DESERT AIRCRAFT "DA-120"

BY: ***Mike Hoffmeister***

TWIN-CYLINDER, 2-STROKE, 120-CC GAS-POWERED ENGINE

Giant-scale remote control (RC) pilots are a demanding bunch! They've been levying what seemed an impossible request on Desert Aircraft—to make a lighter, more powerful engine than the DA-100L. As a result, Desert Aircraft has been quietly and feverishly working on a new engine that delivers exactly what customers asked for—the DA-120!

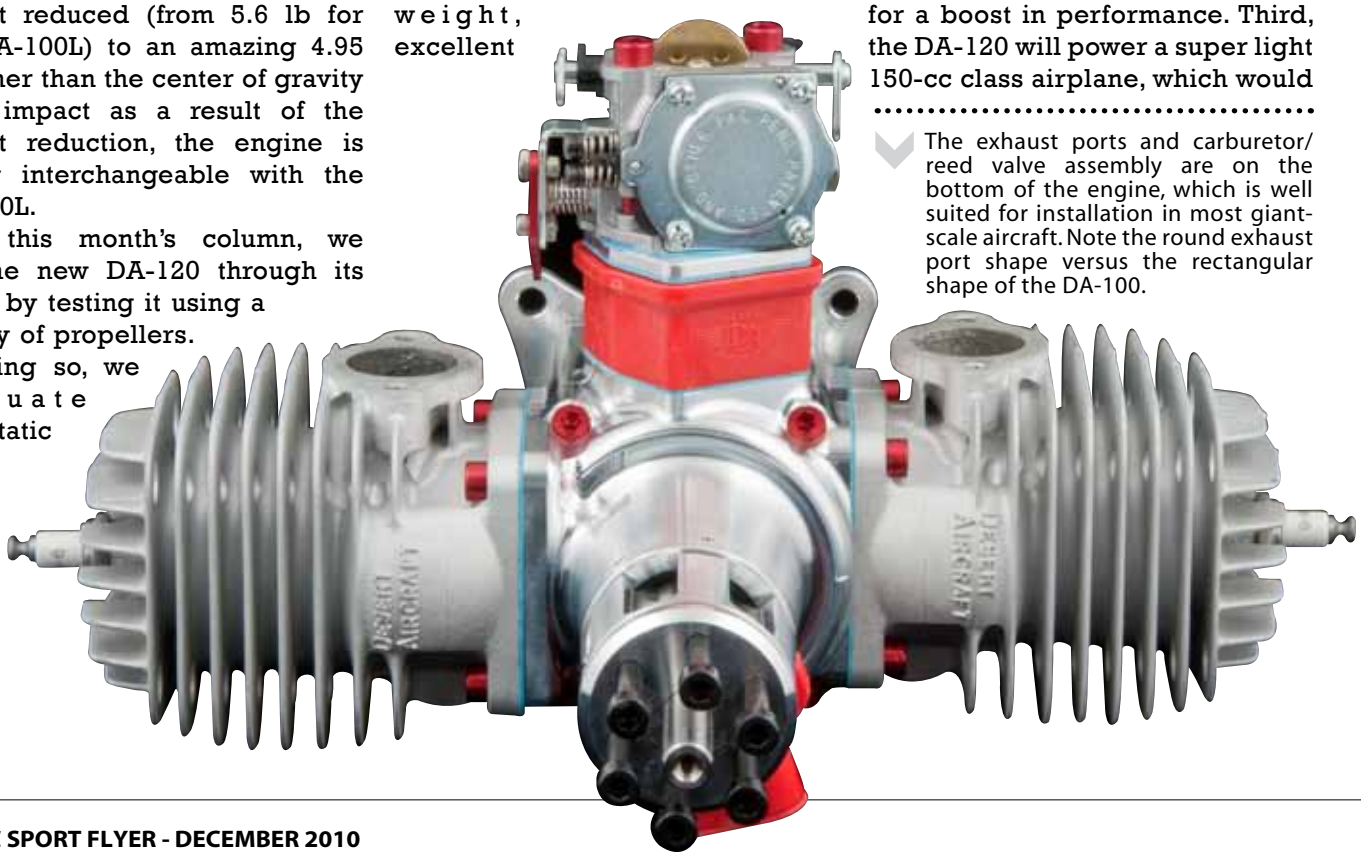
What the new 120-cc engine offers is displacement up 20 percent, power and thrust output up a similar amount, and engine weight reduced (from 5.6 lb for the DA-100L) to an amazing 4.95 lb. Other than the center of gravity (CG) impact as a result of the weight reduction, the engine is nearly interchangeable with the DA-100L.

In this month's column, we put the new DA-120 through its paces by testing it using a variety of propellers. In doing so, we evaluate its static performance, throttle response, and noise level. Be sure to read the Hop-Up article also in this issue. That article covers the process of installing the DA-120 engine in an AeroWorks 105-in. wingspan Yak 54, which has been equipped with a DA-100L engine. Also, we evaluate the effects of more power and less weight on the Yak's flight performance.

Why to Buy

For years, Desert Aircraft engines have been regarded as delivering outstanding power, light weight, excellent reliability, and the best after-sales support, including a three-year warranty. Combine this with higher power and less weight in an engine that fits 100-cc (and larger) aircraft, and no matter what criteria you apply, the DA-120 is a winner!

There are at least three scenarios where the DA-120 will excel. First, when building a new 100-cc class airplane, the DA-120 would be a great choice to assure extreme thrust-to-weight ratio and flight performance. Second, if you have an existing 100-cc class airplane that performs well but have an itch for a boost in performance. Third, the DA-120 will power a super light 150-cc class airplane, which would



The exhaust ports and carburetor/reed valve assembly are on the bottom of the engine, which is well suited for installation in most giant-scale aircraft. Note the round exhaust port shape versus the rectangular shape of the DA-100.

result in a large aerobatic airplane with the lightest possible wing loading, for the best possible 3–D performance.

Break-In

The first step was getting the engine securely mounted to the test stand. In order to make the throttle hookup easy, and to avoid interference between the mufflers and test stand, I mounted the engine carburetor side up. Since we had previously tested the DA-100L engine, mounting the DA-120 engine was simple. The included aluminum engine mount plate has the same mounting pattern as the DA-100L.

I started the tests using a Mejzlik 28x10 carbon fiber propeller, to keep the load on the engine fairly low during break-in running. Once everything was connected, I turned over the engine several revolutions by hand, with the carburetor at half throttle and choke on until I saw fuel in the hose up to the carburetor. Then I turned the engine over a couple of more revolutions. Reducing the throttle setting to just above idle, I switched on the ignition and flipped it a few more times until it started. The engine sounded good from the start, with the initial carburetor settings pretty close to right from Desert Aircraft, just a bit rich—perfect for break-in.

Desert Aircraft recommends using Lawn Boy® two-cycle ashless oil, mixed 32:1 for the first few gallons of fuel. This oil helps the piston rings to seat into the cylinder bore, assuring a good seal for maximum performance and engine life. Prior to starting performance testing, I ran slightly less than a gallon through the engine on the test stand for the initial break-in. Performance will

The DA-120 is a compact twin-cylinder engine, weighing less than 5 lb. This top view shows the fine machine work done on the crankcase to minimize weight, while the cylinders show off their generously sized ports.

This side view shows the compactness in the lengthwise dimension. The DA-120 is a 1/4 inch shorter than the DA-100L.

The picture on the left shows the piston at bottom-dead-center (BDC). Note how far down inside of the crankcase the skirt of the piston goes. The picture on the right shows the piston at top-dead-center (TDC) to demonstrate how far the piston moves up and down, at a rate of 100 times per second.

likely further improve from what is stated in this review.

On the low end of the throttle range, the engine could easily hold 1300 rpm idle without hesitation upon quick throttle opening. At one point, I had it idling steadily for two to three minutes below 1000 rpm! While this is not a practical setting for use in an aircraft, it does demonstrate its low idle capability, and gives confidence that a 1300 rpm idle has plenty of margin to avoid a stall during flight.

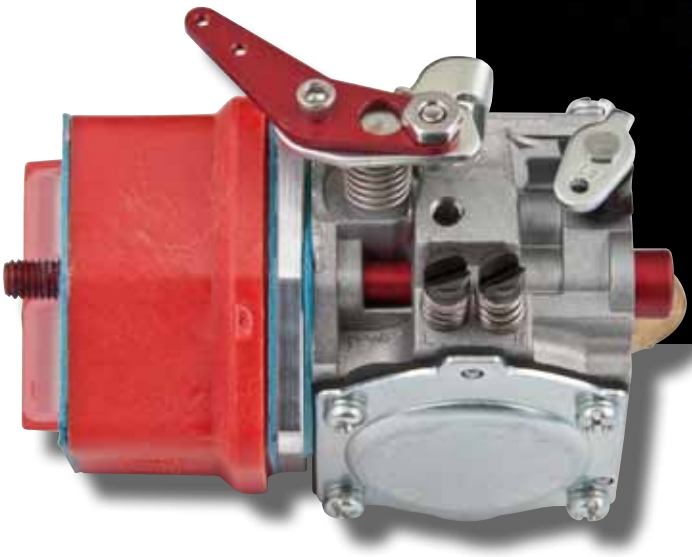
The last two steps in preparation for the computer-controlled test runs were to get the propellers and sound level meter organized, and to make sure the throttle's endpoints were precisely set. My standard test sequence is to start the engine, warm it up briefly, run it up to full-throttle for a few short bursts, then return the engine to idle. It is then switched over the throttle to PC control. The PC collects rpm and thrust data for five seconds at idle, advances the throttle to 20 percent, and holds it there for five seconds. It then advances to 40 percent and

This is the firewall view of the DA-120 mount, which has the same mounting pattern as the DA-100/100L. Through the hole in the engine mount adapter plate, you can see the round extension from the crankcase, where the rear crankshaft bearing is located.

holds it for five seconds, and so on. The test concludes with a five-second hold at full throttle.

I set up a digital sound pressure level meter on a tripod at the same height as the crankshaft centerline, with the meter at a 45 degree rearward angle from the propeller hub at a distance of 10 feet. I put it on peak hold setting in order that after each test run I could record

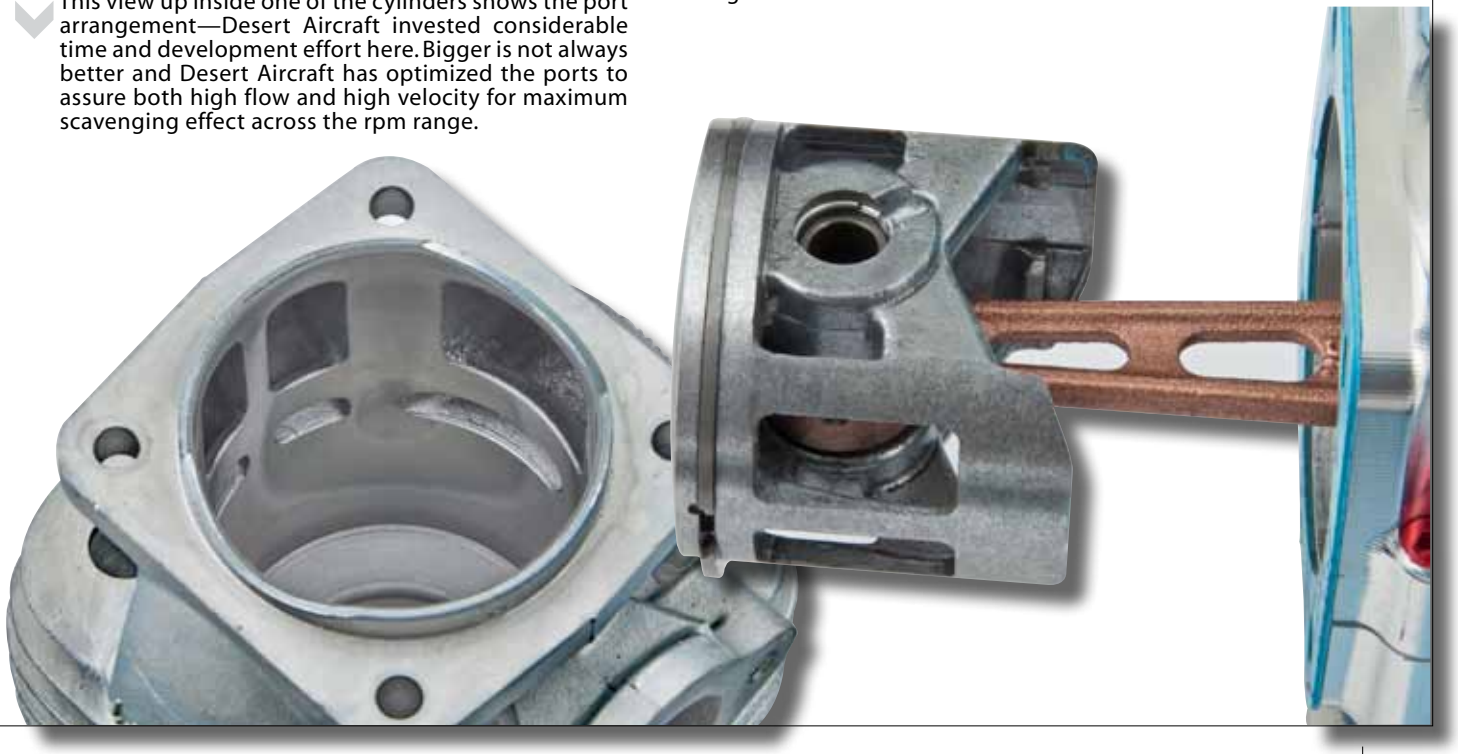
Perhaps not immediately obvious, the DA-120 cylinder features technology for performance and minimum weight. Desert Aircraft first optimizes the castings for cooling fin area and minimum weight, then uses a multi-axis computer numeric controlled (CNC) machine to profile mill around the ports to remove excess material. They finish-cut each cylinder fin to remove excess weight without compromising durability.



The carburetor/reed valve assembly is common to the DA-100L engine, and works perfectly. Due to the commonality, replacing a DA-100L with the new DA-120 is even easier because the carburetor interfaces are the same.

Each side of the piston has two windows to either side of the wrist-pin that helps feed the main transfer ports. The long rectangular windows in the piston skirt feed the boost ports that are cast into the cylinder wall opposite the exhaust port. This helps cylinder scavenging and complements the primary flow through the main side transfer ports. The connecting rod has windows to help reduce weight.

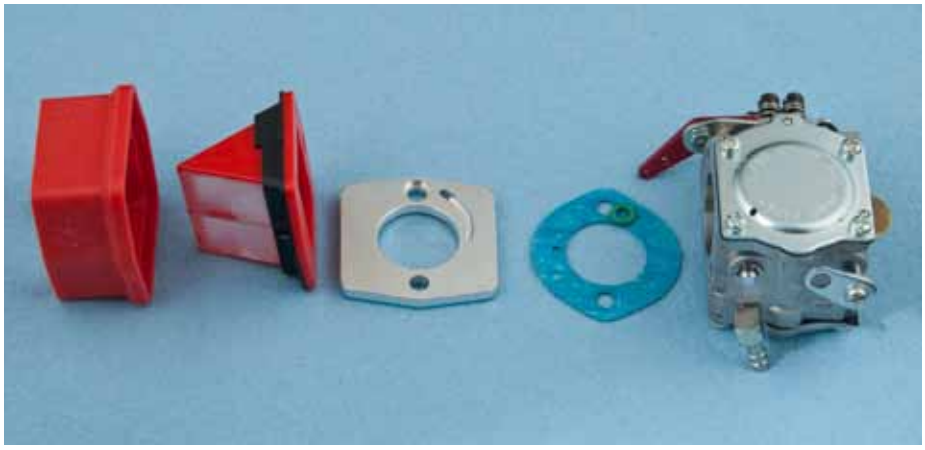
This view up inside one of the cylinders shows the port arrangement—Desert Aircraft invested considerable time and development effort here. Bigger is not always better and Desert Aircraft has optimized the ports to assure both high flow and high velocity for maximum scavenging effect across the rpm range.



the peak decibel value during the test. The meter was set on the A-weighting scale, which simulates the frequency sensitivity of the human ear.

Performance Testing

The first propeller tested was the Mejzlik 28x10 carbon propeller. This is the identical propeller that we had tested on the DA-100L engine, which was featured in the December 2009 issue of *RC Sport Flyer*. For reference, the DA-100L produced 47.4 lb of thrust at 6325 rpm, while the DA-120 makes 55.1 lb thrust at 6800 rpm—a gain of 7.9 lb and 475 rpm. This initial



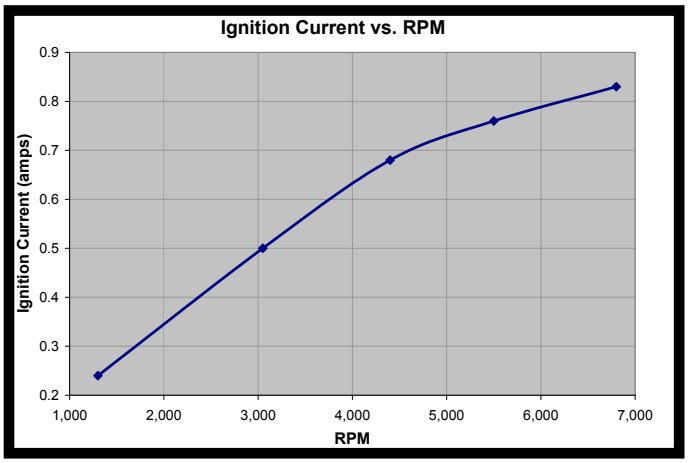
The pieces of the reed valve assembly are precision molded from high-strength plastic. They fit together perfectly to create a smooth flowing, compact reed valve system that uses a thin aluminum plate the Walbro carburetor mounts to. It is both simple and compact, assuring maximum flow velocity through the intake tract.

The engine and fuel tank are mounted to a thick aluminum plate that rides on a recirculating roller bearing block, which assures nearly friction-free motion for accurate thrust measurement. Thrust is translated to downward force on the blue thrust scale via the L-arm. (The L-arm has ball bearings at the pivot and scale interface.) The Thunder Power LiPo battery runs the data system and provides power (via a 6-volt regulator) to the DA-120 ignition system.

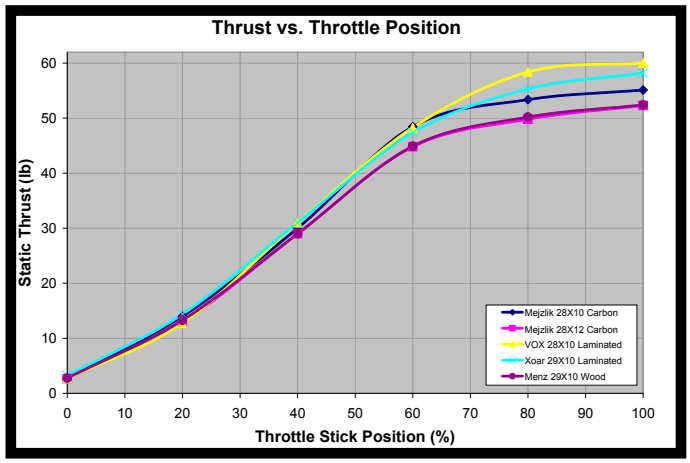
A variety of two-blade propellers were used for testing. The VOX 28x10 and the Xoar 29x10 laminated wood propeller produced the highest static thrust with results in the 58-60 lb range. The Mejzlik 28x12 carbon propellers produced the most pitch speed while still maintaining outstanding thrust. Testing on an airplane will be the true test of which propeller is best for an application.

The camera flash freezes the Mejzlik 28x12 carbon propeller while viewed head-on at idle. You can also see how the mufflers fit nicely around the carburetor, leaving enough room for linkages and fuel line, but keeping the overall power plant compact.

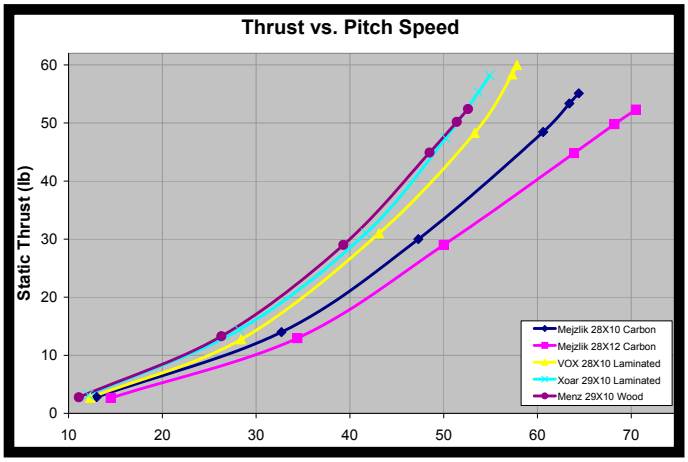
Here is a closeup view of the DA-120 engine at idle, with the Xoar 29x10 laminated wood propeller fitted. Note the optical tachometer/bracket mounted under the lower forward cylinder bolt. This feeds rpm data into the Medusa Power Analyzer Pro system for later analysis.



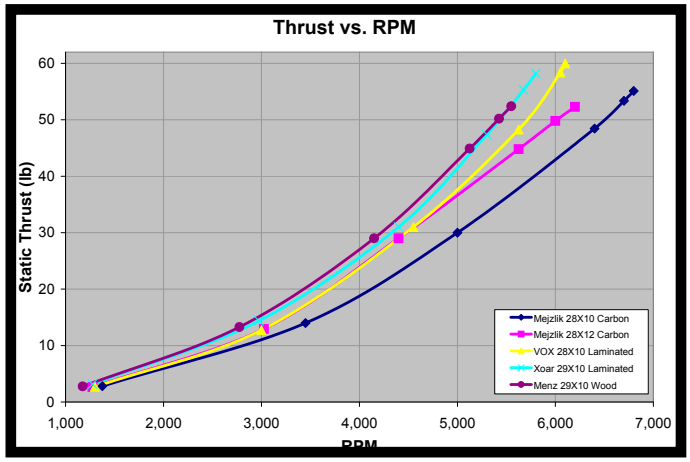
This table shows the current consumption of the ignition system as a function of rpm. At idle, the ignition system is drawing only 0.24 amp and at maximum rpm, it draws 0.83 amp. This is very efficient for a twin-cylinder engine. With a 2-cell A123 2300-mAh battery pack, over two hours of engine run time is possible with reserve power remaining!



This graph shows how thrust output varies with throttle position. Note that at idle there is about 2.5-3 lb of residual thrust. Thrust response is smooth and progressive up to 60 percent. Then from 60-100 percent the thrust increases at a reduced rate, which is typical of a gas-powered engine. Note that thrust is about 30 lb at 40 percent throttle, so a 30 lb airplane should hover at this throttle setting.



This shows how static thrust relates to pitch speed. Typically a higher pitch propeller will deliver more pitch speed and more flight speed, but less static thrust. Ultimately, flight testing is the best way to choose a propeller, but this data can help you visualize the trade-offs in static performance.



This shows how thrust output varies with engine rpm for each of the five propellers tested. At full throttle, static thrust ranges from 52 to 60 lb, depending on propeller choice.

result left us shaking our heads in disbelief. Desert Aircraft had done it—less weight, more power, and with the same excellent behavior as the DA-100L engine.

After every propeller change I ran each test multiple times. This allowed me to capture the necessary data to produce the comparative performance graphs included in this review.

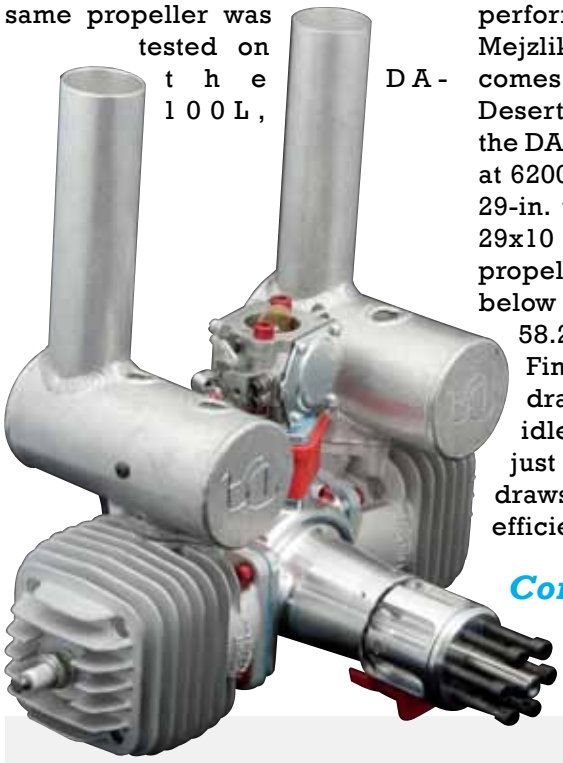
The engine's maximum static thrust was produced using the VOX 28x10 laminated wood propeller. With it the engine produced a

DA-120 Gas Two-Stroke Engine				
	RPM	Static Thrust (lb)	Pitch Speed (MPH)	Sound Pressure Level dBA
Mejzlik 28X10 Carbon	6,800	55.1	64.4	106.3
Mejzlik 28X12 Carbon	6,200	52.3	70.5	105.2
VOX 28X10 Laminated	6,100	60.0	57.8	104.7
Xoar 29X10 Laminated	5,800	58.2	54.9	105.2
Menz 29X10 Wood	5,550	52.4	52.6	104.1

Sound Pressure Level at 10 ft, at 45 degree angle to side/behind engine

Here you see the rpm, static thrust, and pitch speed achieved with each propeller tested. Full-throttle sound pressure level data is also included.

whopping 60 lb of thrust at 6100 rpm. By comparison, this same propeller was tested on the DA-100L, producing 46.6 lb thrust at 5600 rpm. For more in-flight performance and speed, the Mejzlik 28x12 carbon propeller comes highly recommended by Desert Aircraft. With this propeller, the DA-120 produced 52.3 lb thrust at 6200 rpm. I also tested a pair of 29-in. wood propellers, the Menz 29x10 and the Xoar 29x10. Both propellers kept the engine's rpm below 6000, producing 52.4 and 58.2 lb of thrust respectively. Finally, I measured the current draw of the ignition module. At idle, the ignition system draws just 0.24 amps. At full-throttle, it draws 0.83 amps, which is very efficient.



Conclusions

Desert Aircraft has truly outdone itself with the DA-120! It delivers more displacement and power, while at the same time shaving off an additional 0.65 lb (versus the DA-100L) of weight. The DA-120 performed flawlessly during all testing, and with a wide variety of propellers. It delivered easy starting, smooth and steady idle, excellent throttle response, and stable performance during sustained full-throttle operation.

To see and hear the DA-120 engine run, please visit youtube.com and search for RCSportFlyer videos.

Desert Aircraft "DA-120" Specifications

Type	Twin-Cylinder, 2-Stroke Gas
Displacement	7.4 ci (121 cc)
Bore	1.811 in. (46 mm)
Stroke	1.438 in. (36.5 mm)
Specified Weight	4.95 lb
Measured Weight	4.93 lb (2.24 kg) [w spark plug and propeller washer/bolts]
Muffler Weight	9.6 oz (DA in-cowl, pair)
Length	6.25 in. (159 mm)
Rpm Range	1000 to 6800
Warranty	Three year
Propeller Range	28x12, 29x10, 27x12 3-blade
Fuel	Gasoline with oil mix of 40:1
Cylinder Type	Ringed
Ignition	DA Ignition 4.8- to 6-V (or A123)
Carburetor Type	2-needle Walbro
Induction Type	Reed Valve
Crankshaft	Three bearings, wide–spaced front bearings

Desert Aircraft "DA-120" Distributor

Desert Aircraft
1815 South Research Loop
Tucson, AZ 85710
520-772-0607
desertaircraft.com