	344	1.61	0.55	0.040
	50	390	1.82	0.62	0.046

Note: Oil is introduced to the system through the “dipstick” tube , and removed via the sump drain plug. (i.a.w the ULP maintenance manual)

Remember : Fill the oil system with the correct volume of a ULP approved oil . See [here](#)

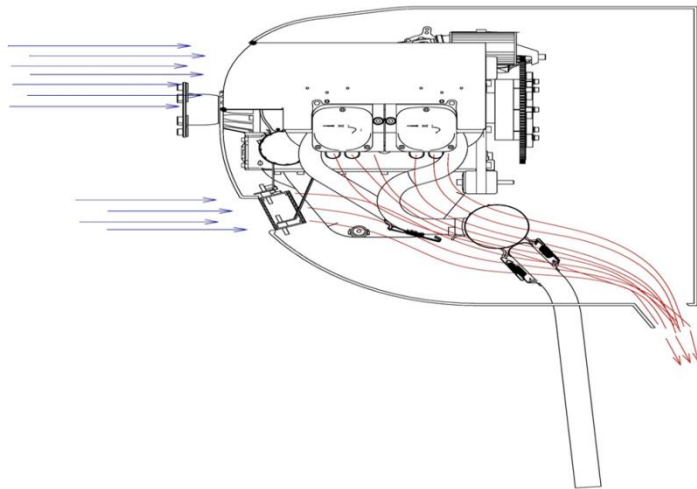


Air system



Baffles

ULPower engines come with CNC machined ram air boxes. Install them over the engine and cut the ram airboxes to fit your cowling. Make sure no air can escape and CHT's are within limits (see OM). Modifications might be needed after your first test flight.



Depending on the powersetting and/ or speed, both ram air boxes need an entrance surface ranging from 70 to 100cm² (11 to 15,5 sq inch).

High powersetting and/ or low speed = bigger surface

Low powersetting and / or high speed = smaller surface

All incoming air needs to be guided through the cooling fins of the cylinder heads. In order to ensure no air can escape between the airboxes and the cowling install rubbers on top of the airbox or close off the airbox with an aluminium cover.

Avoid interference between the incoming air which is guided through the oil cooler and the incoming air through the cylinder heads. Create an easy exit for all air coming out of the engine room

Remark: Incoming air must also be guided over the oil cooler. Where appropriate ducting and or baffling may assist with cooling

Inlet air filter



Bringing fresh air to the turbo inlet / air filter is very important for the performance of your engine

The UL520T comes with an inlet filter and a SCAT hose . It is up to the builder/OEM to find best spot for installation

When using an alternative air filter, the filter must contain following properties :

- Four fold cotton fabric
- Face covered with metal screen
- Filter area at least 250 cm²
- Flow rate min. 750m³/h
- Max. pressure loss 5 hPa.

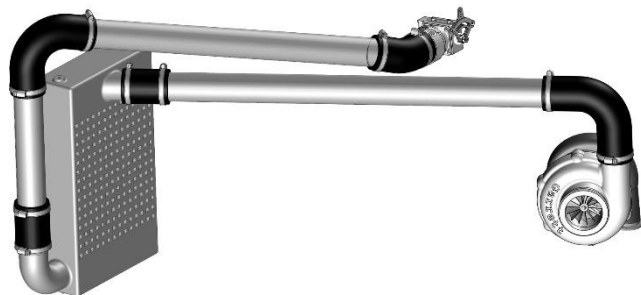


When relocating, make sure you use an appropriate connection tube (SCAT /rigid silicone).

Intake and related icing must be avoided by the design of the airframe installation



Intercooler



Hot (manifold) air decreases the power output of the engine. **It is important to mount a suitable intercooler to keep the manifold temperature as close as possible to the ambient temperature.**

Always provide enough fresh air to the intercooler core using a naca or scoop.

Mount the intercooler with rubber mounts. The intercooler must be free of vibrations.

Use appropriate ducts and connections

When installing a non-ULPower intercooler, be aware that :

The pressure loss over the intercooler must not exceed 250 hPa (3.63 PSI)
[Wide open throttle]

Inlet / outlet must be minimal \varnothing 50 mm (2 inch)

Intercooler must be of sufficient size to provide enough cooling

As guidance : an intercooler with a core size of 25 cm (10") x 28 cm (11") x 7,5 cm (3") (thickness) is in most climate conditions sufficient

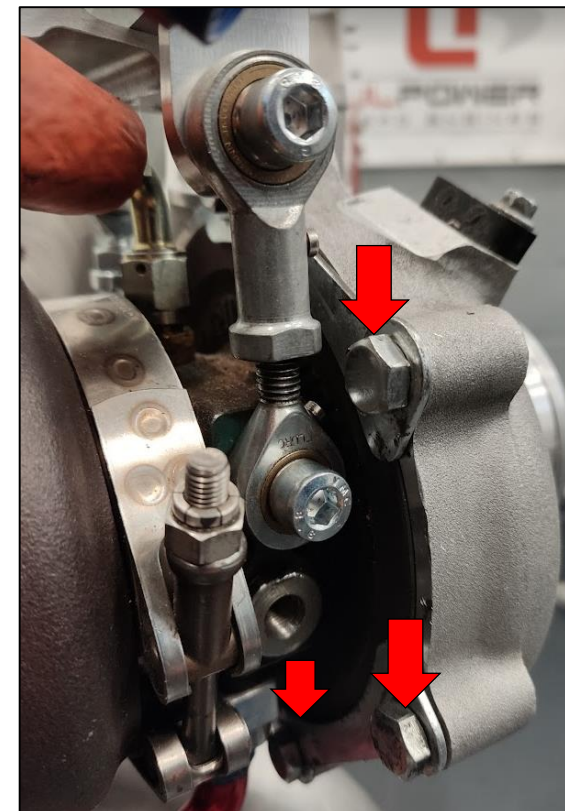
In all conditions, the manifold temperature must not exceed 75°C (167°F). Preferable 60°C (140°F) maximum.



Rotating compressor housing

If necessary, follow the steps below to rotate the compressor housing.
Depending on the installation, it may be necessary to rotate the compressor housing to get a better connection to the intercooler.

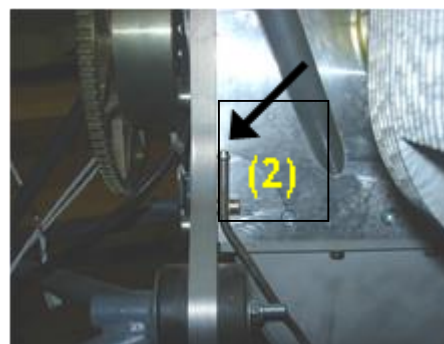
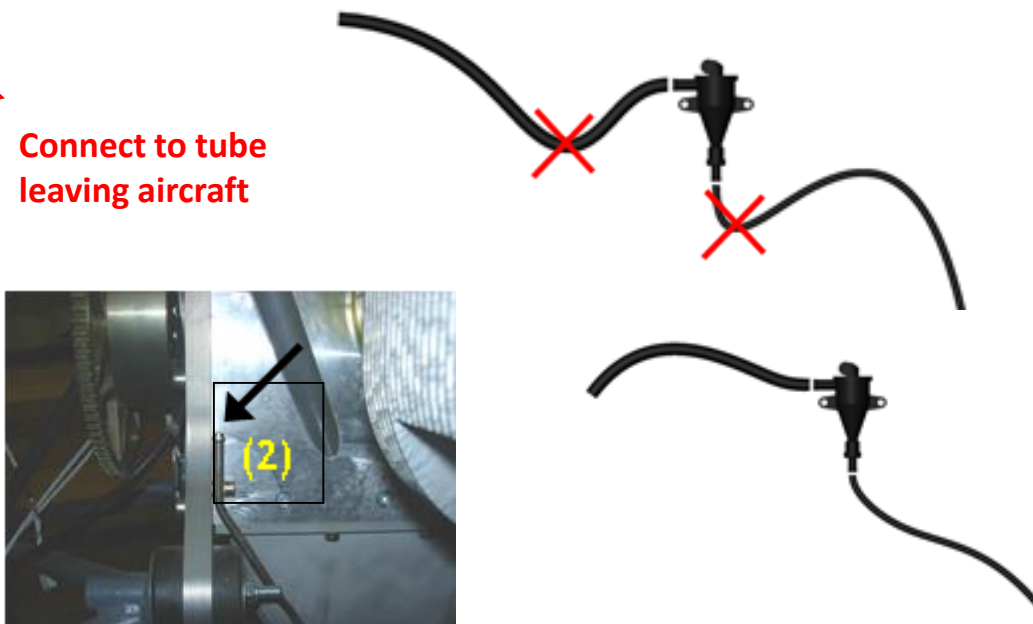
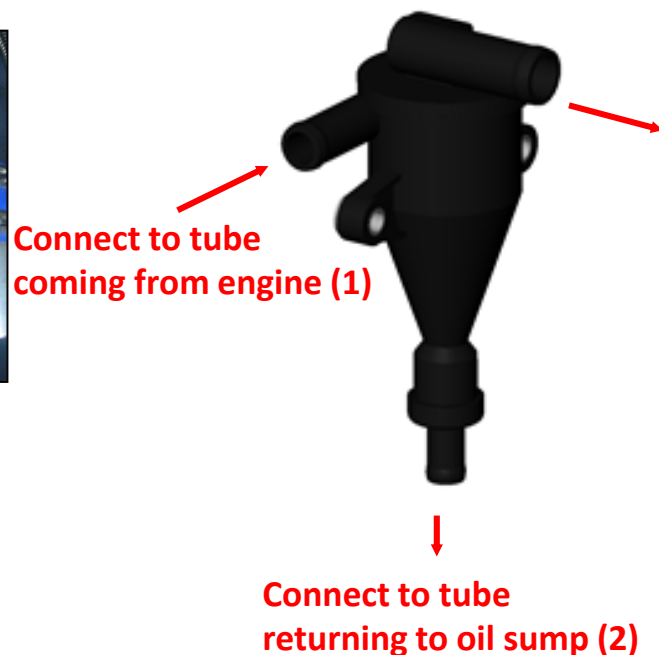
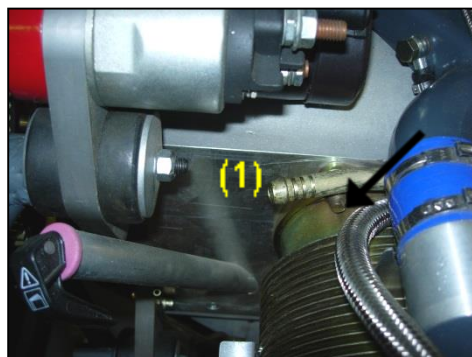
- 1) If realignment is required, loosen the 6 bolts on the back of the compressor housing (3 bolts visible in picture to the right) with a $\frac{1}{2}$ " wrench: loosen the bolts (0.5 - 1 turn) **but do not remove them !**
- 2) If applicable, remove other points of interference (e.g. turbo oil return line)
- 3) Rotate the compressor housing to the desired position
- 4) Retighten the bolts (16 Nm/12 ft-lb)





Oil/Air Separator

Install the oil/separator on the firewall in an upward position. Mount it as high as possible (at least above the centre of the crankshaft) Connect the breather line (1) and the oil return tube(2) to the oil/air separator



Make sure the hose coming from the engine (1) goes straight into the oil/air separator and the hose returning to the oil sump (2) follows a downwards line to the sump. No "bucket" bend in the hoses. Keep the lines away from heat ! Avoid contact between the return line and the exhaust ! Use lines that can withstand 120° C (250°F) and are specified for use with oil. Place the oil/air separator within the engine compartment (or heated compartment). Venting must be protected to the blockage of the vent by ice. In case of low ambient temperature before start, the oil air separator must be checked if there is no ice blocking the vent.

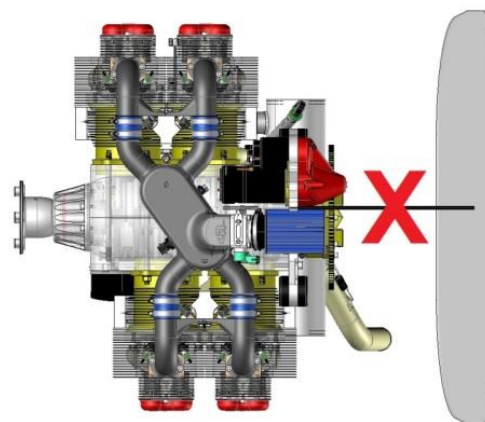


Throttle cable

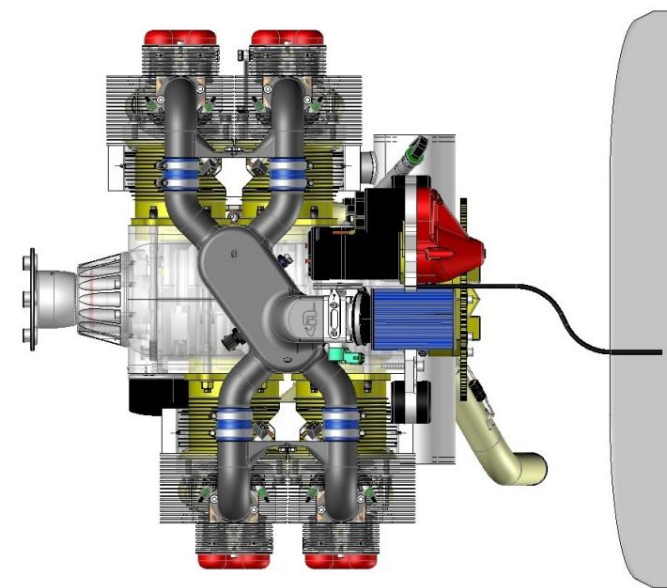


When a throttle cable is installed in a straight line from the throttle lever to the fire wall , or when the lever is controlled by a push/pull (or similar) system, engine vibrations create a non-stop movement of the TPS's resulting in an unstable signal to the ECU . This may lead to an unstable RPM and even a possible engine stoppage in flight.

A [throttle cable kit](#) is available from your ULPower dealer



Not Good



Good

Always install the throttle cable in accordance with the above drawings to avoid engine runs roughly.





Idle speed adjustment...

All engines are factory tested and set to a **warm engine idle** speed of approx. 850 rpm. However, depending on your propeller pitch/diameter, this may need adjusted on installation in your airframe by changing the throttle stop on the throttle body.

- All setting changes require an engine oil temperature of at least 50°C/122°F. Before working on the settings you must turn engine and master switch "OFF". Be careful when adjusting the throttle lever stop as the engine will be hot.
- Do not leave the throttle lever stop screws (3) loose while engine is running to test the idle speed.

If idle speed is too low:

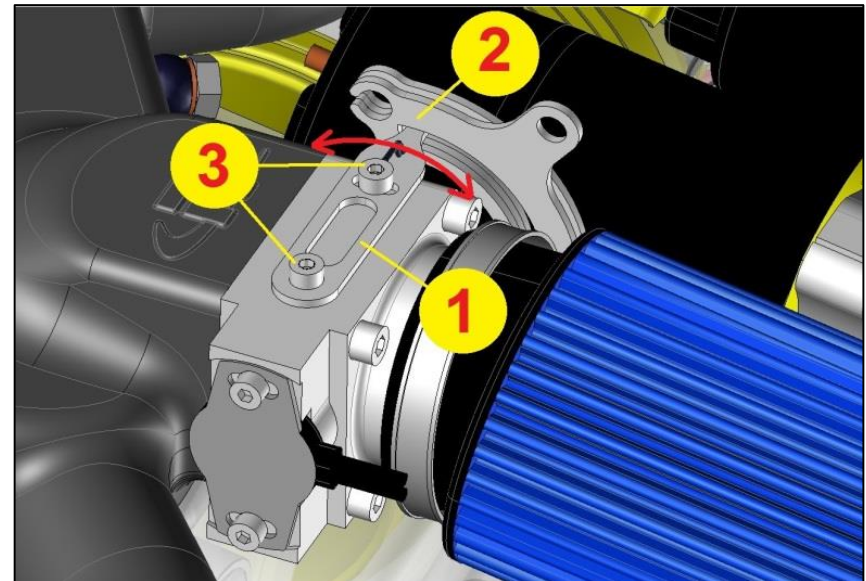
1. Set desired rpm with aircraft throttle and LOCK the aircraft throttle.
2. Loosen stop screws (3) (2.5mm Allen key) and set lever stop (1) to desired stop point
3. Tighten throttle lever stop screws (3) to maximum 3 Nm (2.25 ft lbs).

If idle speed is too high

1. Verify if the throttle lever is completely against the throttle lever stop. If not, stops of aircraft system are not set correctly. Adjust i.a.w aircraft manual. Otherwise...
2. Loosen throttle lever stop screws (3) and move throttle lever stop (1) a few mm towards the right.
3. Tighten throttle lever screws (3) maximum 3 Nm (2.25 ft lbs) and test engine idle.
4. If new idle rpm is too low; re-adjust as described above.

For safety, the throttle spring brings the lever to "wide open" in the event of a throttle cable break.

The idle setting (locking plate) is very sensitive. Changing it 1mm/0,04" can give you 50 RPM difference.



When setting RPM avoid low revs (<850rpm) and rough running as it may cause damage to the engine.



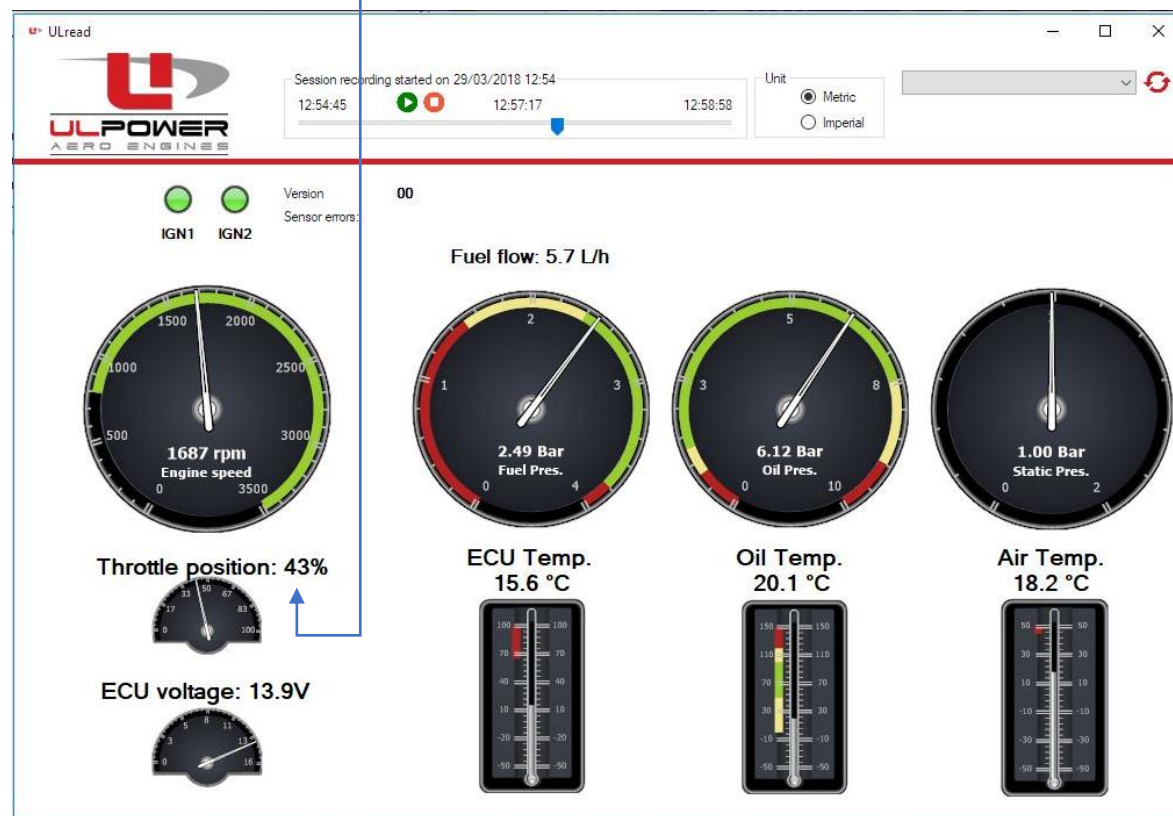


Idle speed adjustment...

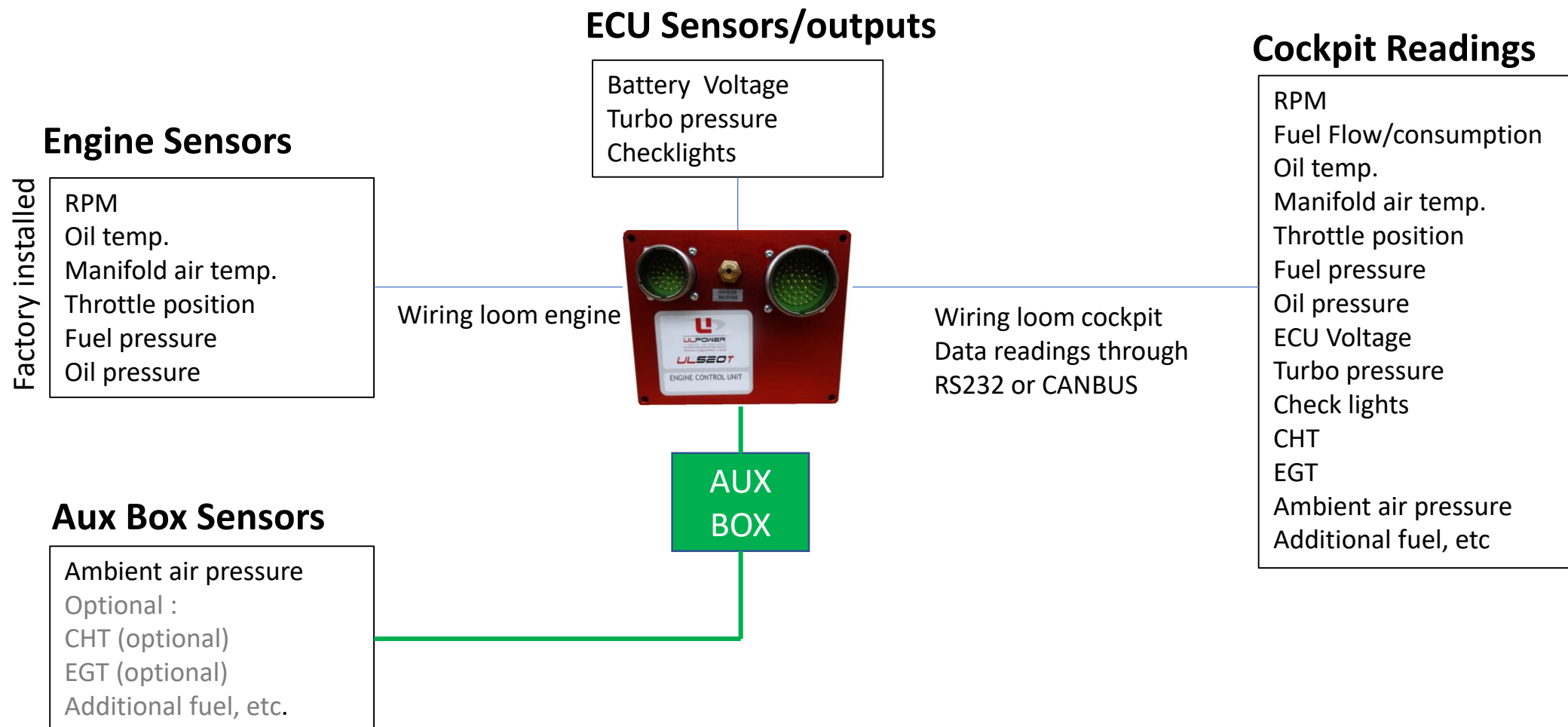
The ECU will automatically adjust the fuel/air mixture when the engine is cold, therefore, **never test/ set minimum idle speed on a cold engine**. The idle RPM can vary (even with warmed-up engine) depending on the atmospheric conditions. Under all conditions, the idle must be at least 850 RPM.

1. Let the engine run hot between 1000-1500 RPM
2. Wait until the oil temperature has reached at least 50°C/122°F (do not exceed 1500 RPM before reaching this temperature)
3. Increase the RPM to 2000-2200 RPM for ± 1 minute
4. Go to idle (throttle lever completely against the throttle lever stop)
5. Assure that the idle speed is **minimum** 850 RPM. If the warm idle speed of the engine is unsatisfactory, adjust as described on the previous page

If you have access to [ULRead software](#), you may want to read out the %age throttle setting:



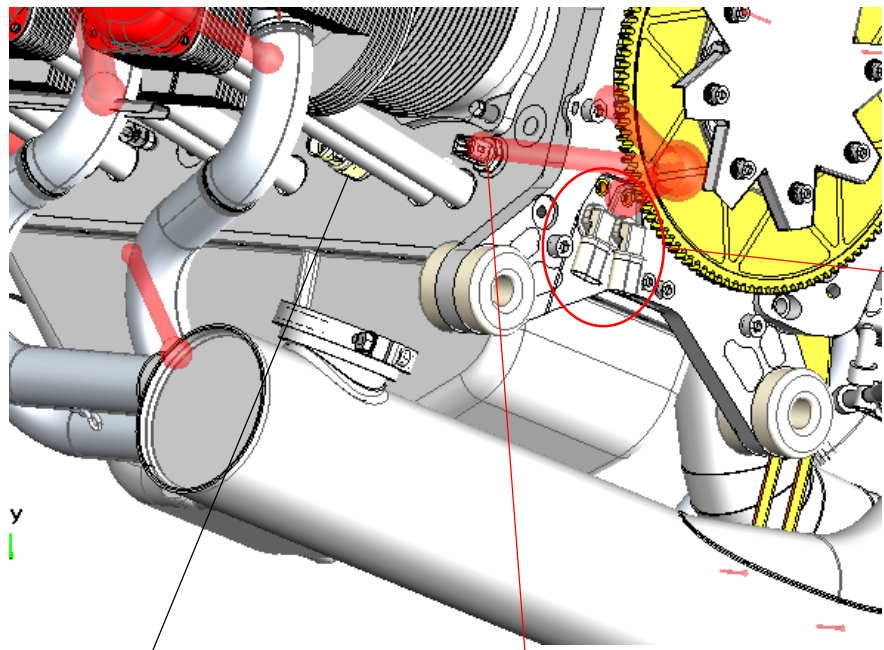
Ecu data output with AUX box





Factory installed senders

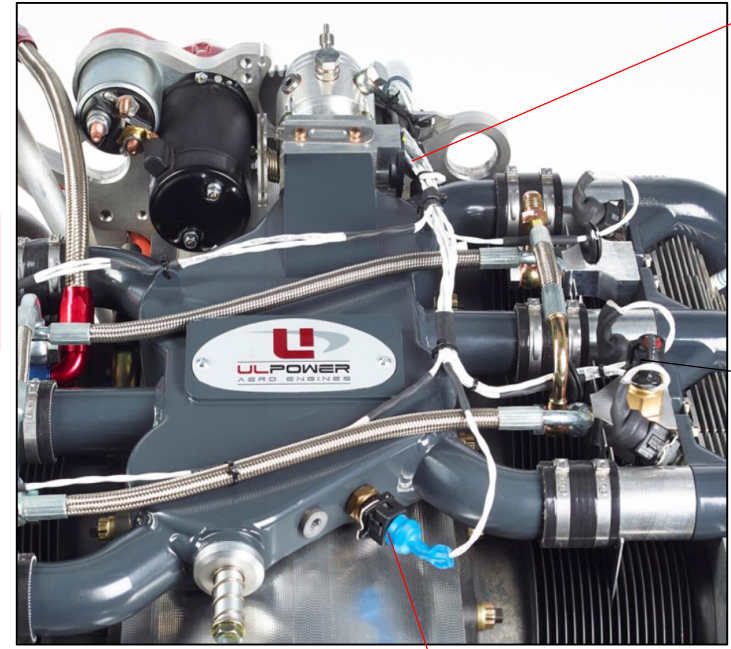
Read out through the ECU per RS232/CANBUS when using a compatible EMS



Oil Pressure Sensor (OPS)

Oil Temperature Sensor (OTS)

Hall Sensor
RPM Sensor



Throttle
Position
Sensor (TPS)

Fuel
Pressure
Sensor (FPS)

Air Temperature Sensor (ATS)



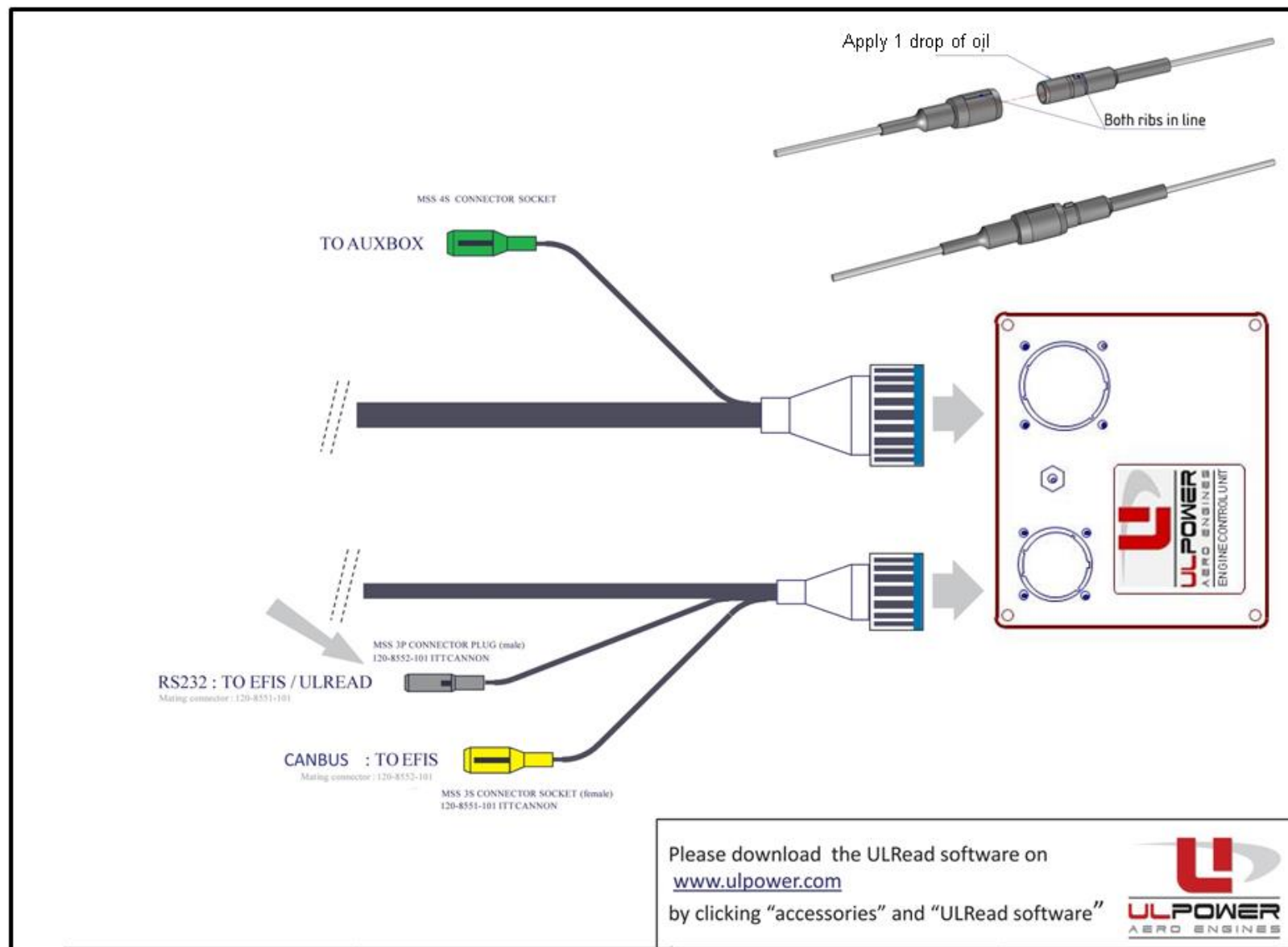
How to connect factory installed senders to your EMS

When using a compatible EMS (engine monitoring system), data will be displayed on your screen by installing 1 single cable and connect to your ECU-COCKPIT wiring loom

Order the connection cable for canbus data transfer (E080303)

Order the connection cable for RS232 data transfer (E080305)

If your system is not compatible or you prefer to work with analogue gauges, please go to the next page





Additional senders -OTS

If your system is not compatible or you prefer to work with analogue gauge, extra sensors (not included) are needed. They can be installed as indicated below

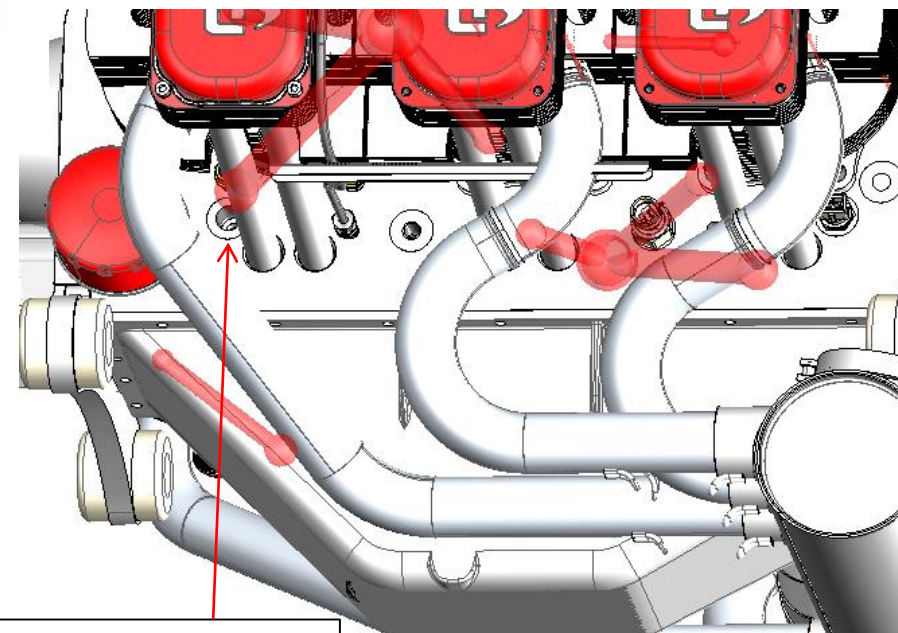
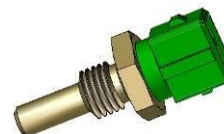
Oil Temperature Sender (OTS)

Recommended specifications

- Range up to at least 130°C (266F)
- Thread 5/8"-18UNF or M10; M10x1; M12x1,5; 1/8NPT if adapter plug (option) is used.

The oil temperature is measured on the left side of the crankcase. (See picture)

An OTS with 5/8"-18 UNF thread combined with a sealing ring can be screwed in. This sensor will indicate the oil temperature in the cockpit. Sensors with M10; M10x1; M12x1,5 or 1/8 NPT thread can also be used with an adaptor plug. These adaptor plugs are available from ULPower if needed. (See accessories/parts)



Interface for oil temperature sensor in case you are not using an EFIS



Additional senders – OPS

If your system is not compatible or you prefer to work with analogue gauge, extra sensors (not included) are needed. They can be installed as indicated below

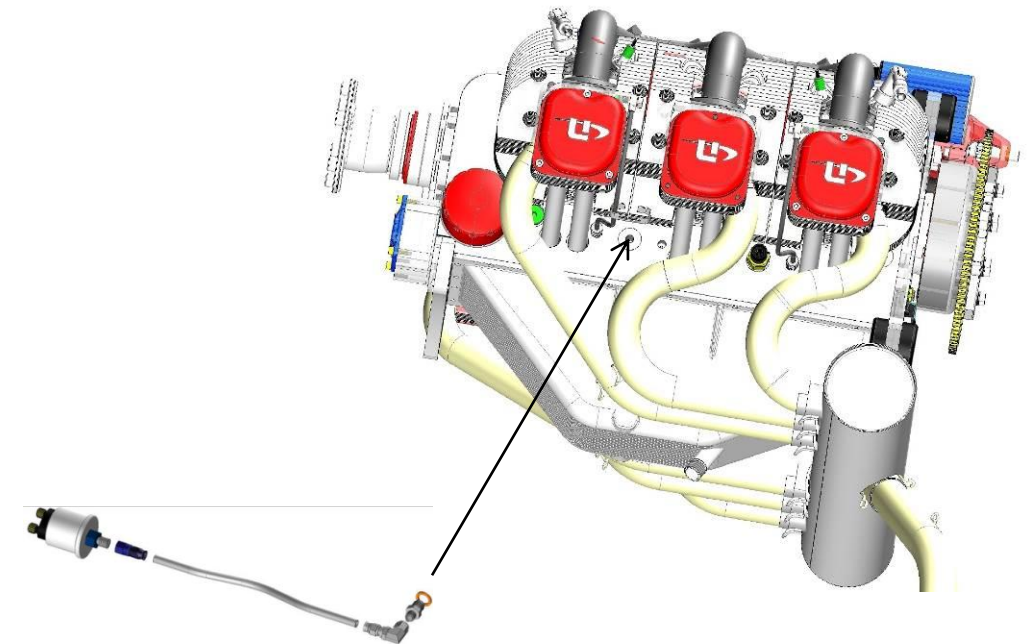
Oil Pressure Sender (OPS)

Recommended specifications

- Range 0-10bar (0-150psi)
- Thread 1/8" NPT

The OPS shown is a passive analogue sensor of the resistive type. This type has to be connected by means of a flexible pressure line in order to avoid sensor failure due to engine vibrations. The sensor can be attached to the engine mount frame or the firewall. [How to install ?](#)

Oil pressure is measured in the main oil gallery at the (top) side of the engine casing, where M12x1,5 thread is foreseen.



Active 12V solid state sensors are more expensive but are much less sensitive to vibration and therefore more reliable. However only certain instruments will accept active pressure sensors.





Additional senders - FPS

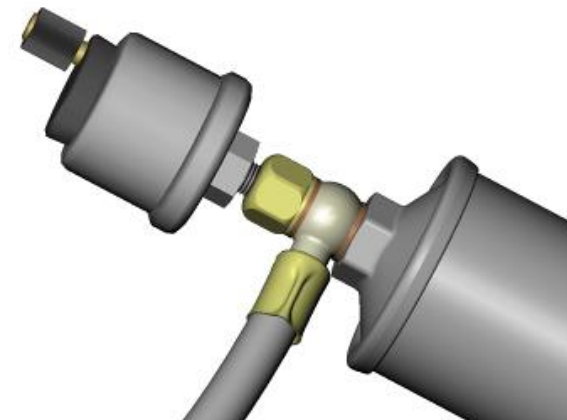
If your system is not compatible or you prefer to work with analogue gauge, extra sensors (not included) are needed. They can be installed as indicated below

Fuel pressure Sender (FPS)

Recommended specifications:

- range: 0-5 bar (0-80 psi)
- thread: 1/8"NPT

If you have ordered the ULP Fuel connection kit, you will have to change banjo bolt (F2551200) that comes with this kit to the banjo bolt with 1/8NPT (E064502) from the K100001 (no efis kit – see next page) . This bolt is screwed on top fuel fine filter. The pressure sensor need to be screwed in the banjo bolt. (see picture)



It is possible to install an optional fuel pressure sender BEFORE the fine fuel filter, which may give early warning of filter contamination – if compared to the fuel rail pressure (which is controlled by the pressure regulator). Rising pressure pre-filter is an indication of a compromised filter.

The 1/8NPT (E064502) banjo bolt needed for the fuel pressure sensor (see previous page) is also included in this kit.



Additional senders - special kit

A special kit K1000001 (fuel and oil pressure kit – no EFIS) is available and contains following items

1m Stainless Braided PFE Hose,

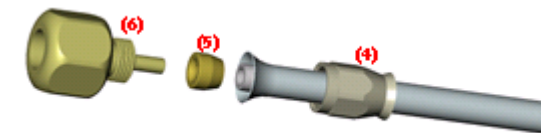
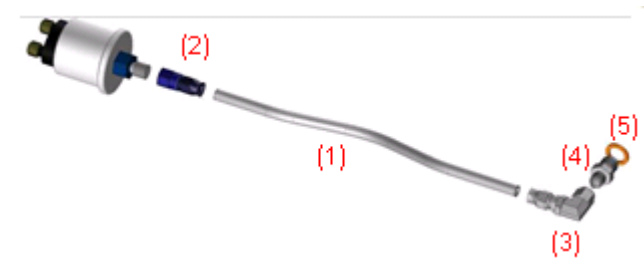
Oil Pressure Sensor Adaptor (2),

90°Reusable-3Jic Swivel (3) with nipple (4) and Copper Sealing Ring (5) .

Banjo bolt 1/8NPT (for fuel pressure sensor – see previous page)

The length of the line will depend on where you would like to install the sensor. Determine the length and assemble the line as follows:

- Apply tape around the hose at the point you wish to cut it to length. This way the stainless steel braid will stay in position and doesn't unravel; a cleaner cut is obtained.
- Cut hose with a metal saw or grinding disc in such a manner that a nice straight end is obtained.
- Unscrew the socket screw (4) of the oil pressure sensor fitting (6). Be careful not to loose the brass cone (5) that sits inside. Before removing the tape, slide the socket screw over the hose including the stainless steel braid.
- Remove the tape.
- Open the stainless steel braid towards the outside to free the end of the inner plastic tube. As shown on the image above. Do not unravel the braid too much.
- Slide/push the brass cone (5) over the plastic tube all the way to the end.
- Push the oil pressure sensor adaptor fitting (6) into the tube.
- Pull back the socket screw towards the fitting and screw onto the fitting as far as possible. Make sure the steel braid does not go in between the thread. Use two spanners - one to hold fitting, the other to tighten the lock screw.
- Repeat on other side with the banjo fitting.
- Clean the oil pressure line thoroughly to ensure no metal, rubber or other particles are inside before connecting the line.





Additional senders -CHT

Cylinder Head Temperature Sender (CHT)

Installing CHT sensors onto your ULPower engine provides essential feedback related to performance. We **recommend** a CHT sender be installed for each cylinder to enable optimum readings of engine performance.

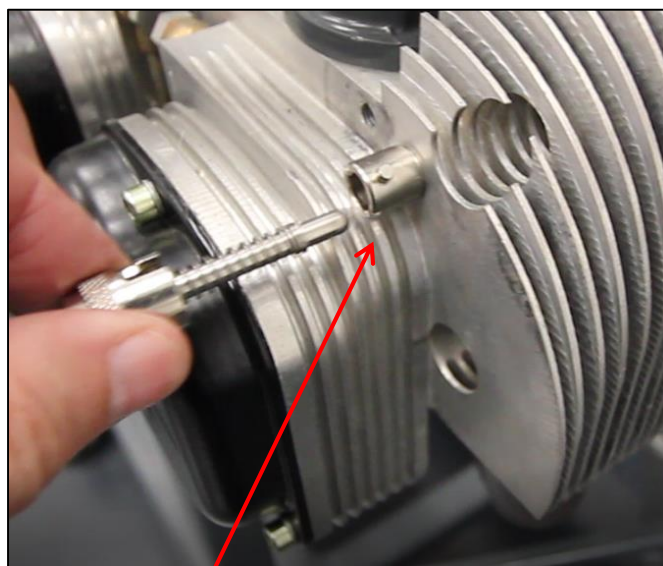
Recommended specifications:

Use a springloaded – bayonet style k- type sensor (yellow wire is +)

[Genuine ULP CHT sensors](#) are available from your ULPower dealer.



READ MORE @  **ULPOWER NEWS**



Before fitting your CHT make sure that the spring is adjusted to ensure CONTACT between the sensor and the cylinder head. Failure to do so will result in inaccurate readings. The genuine ULP CHT sensors are pre-adjusted.

CHT values can be monitored through the ECU (Since the AUXBOX is standard installed) or independently . This leaves the monitoring to the pilot, and allows for the use of either analogue gauges or a feed into a digital instrument of some kind (EFIS, or stand alone)

Interface for CHT Sensor" Thread 3/8 UNF





Additional senders - EGT



READ MORE @ **ULPOWER NEWS**

Exhaust Gas Temperature Sender (EGT)

EGT sensors provide essential feedback related to performance. We **recommend** an EGT sensor be installed for **each** cylinder to enable optimum readings of engine performance

INSTALLATION: EGT senders should be installed at the correct distance from the 'exhaust outlet' on the cylinder head – and all senders should be within a few mm of the recommended 75mm or 3". To install the clamp type, simply drill a small hole, to suit the EGT you are fitting, at the correct distance from the exhaust manifold 'flange', making sure that the orientation of the EGT sensor and lead will not foul the cowling or other items. [Genuine ULP EGT](#) probes are available from your ULPower dealer.

Before drilling the hole in the exhaust, check for interference related to the orientation of the EGT for cowling and other possible interference points.

Securely route EGT cables to your instruments i.a.w. good electrical installation practices.



1. Mark and drill at 75mm (3") from Exhaust manifold

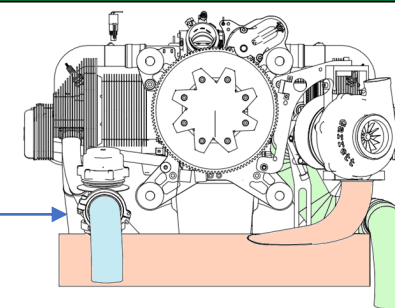


2. Insert EGT



3. Tighten clamp

While drilling into the exhaust tubes, some chips may fall into the exhaust system. Since the muffler is pre-installed at factory, the waste gate must be removed to suck out the particles. This is **MANDATORY** in order to avoid turbo damage.



The ULPower Engine Control Unit (ECU) does NOT monitor EGT temperatures. This leaves the monitoring to the pilot, and allows for the use of either analogue gauges or a feed into a digital instrument of some kind (EFIS, or stand alone). The EGT sensors can be connected with the AUXBOX.





Additional senders- MAP

Manifold pressure Sender (MAP)

An optional Manifold Pressure sender can be installed to give you an indication of how much power you are actually using. The engine power produced is a function of the M.A.P. and engine rpm, the engine performance is controlled by the engine ECU-map, which monitors a variety of factors to adjust mixture, as with all FADEC engines.

INSTALLATION: A suitable flexible hose connected to a MAP sensor may be attached to the air inlet manifold with a double banjo (option) to the inlet collector, instead of the single one supplied for the fuel pressure regulator.

This MAP sensor must be capable to measure a pressure of max. 1.5 bar (44 inHg).



Parts needed :

F2510708 banjo eye M8

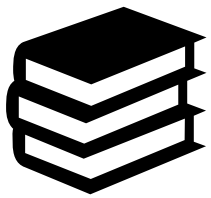
F2520801 double banjo bolt M8

S3081210 (3*) copper ring 8 x12x 1

F2550006 cloth braided hose 9,5 x 4,5

The ULPower Engine Control Unit (ECU) OR **AUX-BOX** does NOT monitor Manifold Air Pressure . This leaves the monitoring to the pilot, and allows for the use of either analogue gauges or a feed into a digital instrument of some kind (EFIS, or stand alone).





Non-ECU/EFIS sender options

In some cases, installations do not take the available data (in full or part) from the ECU RS232 or CANBUS outputs, and therefore may not feed into the EFIS system or in cases where a preference for analogue gauges exists.

When not using the ECU outputs and wiring directly to an EFIS that requires direct connection or to analogue gauge(s), you have choices:

EITHER: Install a Digital to Analogue converter that will stream the data from the ECU into analogue format for your various instruments.

AND/OR: Use the analogue output loom wiring on the ECU cockpit loom GREY heat shrink bundle for RPM and fuel consumption data AND/OR Install additional sensors.

REMINDER:

5. Grey shrink sleeve

white : RPM signal (2 pulses/ rev. 0 – 9V)

white/blue : Fuel consumption (Injector pulse). Output is a duty cycle

100% is equal to 72l/hr

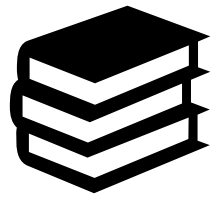
white/red : fuel consumption (pulses/litre)

72l/hr = 170Hz (170 pulses/sec)

DO NOT ATTEMPT TO USE THE SENSORS LOOMED TO THE ECU. THEY ARE AN INTEGRAL COMPONENT OF THE ENGINE CONTROL DATA SYSTEM.

Any interference with this may result in engine performance issues and even engine damage or failure.





Choosing a propeller...

It is possible to use a fixed pitch, a ground adjustable or a constant speed propeller. When using a fixed pitch or ground adjustable propeller it is important to not overload the engine during take-off (see operation manual for min. take off RPM).

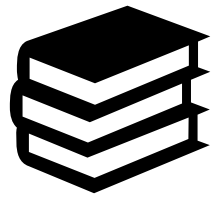
We recommend to use a 'constant speed propeller' to reduce the load on the engine during take-off (only an electrically commanded propeller can be used).

Make sure your propeller is dynamically balanced !

Propellers with a Rotational Moment of Inertia of up to **0,8kgm²** have been used with no known problems. If you are considering a composite propeller, make sure they have been specifically developed to withstand high revving ULPower engines.

It is important to ensure that the propeller is matched to the engine to prevent vibrational frequencies from damaging both the engine and / or the propeller !





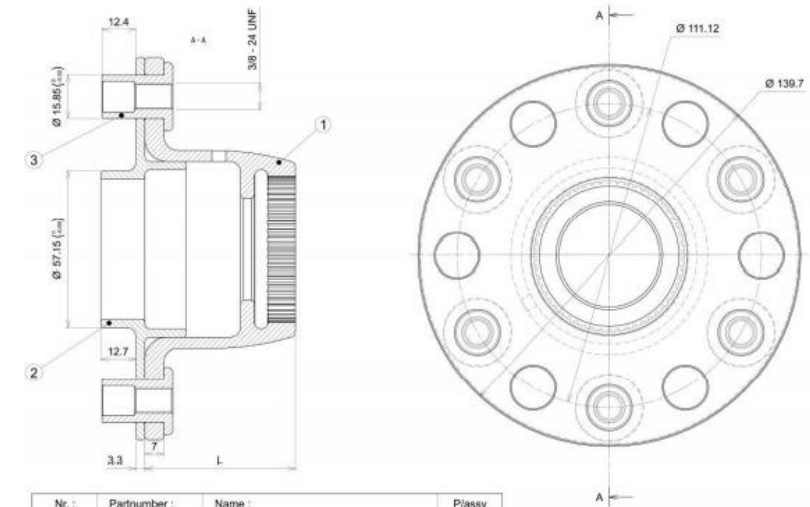
Choosing a propeller...

Ask your propeller manufacturer which prop flange is recommended.

In the [propeller flange document](#) you can find the different types of prop flanges that are available.

- Never (test)run the engine without a propeller or flywheel as this will inevitably cause engine damage and present a hazard of explosion.
- Propeller/flywheel and its attachment with a moment of inertia in excess of the specified value must not be used and releases engine manufacturer from any liability.
- Install the propeller in accordance with the propeller and aircraft manufacturer's instruction.

SAE I - F - Flange : **E022550 L055 / E022550 L090 / E022550 L110 = assembly**



Nr. :	Partnumber :	Name :	Plassy
1	E022520C E022521C E022522C	Propeller flange SAE I L = 55 F - Flange Propeller flange SAE I L = 90 F - Flange Propeller flange SAE I L = 110 F - Flange	1
2	E022535A	Propeller reduction F - Flange	1
3	E023020A	Drive lug F - Flange (SAE I)	6



Preparing for first start / first flight...

Congratulations ! You have now finished your installation and are almost ready for the first start. The [ULPower checklist](#), which you can download on our website, might help you to verify if you haven't forgotten anything important.

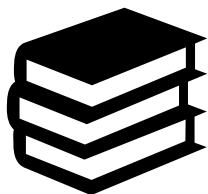
It is now time to move on to the operations manual (OM) . To get you started, we have made a summary of the operational limits on the next pages. Consult the OM for more detailed information.

Make sure that all engine parameters are within limits . Modifications to the cowling, location of the oil cooler or propeller adjustments might be needed.

If you discover any issues, consult our trouble shoot manual or contact your local dealer for assistance.

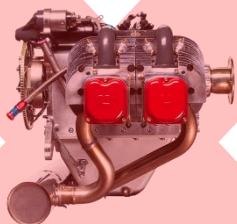
READ MORE @  **ULPOWER NEWS**





Valve cover colours

RED



Red valve covers: engine runs on mogas with minimum 95 oct (RON)

Not available for turbo engines

BLACK



Turbo engines are only available with black covers

Black valve covers: engine runs on **avgas** and **mogas** with minimum of :

97 RON /88 MON – Notation mainly used in Europe, Asia, Africa, South America -

or

93 AKI (RON+MON)/2 method – Notation mainly used in USA and Canada-

15% Ethanol max. (E15)

MOGAS	
Min.fuel grades	RON97/AKI94
Engine	UL520 _r
Fuel specifications	
US Standard	ASTM D4815
European Standard	EN 228 E5 [Superplus]
	R51105-97 (Premium 98)
Russian standard	GOST R51866-2002 (Premium Euro 98)
South African standard	SANS 159-2007
Australian standard	F2019L00456
Indian standard	IS2796
Ukraine standard	DSTU4839-2007

AVGAS	
Min.fuel grades	100/100LL (leaded*)/UL91 (unleaded)
Engines	UL520 _r
Fuel specifications	
Leaded 100/100LL	ASTM D910/DEF STAN 91-90
	UL91/UL94: ASTM D7574/DEF STAN 91-90
Unleaded (UL)	Hjelmco 91/96 UL

*Leaded avgas forms lead deposits in the combustion chamber and valve seats. If possible, use unleaded fuel.





Fluids and Limits – Fuel and Oil

OIL:

Recommended oil volume = 4 litre

1. When using leaded fuel (avgas 100LL) : **Only use semi-synthetic oil** = Aeroshell 15W50
2. When using unleaded fuel : ULP recommends full synthetic oil = Motul (Competition) 300V 15W50

Each engine installation volume will vary depending on oil line/cooler dimension. Always refer to the markings on the oil dip stick with the engine/aircraft levelled as required.

FUEL: The UL520T engine has been tested and is approved with the following fuels. Use of inappropriate fuels will result in engine damage.

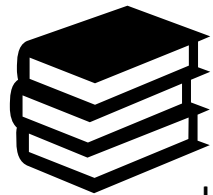
MOGAS	
Min.fuel grades	RON97/AKI94
Engine	UL520 _r
Fuel specifications	
US Standard	ASTM D4815
European Standard	EN 228 E5 [Superplus]
Russian standard	R51105-97 (Premium 98)
	GOST R51866-2002 (Premium Euro 98)
South African standard	SANS 159-2007
Australian standard	F2019L00456
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Unleaded (UL)	UL91/UL94: ASTM D7574/DEF STAN 91-90
	Hjelmco 91/96 UL

*Leaded avgas forms lead deposits in the combustion chamber and valve seats. If possible, use unleaded fuel.

Hot AND/OR ethanol containing fuel is more prone to vapour formation and you must ensure your installation, operation and fuel choice does not result in vapour lock or other issues that may affect your ULPower Aero Engine. Up to E15 fuels will not affect your ULPower engine/Lines, however, it may affect other parts of your fuel system (fuel lines, tanks, etc) which is outside this scope. See Operating Manual for specifics on fuel choices.





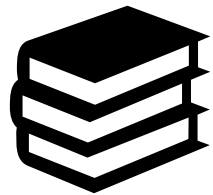
Fluids and Limits – Temperatures/RPM

ULPower Engines (260/350/390/520 series) all have the same operational limits. Generally, there is a software option to enter these limits into your EFIS, or for those with analogue gauges the use of coloured marker tape is recommended.

Value	Volts V *	Oil Temp C / F	Manifold Air Temperature C / F **	Fuel Pressure (rail sensor) Bar / PSI ***	Oil Pressure Bar / PSI +	EGT C / F ++	CHT C / F +++	Outside Air Temperature C/F	Turbo pressure Bar/PSI ++++
Min: Red	12.5V	50°C 122°F	-30°C -13°F	2.4Bar 35PSI	0.7 – 1Bar 10 – 15PSI	300°C 573°F		-25°C -13°F	++++
Yellow	12.5 – 12.7V	50 – 80°C 122 – 176°F			1 – 2Bar 15 – 29PSI	300 – 400°C 572 – 752°F	<50°C <122°F		++++
Green	12.7 – 14.5V	80 – 100°C 176 – 212°F	-30 – 60°C -13 – 104°F	2.4 – 3.4Bar 39 – 49PSI	2 – 5Bar 29 – 73PSI	400 – 850°C 752 – 1562°F	50 – 150°C 122 – 302°F	-25 – 50°C -13 – 122°F	1.32-1.38Bar 19.1 – 20.0PSI
Yellow	14.5 – 15.5V	100 – 120°C 212 – 248°F	60 – 75°C 104 – 167°F	3.4 – 3.8Bar 49 – 55PSI	5 – 8Bar 73 – 116PSI	850 – 880°C 1562 – 1616°F	150 – 170°C 302 – 338°F		1.38-1.40Bar 20.0 – 20.3PSI
Max: Red	15.5V	120°C 248°F	75°C 167°F	3.8Bar 55PSI	8Bar 116PSI	880°C 1616°F	170°C 338°F	50°C 122°F	1.40Bar 20.3PSI

- * When volts are below 12.5V you must land as soon as possible. At around 10V the ECU will stop functioning and the engine stops.
- ** Manifold Air Temperature may be 60 – 75°C on start, but should be below 60°C in flight (Install a suitable intercooler).
- *** Rail fuel pressure is the difference or delta pressure ABOVE the Manifold Air Pressure (M.A.P. may be measured by optional sensor)
- + Oil pressure when running below 900rpm may be between 0.7 and 1.0 bar, when running above 2000rpm oil pressure should be above 2 bar. NOTE: Oil pressure generally reduces as the engine oil warms and changes viscosity.
- ++ EGT values should normally be within 100°C of each other, depending on installation and operations.
- +++ Adjust fin cooling to remain CHT values within 20°C of each other.
- ++++ Turbo pressure must be in 'green zone' AND stable at min. 2300 RPM and min. 40% throttle position. At start (idle) turbopressure = ambient pressure





RPM and Altitude Limits

RPM Limits: The engine has an ECU RPM limiter set to 2700rpm as standard.

Minimum Recommended Idle*	**	Normal Operation ***	Maximum
850 rpm	850 – 1000 rpm	1000 – 2700 rpm	2700 rpm

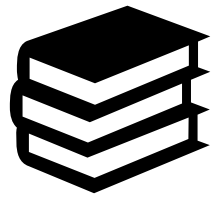
- * For specific applications idle may, exceptionally, be reduced to 700 rpm provided vibration is not excessive on the installation. Idle values are WARM idle. That is once the engine has reached an oil temperature of 50°C or above. Always ensure the engine is warm before setting your idle values. Avoid unnecessarily low idle speeds and vibrations.
- ** Once started, warm the engine between 1000 and 1500 rpm until oil temperature reaches at least 50°C.
- *** Operation in the this range is normally for take-off and climb operations.

RPM: Where applicable, we recommend a red line at 850rpm and 2700rpm and that the 850 - 1000 range be in yellow

For further details and propeller operating ranges refer to the Operating Manual

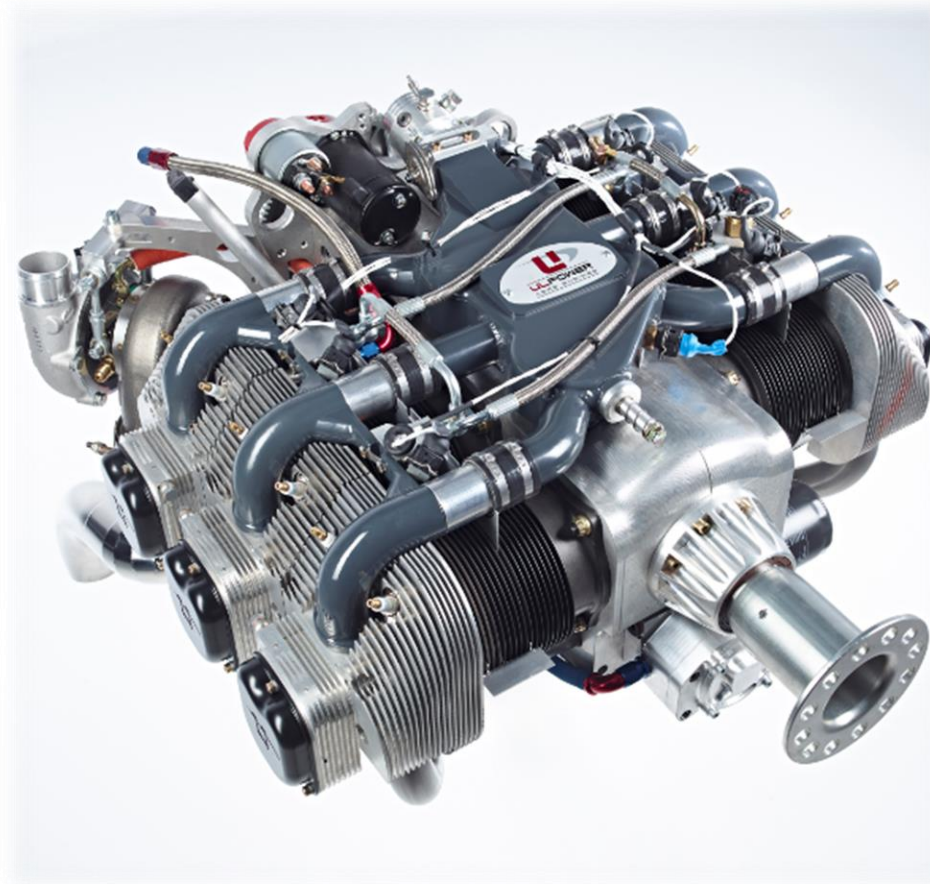
Altitude Limits: The 3-dimensional fuel map, calibrated from -3 000ft to 27 000 ft density altitude, controls the mixture and timing from start-up to shut-down.





Dimensions

The technical data document, which is available on www.ulpower.com , provide diagrams and information on dimensions, weighs and other engine specific data.





Further resources

ULPower Aero Engines have a number of places where you can find further resources: Click on the logos/links to link directly...



www.ULPower.com - [The Official Company website](#)

www.ULPower.com - [Authorised Manuals Pages](#) (includes the latest installation, interactive troubleshooting and maintenance guides shown below as well as Illustrated Parts Catalogue, etc)



The illustrated troubleshooting and maintenance guides, coupled with the Illustrated parts manuals are essential documents to keep to hand (on your phone or tablet or printed out, as suits you).

ULPower Service Bulletins: <https://ulpower.com/en/engines/service-bulletins>



www.ULPower.news - [ULPower blog](#), technical pages, people, aircraft and much more – just for ULPower Aero Engine owners and prospective owners.



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Revisions

Revision 1.1 (2022-04-01)

[Slide 38-39](#): Add heat shrink colour engine wiring loom

[Slide 38](#): Breakers instead of fuses

[Slide 42-45](#): Add additional AUXBOX installation instructions

[Slide 76](#): Rotating compressor housing

[Slide 93](#): refer to prop flange document

[Slide 95](#): Incorrect value (39 PSI) for min. fuel pressure. Changed to 35 PSI. 'bar' values are correct.

[Slide 96](#): Only use semi-synthetic oil

Revision 1.2 (2022-07-14)

[Slide 5](#): picture caps added, spin compressor wheel

[Slide 38](#): Switches FP 1,2 and ECU behind breakers

[Slide 89](#): Clean muffler when drilling EGT's

[Slide 90](#): extra info on connection MAP sensor

[Slide 96](#): Only use semi-synthetic oil for avgas, recommend full synthetic oil for mogas

[Slide 97](#): CHT green, yellow, red range adjustment (50-140, 140-170, 70 was 50-160,160-180,180)

Revisions

Revision 1.3 (2023-10-05)

[Slide 21-23](#) : Boost controller wiring loom : 2 inputs since SN220101

[Slide 33](#) : Check light additional information

[Slide 39](#) : 20A fuse for ECU

[Slide 51-52](#) : Regulator : provide cooling air

[Slide 58](#) : Capacitor M5 or M6 screws

[Slide 80-81](#) : Clarification 'how to set idle'

[Slide 95](#) : Additional information RON/ROK/AKI fuel