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XICOY X120

RCJI tests the new turbine from Xicoy

Turbine Package Contents:
- Xicoy X120 Turbine
- Instruction Manual on USB Card
- Brushless Fuel Pump
- Turbine Interface
- SDT (Smart Data Terminal)
- Leads
- Fuel Filter
- Fuel tubing

Having tested the X45 turbine from the innovative Spanish company of Xicoy Electronica a few issues ago and been hugely impressed, I was keen to see what would follow from the imaginative mind of Gaspar Espiell, the creative genius that owns the company. Well, I was not to be disappointed, with the almost simultaneous release of both a 90 and a 120 Newton turbine. With limited supply and many eager customers, it was always going to be difficult to obtain an engine for testing, but thankfully our regular columnist David Gladwin had ordered an X120, and very kindly agreed to pass it on to me for testing, even before he had a chance to give it a run.

Supplied in a very attractive full colour box (shared with the X90), the X120 and its ancillary parts are nicely packaged and well protected from harm. The turbine itself was the first item removed from the box, and rather like I found with the X45, the extremely compact dimensions were a shock, when compared with almost all current engines with a similar thrust level. With an overall length of 198mm and diameter of 90mm, the X120 looks tiny, and weighing a mere 1042 grams, complete with mounts and the supplied FOD guard, it is also exceptionally light. To illustrate just how turbine technology has progressed over the years, I took the photo shown here of the X120 alongside my old RAM1000 (which has a similar nominal thrust), the size difference is obvious, however perhaps even more impressive is the reduction in weight, with the X120 plus all ancillaries being roughly 50% of the weight of the RAM, whilst also having significantly lower fuel consumption.

This neat full colour box is used by both the X120 and X90, only the internal packaging being different.

The turbine itself has a very smart overall appearance, utilising a machined from solid main casing with a purple anodised front cover, within which the fuel valves and ECU are situated. Having a very clean and uncluttered external appearance, as both the igniter and thermocouple are internally mounted; the engine has only two connections, a single 4mm fuel input and a three pin electrical socket, as the engine features full digital operation.

The turbine and main components laid out, note the minimal overall component count given the simplicity of the X120, the digital control system reducing the lead count.

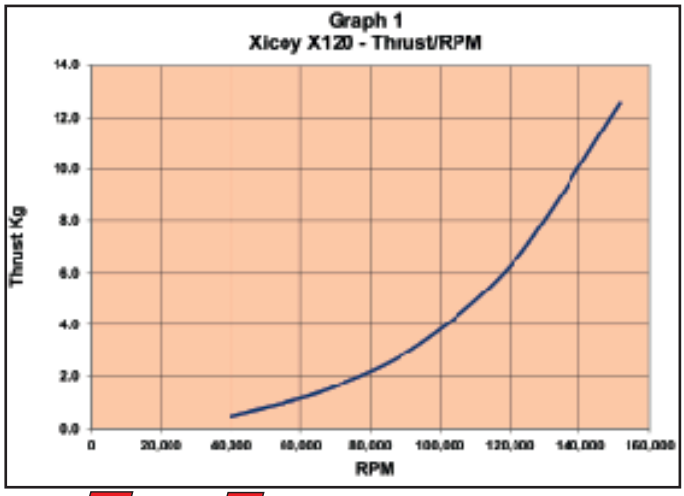
Very clean and uncluttered external appearance of the X120, aided by the use of a single electrical connection.

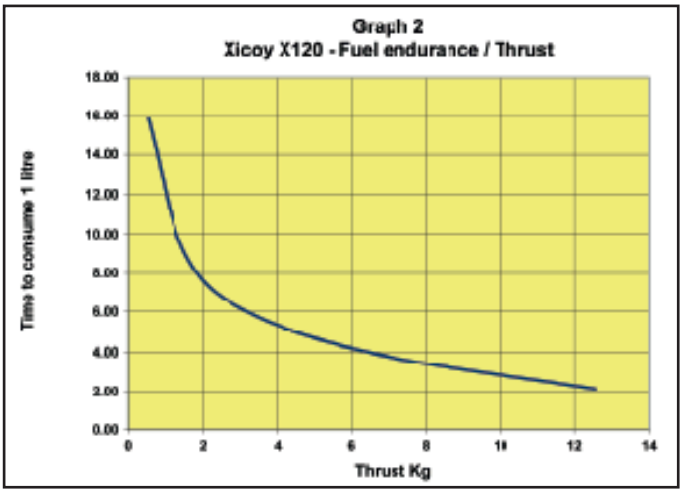
The brushless starter motor is mounted in a machined aluminium bullet, also purple anodised, with three mounting legs for accurate and rigid mounting.

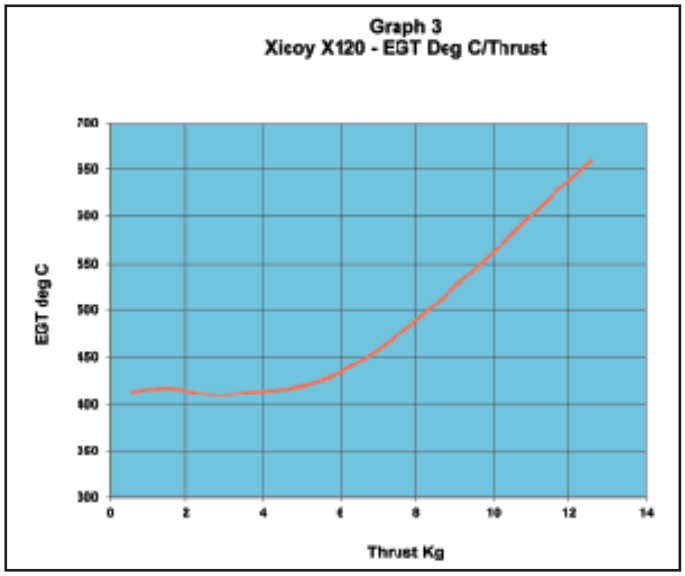
Ancillary items include a super neat and extremely small and light brushless fuel pump, smart data terminal, fuel filter, tubing and leads plus a small electronic hub unit which acts as the interface between turbine, battery, fuel pump and telemetry modules/display etc. As is now standard no battery is included, with the instructions recommending a 2 cell 7.4 volt Li-Po, the alternative option being a 3 cell 9.9v Li-Fe pack. A quick start guide is included in the box, which will be enough for experienced turbine operators, with the full instruction manual being supplied on a neat credit card sized USB stick.

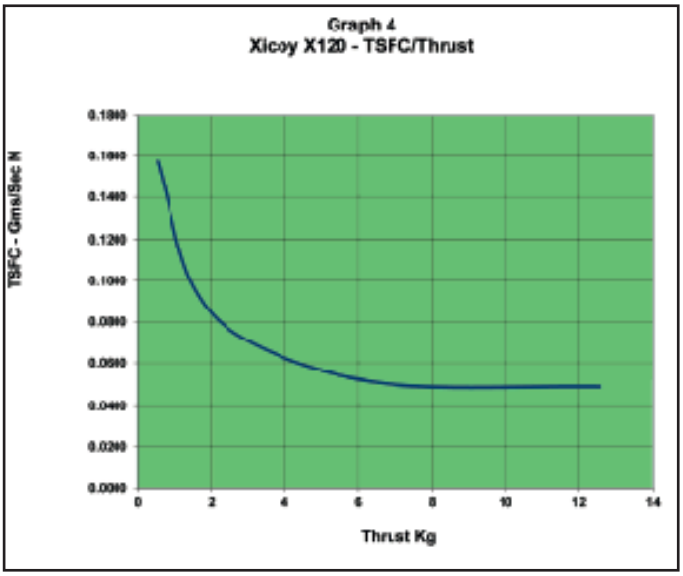
As already mentioned, the engine is exceptionally light, whilst the fuel pump

Close up view showing very nice machining on the compressor and the single fuel connector.









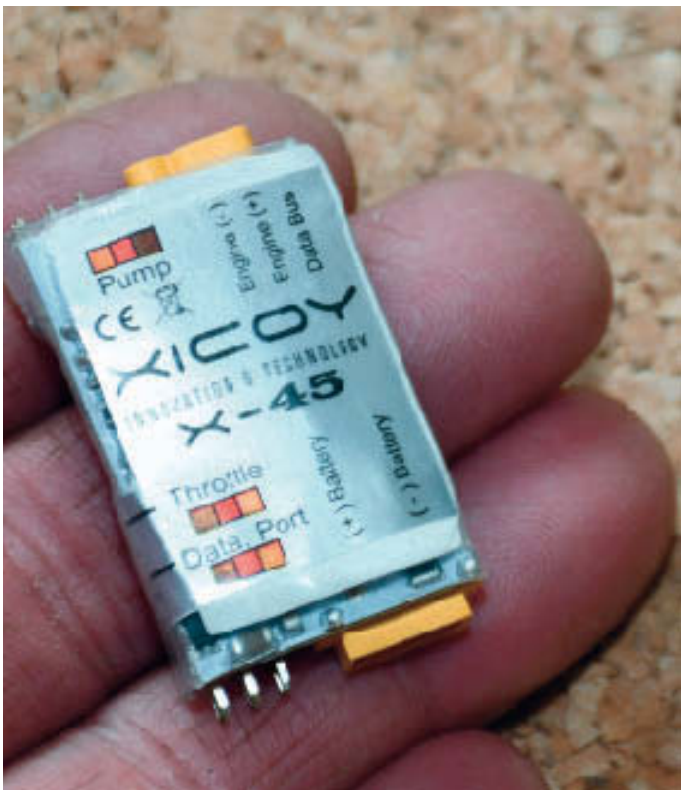
plus leads, hub, filter and tubing adds only another 137 grams; the battery weighing a further 118 grams, making the total on-board weight a remarkably light 1297 grams.

Given the low overall weight, installing the current smart data terminal would be viable in many models, as this weighs a mere 23 grams, whilst having a bright and easy to read colour touch screen which is used both for programming the turbine and for displaying information. Having the data terminal onboard is particularly useful as the unit stores the last 66 minutes of engine run time. Of course the ECU also stores the engine data, in this case the last 51 minutes of run time.

With the model on the ground the terminal can be disconnected from the interface unit, and a 5-10 volt battery connected to it to allow the stored data to be viewed, this can be in real time, or at 10 or 100 times normal speed. Of course it is also possible to view the turbine information via telemetry, either on a phone/tablet via Bluetooth whilst the model is on the ground, or at all times through the transmitter display, with Futaba, JR, Jeti, Multiplex, Hott, Spektrum, Core and FrSky now being catered for. Interestingly the new FlexPower software in the ECU allows the thrust level to be adjusted to any level from a low of 60 Newtons to a maximum of 120 Newtons in seconds, so enabling the use of this lightweight engine in smaller airframes if required, with the knowledge that full power can be restored easily if the engine is transferred to a larger and heavier model at a future date. Also included is the ability to instantly change the settings in the ECU between Kerosene and Diesel.

As was discussed in the X45 test, the X120 features an auto-restart function in the software - this being designed to allow the engine to restart automatically in the event that an air bubble in the fuel feed causes a flameout. Although it has long been possible to restart turbines in flight, until recently this has been limited to turbines used in large gliders, due to the need for the engine to cool down to below 100° C before it can be restarted. The cooling procedure of course takes time, and as the engine is then cool it also takes a considerable time to complete the restart, so it used to take anything up to 2 minutes for a restart in the air, not too practical for the vast majority of jet models. The X120 auto-restart system operates in a very different way, the ECU software detecting when the engine has flamed out due to an air bubble/fuel interruption, and in this event it automatically commences an aggressive restart procedure that should in most cases restart the engine within 10-15 seconds, this dramatic difference being due

View of the turbine wheel showing the neat casting of the blades and the signs of balancing work.



The electronic hub interface connects turbine, battery, fuel pump and telemetry modules/display etc.

Throttle	RPM	EGT Degrees C	Fuel Consumption ml/min	1 Litre run time in minutes	Thrust lbs	Thrust Kg	Thrust N	TSFC
idle	40	414	52.9	15.93	1.2	0.5	5.2	0.1572
25% stick	68	418	111.9	8.93	3.4	1.5	15.1	0.0963
50% stick	94	412	169.8	5.89	7.3	3.3	32.5	0.0678
75% stick	122	451	257.8	3.86	14.9	6.8	66.4	0.0504
100% stick	150	658	465.3	2.15	27.7	12.5	123.1	0.0491

The very compact and beautifully manufactured brushless fuel pump, which incorporates a neat mounting lug on the rear.

to the engine being restarted whilst still hot.

As is detailed in the manual, the use of this auto-restart function should be carefully considered before being activated, as its use could result in a fire in the event that a crash occurs as the engine is restarting. The default setting in the software is to have the auto-restart function switched off, with the recommendations for use focusing on lightly loaded jets, jet gliders and multi engined models, basically any airframe that is likely to be able to fly/glide for at least the 10 seconds required for a restart. The manual also suggests simulating a flameout situation to test if the restart function will in fact be helpful, and this makes a great deal of sense.

Test Results

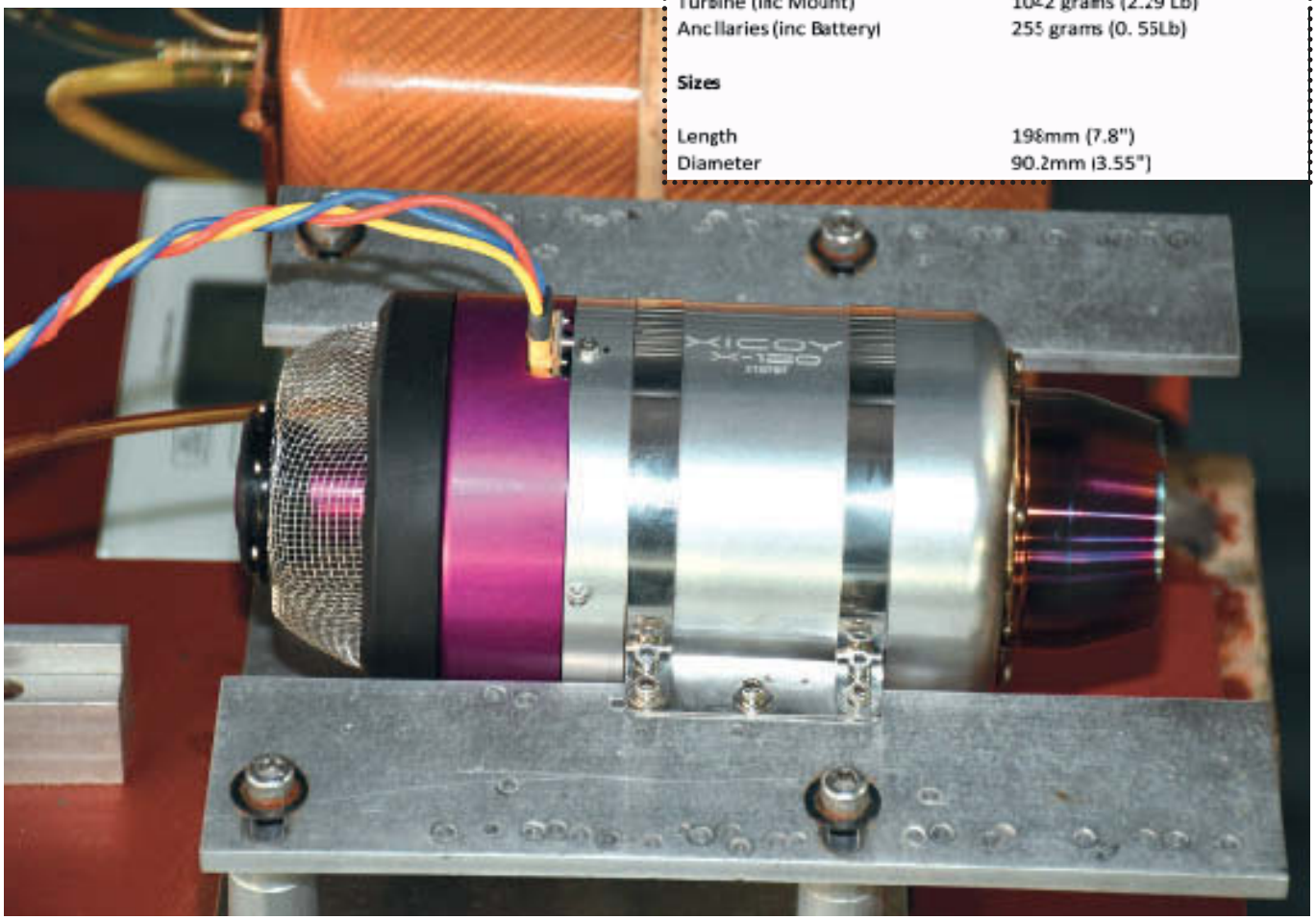
Idle RPM	40,000
Idle Thrust	5.2 Newtons (0.5Kg/ 1.2Lb)
Idle Temperature	414 degrees Centigrade
Maximum RPM	150,000
Maximum Thrust	123.1 Newtons (12.5Kg/27.7 Lb)
Maximum Thrust Temperature	658 degrees Centigrade
Fuel Consumption at Max Thrust	465ml/min
Fuel Used	Kerosene
Lubricant	Power Model Jet Oil
Fuel/Oil Ratio	5% (20:1)

Weights

Turbine (inc Mount)	1042 grams (2.29 Lb)
Ancillaries (inc Battery)	255 grams (0. 55Lb)

Sizes

Length	198mm (7.8")
Diameter	90.2mm (3.55")



Looking pristine at the end of the test programme, the X120 proved very easy and straightforward to operate.

The use of the auto-restart function should not be seen as an answer to poor installations or fuel supply problems, it should be used purely as an emergency feature that might save an airframe and allow investigation and correction of the problem.

The X120 does offer another restart option, this being aimed primarily at usage in gliders, where the engine can be shut down normally, and it then goes through its standard shut down procedure. Once the engine has cooled to below 100° Centigrade the engine can be restarted from the transmitter simply by raising the throttle stick and trim. Of course this takes far longer than the auto-restart, but for glider usage it allows the engine to be restarted if height is lost, and does not impose the stresses on the engine brought about during an auto-restart.

With the engine mounted on the test stand, ancillary items connected, and ECU programmed, a start was commanded, which the engine carried out without fuss, and pretty quickly, it taking a mere 44 seconds before the engine was at idle with control having been passed to the radio system - this being faster than the vast majority of turbines I have tested. Running was notably smooth at all throttle levels, with almost no variation in rpm, and it was amazingly easy to get the engine running at the exact rpm points required as part of the testing process, this being one of the advantages of the brushless fuel pump, which runs at much more precise rpm than a brushed motor. A second advantage is that this consistency of running will be maintained over a much longer period, as unlike a brushed motor, there are no brushes to wear, which would change the running characteristics of the pump, and in turn the turbine.

Acceleration was impressive, being measured at a fraction over 3 seconds from idle to full power, whilst deceleration was a fraction slower at 3.5 seconds, both of these being excellent figures, particularly for an engine with such a high power output for its size. The corrected full power figure of 123.1 Newtons was slightly above the claimed figure of 120 Newtons, and it should be noted that the engine was being run on kerosene with 5% oil (Power Model Jet Oil), rather than the 4% recommended (5% can safely be used according to the instructions), so a small amount of power is being lost here, and of course the FOD guard was fitted during all the test runs, which often also reduces the maximum thrust slightly. Overall a very impressive outcome, whilst the idle thrust figure was nice and low at just over 5 Newtons, although this was a little above the 4 Newtons specified.

I couldn't resist illustrating the progress in model turbines, putting my old RAM1000 turbine alongside the X120, both engines being of similar thrust, but of very different sizes and weights!

Fuel consumption was very slightly above the claimed figure of 350g/min at 355g/min, or 465c per minute, an excellent figure, and completely logical, given that the maximum thrust was also above the specified figure.

I was looking forward to testing the auto-restart system, but when first tried this was unsuccessful, with the engine generating a large volume of smoke and then spooling down to a stop. When I checked with Gaspar he explained that as the auto-restart procedure placed significant stresses on the kero plug, the factory settings minimise the voltage supplied to the plug. Raising the voltage by a mere 0.2v was enough to cure the problem, the engine restarting smoothly at the first attempt, it taking a total of around 13 seconds from the engine flaming out from 90,000rpm after the fuel line was deliberately kinked, to the engine back running at the same rpm and under control of the radio, an excellent performance.

The final test carried out was to start the engine when still warm from a previous run, in this case the start process proved to be a little faster, being timed at just under 40 seconds in total.

As I was completing this article Gaspar advised that the software used by the X120 and shared with the X45 and X90 has been developed further, improving the start routine with revised fuel management during the fuel ramp stage, providing a continuous rpm increase rather than the current step by step situation. The restart program has also been revised, whilst the SDT will now display the mA consumed and the ambient pressure, temperature and altitude data, plus the percentage of maximum power to be expected in the prevailing conditions. All new engines will be supplied with this updated software, and existing engines can have their software updated when they are returned for service.

One useful facility available via the Xicoy website is the ability to download drawings of the engines in pdf, stl or dxf formats so that a dummy engine can be 3D printed; this can then be used during the building/assembly of a model instead of the real engine, avoiding any possibility of dust or small items getting into the engine during the build.

In summary I am very impressed with the Xicoy X120 - it really does appear to be another step forward in model turbines, being user friendly in both installation and operation, yet with a truly excellent performance across the board in terms of thrust, acceleration and fuel consumption, whilst being available at a very competitive price. I am sure that the X120 will emulate the success of the X45, and become popular for use in a wide number of models, given its overall combination of compact size yet high power, not to mention its superbly smooth running characteristics and effective and rapid auto-restart system.

Colin Straus

WEBSITE
www.xicoyturbines.com