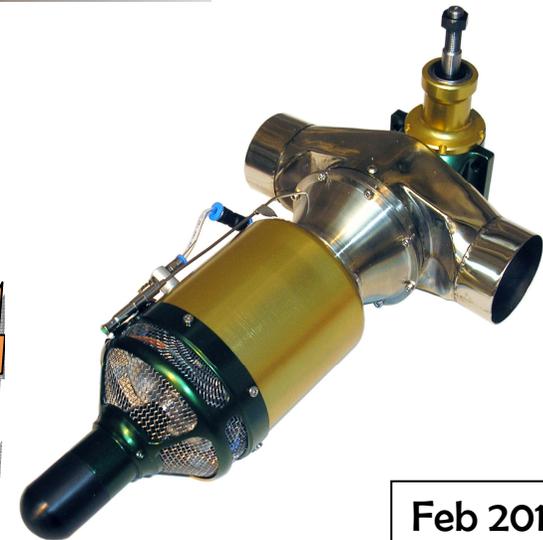




Kerostart supplement
for Wren 44 Gold Thrust,
Turboprop and Heli engines



Wren 44 Gold KeroStart Supplement



Feb 2012

Wren 44 Kerosene Start Supplement

This supplement is supplied to assist Wren 44 owners to install and operate the new Wren kerosene start system with Xicoy Au107K ECU. This system replaces propane start components except the valves which are retained. Propane tanks, flow controls, filling valves etc, are no longer required. **The green propane feed pipe should be blanked off close to the engine.**

PLEASE NOTE – If you have bought an engine from Wren Turbines with a kero start fitted, PLEASE DO NOT jump in and change the settings supplied as the engine will have already been carefully set up ready to run.

Setting up the kero-system is straight forward but users are requested to take particular care in setting values to the ECU. The ECU allows access to all values held in the memory. Most should not need adjusting and customers are asked to refrain from making changes to these values as they may have a significant effect on the engine starting and operation.

Those settings which access IS needed are described in the checklist. These notes are not intended to replace the existing instructions and users should refer to these for guidance on installation and operation.

The installation assumes the engine is fully serviceable and is a current Wren 44 Gold unit. Contact us first if your engine is an earlier model. Fitting a kero-start system will not cure a poorly starting engine – so be sure your engine is in good working order before fitting. If you are unsure of the suitability of your engine please contact Wren Turbines Ltd.

All Wren 44 Turboprops and 44 Heli's are based on the 10Lb thrust Gold engine so if you have one of these this system will be suitable. The system requires a LiPo battery of 1800mAh or better. A C-rating of 20 or more is needed.

The operation of the fuel pump is more critical in a kerostart system as the fuel pump must be able to reliably run at a slow power setting. For this reason we use a fuel pump made especially for small engines. Other pumps are not suitable.

Operation of the two valves is also critical as rapid switching of these is used to regulate fuel flow at the starting, these components must be in perfect order. The brass type are suitable and have proved reliable.

Fuel must be kept clean and free of water ingress – even tiny amounts can make deposits on the pumps gears and spoil the valve seats and make successful kerosene starting impossible. Inspect your fuelling equipment and filters regularly and dispose and replace any fuel with water or particle inclusions.

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How does it work?

The kerostart system is basically an alternative form of heating from the propane system used in gas start engines.

Heating is achieved by igniting and burning a small amount of fuel using a small plug called the Burner. This is a small ceramic element enclosed in a stainless steel housing with a very small clearance around its tip. The housing fits the normal glowplug hole and uses the same glowplug cable.

The element is heating by passing electrical current through it and its tip glows bright orange (voltage set in ("Glowplug Power")). Kerosene fuel is then pumped through the narrow gap next to the glowing element and it bursts into flame. This flame then provides enough heating in the combustion chamber to allow fuel to vapourize when passed down the vapourizer tubes in the normal way.

The amount of fuel used for the burner is very small and the fuel pump is unable to run this slowly in a reliable way, so the solenoid valve supplying the burner switches on and off rapidly to help regulate the flow. The longer the valve stays open the more fuel passes and this is how the ECU controls the flow.

The setting for this is important as too little flow and there will only be a small flame, but too much and the element may be cooled so much the fuel fails to ignite into flame. Also, if the engine is spinning too fast while the small flame is going it may blow the flame out so rpm must be carefully controlled ("Starter Power at Ignition" and "RPM Ignition Kero").

This stage is called *Ignition*.

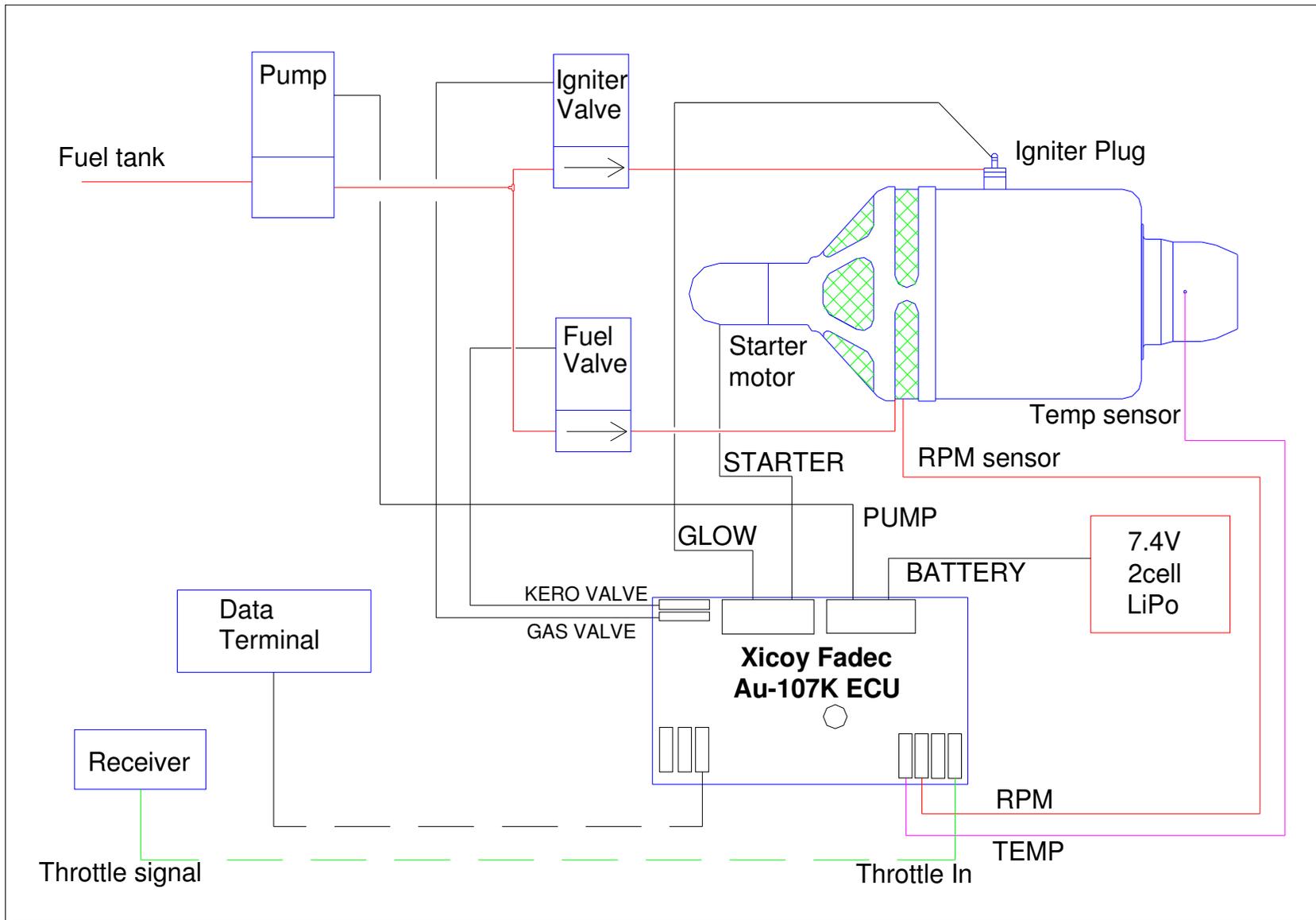
In the ECU, the amount of fuel fed to the burner is controlled by the function "Pump Power Ignition Kero" in the START menu and the engine speed after the burner has ignited, is controlled by "RPM Ignition Kero".

Once the ECU has seen enough temperature rise from the small flame it will begin pulsing the main fuel valve to the combustion chamber in addition to the burner - a very small amount initially so as to establish combustion properly. This stage is called *Preheat*. Functions used at this stage are "RPM Preheat Kero" (sets the rotor speed at this point) and "Engine Preheat Fuel" (amount of fuel allowed into chamber).

Once the ECU has seen enough temperature rise (set in "EGT End Preheat") it will gradually increase the starter speed and main fuel valve opening time to increase the fuel flow to the main chamber and conversely reduce fuel flow to the burner until it is shut off completely. This stage is called *Switchover*.

At *switchover* the fuel pump is driving at a new rate set by a number - "Pump Start Point" and the rate of increase of the starting is set by "Pump Start Ramp" and the initial %flow through the fuel valve is set by "Engine Min Flow". This %flow and increasing rpm continues increasing as the engines accelerates up to the point where the fuel valve is 100% open – display shows "FuelRamp". The fuel pump power keeps rising until the starter is no longer needed ("RPM Off Starter") and continues until the engine reaches the idle speed set.

Note we have highlighted "Pump Power Ignition Kero" and "Pump Start Point" in red as these are the main adjustments needed to "tune" a new fuel pump or adjust for a worn one.



Connection Schematic for Fadec Xicoy AU-107K ECU.

Components required for 44 kerosene start installation:

44 Gold Engine (thrust, heli or turboprop)
Xicoy AU-107K ECU (pre-programmed for 44 kerostart)
3-wire type Data Terminal
HauSl ZP25M14 magnetically coupled fuel pump
Two valves c/w 3mm push-in fittings, (brass type)
Wren kero burner
3mm ptfе burner feed pipe and inline connector
3mm T or Y connector
3mm fuel piping
2-cell LiPo 1800mAh, 20C rating battery



Xicoy AU-107K ECU showing plug locations.

See text for details on what plugs in where.

Quick start installation, mechanical:

Position the fuel pump, ECU and valves. Place valves as close to engine as possible.

Screw burner onto engine plughole using earth terminal above the banjo fitting.

Rotate the burner feed into the direction to suit your install before tightening.



Fit plug cap to burner nipple.

Push on ptfе 3mm tube onto burner nipple and slide green gland nut over top and screw on firmly/gently.

Connect inline 3mm fitting to end of burner ptfе tube.

Connect a short (20mm) 4mm tube onto fuel pump inlet and longer 3mm tube to outlet.



Push on Tygon feed from tank onto 4mm pump tube.

Position T connector close to valve inlets and connect pump outlet to T inlet with 3mm tube.

Connect T outlets to each valve with 3mm tube.

Connect one valve output to engine fuel inlet with 3mm tube.

Connect the other valve output to the burner feed fitting with 3mm tube.

Quick start installation - electrical:

Refer to the picture of the ECU on previous page for plug locations.

Plug burner valve to the 2-pin socket marked as “Gas valve” on ECU (see top left).

Plug engine fuel valve to adjacent 2-pin socket marked “Fuel valve” (extreme top left), note – this label is on side of ECU.

Plug in the receiver throttle signal wire from receiver to the plug marked “Throttle input” (see bottom right).

Plug in the engine rpm sensor to the 3-pin plug marked “RPM sensor” (bottom right).

Plug in the engine temperature probe to the 3-pin plug marked “Thermocouple” (bottom right).

Plug in the glow/starter cable from the engine, using extension if fitted, (see top right).

Plug in the battery/pump cable (top left). Leave the battery end unconnected at this stage.

Plug in the data terminal (bottom left). A standard servo type extension cable can be fitted to the model to allow convenient access, if required.

Setting up ECU (Engine Control Unit)

Remove all rates, mixes and throttle travel settings in the transmitter. The setup assumes the use of a transmitter with manual trims.

Digital trims and Throttle-Cut function.

If you have a transmitter with digital trims you can simulate the trim up/down function using the “Throttle Cut” switch, which is usually a function switched through a toggle switch mounted on the transmitter (must not be spring loaded). Consult your radio manual for this function. Setting the ECU using the “Throttle Cut” function is done in the same way except that when “trim-up” is required you switch the “Throttle Cut” to off, and when trim-down is required, you switch to “Throttle Cut” on.

For initial testing the normal digital trims can be used if you don’t want to have to explore the “Throttle Cut” function just yet. The trim up/down function is used to switch the engine to “ready to start” and “off”, and would not normally be used to vary the idle rpm. Note - some transmitters may need throttle reversing - see later.

As the display does not photograph well we have reproduced the display readings as a green box.

Turn on the transmitter and receiver. On power-up the screen should come on and after a few seconds should stabilise to the opening screen and should show as right:

Trim Low	T=020°C
RPM 00000	PW 000

(If the temp” probe is not connected it will show as 0°C). “T” = ambient temp’.

There are four buttons on the display. The buttons are: ▼ ▲ -+.

To scroll through the different screens use ▼ ▲.

Start Info Run
Start Radio

The buttons - + are used to change the values stored.

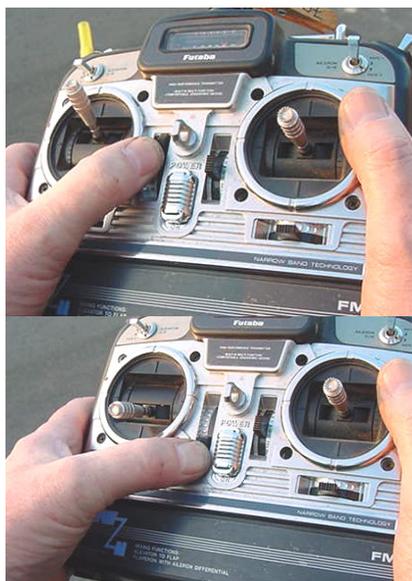
Press the Up button (▲) and scroll through the menus until you find the one showing :

Transmitter adjust Enter

Press the minus (-) button and the screen will change to:

Press the + button to enter the radio setup screen. You should then see this screen:

Stick Up Trim Up (Full power)



On your transmitter, place the throttle stick and trim to maximum and press the + button to set the value into the ECU.

The screen will now change to:

Stick Down Trim Down (Stop)

Move the throttle trim (or switch the "engine cut" switch to on) and throttle stick back to zero and again press the + button.

The display will now change to:

Stick Down Trim Up (Idle)



Leaving the throttle stick in the minimum position, raise the throttle trim to the max position or switch "Engine Cut" switch to off, and again press the + button.

The display should then show:

Thrust curve: LINEAR

Lower trim to zero. Now switch off the receiver.

Turn the receiver on again, if you have done all the steps correctly the opening screen will show "Trim Low" and if you raise your trim to full it should change to "Ready" and a blue led will light on the ecu. If not, you will need to reverse the throttle channel on your transmitter and repeat the radio setup.

This completes your radio set-up. It should only need doing again if the radio settings are changed or installation moved to another radio but it is worth rechecking periodically.

Setting up to run engine:

Turn on the receiver and verify the screen shows a reading.

Go into the 3rd screen and enter the “RADIO” menu and perform the transmitter setup if not already completed.

Connect the LiPo battery. Turn on fuel if you have fitted a shutoff tap between pump and valves (preferred position).

Ensure trim and stick are at zero. Enter “INFO” menu and go down the entries until you get to “test” functions. Find “Test/Prime Pump”. Press “On” button to turn on fuel pump and watch fuel travel along from the tank to the engine. Press “Off” to stop.

Go further down “INFO” menu to “Prime Burner On Off”. Press “On” button and watch fuel travel to burner, then press “Off” to stop. Do not prime longer as you risk pouring fuel into the engine which will cause a flaming start. Small bubbles in the pipes at this stage will not prevent a start, just delay it.

Place the engine/plane into a suitable place and prepare for a start. Use helper if required to restrain model.

Position fire extinguisher – if you get into trouble place trim down, stick down immediately to halt the start. Then energise the starter by raising the stick to full to spin the engine up to clear.

If you have a fire, position CO2 extinguisher nozzle at engine intake and use short bursts to put out.

Starting the engine.

Turn on transmitter and receiver.

Plug in display - screen shows "Trim Low"

To initiate the start, raise trim to full, ((led in ECU lights and screen shows "Ready"). Place stick to full and back down quickly. **(Holding the stick at full will spin engine at full power – can be used to cool down from a previous hot start or run)**

Starter will spin engine briefly and then power igniter (screen shows "Glow Test" then "Burner On").

To initiate start without spinning engine raise trim to full, raise stick half way and back down.

Igniter will heat and after some seconds starter will spin engine slowly, pump will turn on slowly, igniter valve ticking. If pump does not come on raise "pump power ignition kero" until it does.

You should hear a pop and combustion starting in the engine and temperature rise on the display. (Screen shows "Preheat"). If too gentle, increase "preheat fuel".

After some seconds engine speed and temp' will increase, valve pulsing will speed up and the main fuel valve begin to open and engine begins accelerating towards idle. (Screen shows "Switchover" then "Fuel Ramp"). If engine stops at switchover, increase "pump start point" until it continues. (Sometimes needs to be "50" or more).

If the engine slows down or makes smoke at switchover, increase the value for "min flow" as the flow is not high enough to make a successful switchover.

At the end of "switchover", burner turns off at around 20,000rpm, and "fuel ramp proper begins".

Engine continues accelerating and starter turns off as it passes 30,000rpm.

Engine arrives at 55,000rpm - idle, (screen shows "Running").

You now have control of engine via throttle stick.

At any time the start can be terminated by lowering stick and trim to zero. The throttle stick can then be used to switch the starter to clear/cool the engine.

After running.

After running or flight, raise rpm to 80,000rpm for ten seconds and lower stick and trim to zero for cooling.

ECU will spin engine in short bursts until the temp reading goes below 100°C where it will stop. If temp rises above 100°C again ECU will spin the engine again until below 100°C.

Once cooling is complete display shows "Stop".

You can turn off receiver and transmitter and disconnect LiPo battery, if this is the last run for a while, or you need to recharge.

Never recharge a LiPo whilst installed in a model.

Settings used in ECU.

A Wren supplied kerostart engine package will already be adjusted for optimum ECU and pumps settings and should need little or no attention, so do not fiddle with the settings.

As the fuel pump wears it may be necessary to adjust settings – see later.

An upgrade set of kerostart parts will have the ECU supplied pre-programmed with initial values but may need tuning to get clean and secure starting for the particular engine and install.

Please note, ***no*** two installations will be truly identical so ***do not*** swap settings with a colleague with a similar engine as they will most likely not be compatible.

If the fuel pump is replaced, new settings may be required as no two pumps have precisely the same characteristics.

A problems checksheet follows in the next couple of pages. It lists common faults and the likely cures and hopefully will solve your problem quickly.

Please use the checksheet before calling us – it is there to help you to save time trouble and expense.

If you find something not covered then of course mail us with a description and we will try to help you: info@wrenturbines.co.uk

Please note, we can only help users with a kerostart issue on a Wren engine.

ECU default values and adjusted settings:

<u>Item:</u>	<u>Initial value:</u>	<u>Your values:</u>
Pump start point	030-50	
Pump start ramp	004	
Glow power	6.9v	
Low battery volts	6.0v	
Starter power at ignition	060	
Starter power at fuel ramp	070	
RPM point 100% starter power	25,000	
RPM starter off	30,000	
RPM reconnect starter	27,000	
RPM Ignition kero	7,000	
Pump power ignition kero	31-50	
Engine min flow %	55-60	
EGT end preheat °C	180-200	
RPM preheat kero	12-14,000	
RPM fuel ramp kero	20,000	
Preheat fuel	50-70	
Ignition timeout sec's	24.5	

Items highlighted adjusted for fine tuning DO NOT TWIDDLE WITHOUT REASON

Problems Checklist:

The usual problems associated with a kerostart installation can be narrowed to just two key items – the “Pump Start Point” and the “Pump Power Ignition Kero”. Both of these can be trialled with the same number and are adjusted to suit each fuel pump fitted to the system.

A tight or new pump will benefit from some running-in before fitting and this helps to settle the gears etc. The values may need to be raised considerably to get the initial settings to get the pump going. As the fuel pump loosens in service the values for these functions may then need reducing by a few points to make a start less aggressive.

We present here some of the usual things encountered in the hope they clear up any problems you might see.

The checklists are listed in the order in which problems may be encountered, ie setup and starting.

It is not intended in this supplement to cover normal running problems as these would already be covered in the respective operators manuals.

A detailed manual covering all the kerostart functions is available to download from Xicoy Electronica SL on www.xicoy.com

Be sure to ask for the V10 kerostart manual (there is a choice of gas start too).

Symptom	Problem	Action
No reading on ECU display unit	RX not switched on or RX battery discharged	Verify connection and charge if necessary
	Display not connected properly	Ensure that display is plugged in the correct orientation
	Display malfunction	Contact Wren
	ECU problem	Contact Wren
Transmitter stick down/trim up reads “StickLo”	Throttle channel needs reversing,	Reverse channel on Tx (most Futaba’s need this)
Temp’ reading incorrect or “0”	Thermocouple not connected to ECU	Verify connection
	ECU problem	Contact Wren
	Thermocouple failure	Contact Wren
Temp’ reading shows lower or negative figure on ignition	Thermocouple plug inserted wrong way round	Ensure connector matches the label on the ECU
No rpm indicated when engine is spun	Rpm sensor plug inserted incorrectly	Ensure connector matches the label on the ECU
	Rpm sensor lead broken/chafed	Remove source of chafing and repair/replace
	Rpm sensor malfunction	Contact Wren
	ECU problem	Contact Wren
Kerosene does not ignite	Glow power set too low	Check at least 6.8v in start menu - Glowpower
	Poor glow at igniter	Check connections / earth
	Plug partially blown	Replace element
	ECU battery low	Charge
	Burner fuel too low	Increase burner fuel (Pump Power Ignition Kero)
	Burner valve not operating	Check valve inserted correctly into ecu
No kerosene ignition	Pump not turning	Check pump for correct operation (use “TEST/Prime PUMP” in INFO)
ECU shows “GlowBad”	Element blown / open circuit	Replace element (call Wren for service replacement)

Problems Checklist – con't

Symptom	Problem	Action
Fuel pump not running	Pump not connected	Check wiring
	Pump jammed with foreign object	Investigate operation and rectify (disconnect, run backwards to clear)
	No drive from ECU	Contact Wren
No or little temp' rise on ignition	Insufficient burner fuel	Increase Pump Power Ignition Kero
	Temp' probe not inserted into exhaust cone	Insert 6mm
Pump runs but no fuel delivered	Fuel not reaching tank pick-up	Check clunk for blockage. Ensure fuel line is not kinked
	Pump fault	Check solenoid operation
	burner solenoid not opening	Check wiring to ECU
No or little rpm increase as fuel enters	Insufficient revs on starter motor	Recharge ECU battery
	Clutch slipping	Replace O-ring
	Air in fuel line	Purge fuel lines and retry
Trim down/shut off fuel immediately		
Excessive flaming	Residual fuel in engine	Spin engine "dry" for 5 seconds to clear
	"Engine min flow" % too high	Reduce 2 points and retry
	Insufficient revs on starter	Recharge ECU battery
	Starter motor weak/inoperative	Contact Wren
	"Pump Start Point " too high	Lower by 2 points and retry
	Engine malfunction	Return to dealer
Normal problem until ECU settles down		
Engine overshoots at idle	Aggressive starting	Clear excess / lower Pump Start Ramp by 2 points and retry
	Air in fuel line causes late but rapid start-up	ECU will correct itself and settle down
Engine slows or is stopped during start	Engine min flow set too low.	Increase by 2 points and retry
	Wild rpm reading	Interference to rpm pickup by burner wiring (usually), find and move. Check starter/burner wires are well twisted.

We hope you have found this supplement helpful and that you have enjoyed success in operation of your Wren 44 kerostart engine.



Please note, all the items used in the kerostart system are available as individual spares – no need to buy a whole new unit.

The ceramic burner element is regarded as a long life component but as with all electrical devices can decide to give up without warning.

If the screw-in centre section of the kero igniter is returned to us we can refit a new element for a small charge.

Alternatively you can buy an extra one for holding as a spare in your flightbox so you never need to lose a flight due to an expired element!

We are always pleased to get feedback from users and to take additions to this supplement to enhance the experience of others following the same pathway.

Please send us any comments or suggestions for inclusion to info@wrenturbines.co.uk.

Thank-you

Wren Turbines Ltd (UK)
Wren Turbines USA

Feb 2012