

The New Lightning XS

(160 HP O-320 Lycoming)

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“The only substitute for cubic inches is cubic feet.” That was a popular “hot rod” saying among car guys during the late ‘60s and early ‘70s. Of course the meaning was that bigger displacement engines would mean more power and thus more speed and better performance. That old saying certainly holds true for the new Lightning XS, the Lightning with a 160 HP, 320 cubic inch Lycoming engine. More displacement equals higher (excess) performance – acceleration, climb and of course higher speeds.

I recently had another chance to fly Arion’s latest development aircraft, Lightning N320XS. I had first flown this new higher powered (more cubic inches and more horse power) Lightning in late March 2014, just before Sun-N-Fun. However, the overall design and set-up at that time was still being finalized and it needed some changes before it was ready for a flight report test flight. For example, the engine was not developing full power due to fuel distribution issues which caused it to run rough at higher RPM speeds. Also, the main landing gear legs were configured so that the main wheels were too far aft which required touchdown speeds to be too high. There was no nose gear leg fairing or wheel pant installed. And finally, the propeller (a newly developed Sensenich ground adjustable carbon fiber prop) was pitched too low for the 160 HP engine on a low drag airplane like the Lightning. All of those issues have now been corrected, so in mid June, I flew back to Shelbyville, Tennessee, the home of Arion Aircraft, to once again fly N320XS.



N320 XS, the 160 HP Lycoming O-320 powered Lightning.

Before I cover my thoughts on these test flights and pass on some performance data for the new 0-320 powered Lightning, let me cover the reasons that Nick Otterback (Arion's Research & Development and Technical Support chief and the Lightning's lead designer) made the decision to come up with this new higher powered Lightning. Those of you familiar with the Lightning's history will probably remember that the initial design goals for the Lightning were to design and market a good looking, good performing, good handling, economical to operate, "quick to build", and moderately priced kit aircraft. The prototype, powered by a 120 HP Jabiru 3300 that the Lightning was designed around, first flew in March of 2006 and it definitely met all the design goals. I was lucky enough to get to test the prototype and I immediately fell in love with the design. What's not to like? It is a beautiful design, with excellent performance and handling, truly a quick built kit, plus is very economical to operate.



The prototype Lightning, designed around the 120 HP Jabiru 3300.

Aircraft homebuilders quickly bought Lightning kits and many had them flying in less than a year instead of the five plus years that almost all other experimental aircraft with similar performance take to build. Arion also offers a builder's assist program that will have you flying your Lightning in about three weeks of your time. However, the entire process will take a little longer depending on how busy their paint shop is at the time.

Maybe this is a good time to mention that the Lightning kit aircraft has the highest completion rate of any similar performance experimental aircraft kit. Some other kits are taking their builders in excess of ten years to build. Yes, the Lightning is truly a quick build kit that meets the 51% rule for Experimental Amateur Built (EAB) aircraft.

One notable achievement of an early kit builder is that Earl Ferguson built his Lightning to meet the new (at that time) Light Sport rules and then set a World Record for speed for Light Sport Aircraft between Savannah, GA and San Diego, CA. That record still stands today and was the very first World Record set by any Light Sport Aircraft.

Once Earl had built his Lightning to meet the Light Sport aircraft stall speeds, many potential builders started asking Arion for a Light Sport compliant kit. Nick soon designed a wing tip extension that added enough wing area to insure that a normally equipped Lightning could meet the 45 knot clean stall speed required by the Light Sport Aircraft rules. Many builders added the wing tip extension option to their kits so they could build their Lightning as an EAB that met the Light Sport rules and thus fly without a class three medical as allowed by the new Light Sport rules. But other potential customers, without the time or confidence to build their own aircraft, encouraged Arion to go through the ASTM flight test requirements so that the Lightning could be certified as a Special Light Sport Aircraft (SLSA) and thus sold as a “turnkey” or fully assembled and completed aircraft. I was once again lucky enough to be asked to be involved in the ASTM certification flight tests. Once the Lightning was certified as a SLSA (the Lightning LS-1), the rules also allow Arion to also sell an Experimental Light Sport Aircraft (ELSA), which is configured just like the SLSA, but is less than 100% complete. So now Arion can sell you a Lightning that is fully built, the SLSA LS-1, or an almost completed ELSA LS-1, or an EAB that you build and can meet light sport rules, or an EAB that goes fast with the 120 HP Jabiru, or now you can build the Lightning XS to go really fast. You can truly have it your way.

Now back to that old saying, “the only substitute for cubic inches is cubic feet”. Nick is certainly a believer that more power would equal a faster airplane, and he also wanted the Lightning kit to get back to its homebuilt roots and to come up with an even faster and higher performing kit aircraft. Adding more power to the Lightning design could be achieved by just picking any engine that could be adapted to the design that had more horse power. The UL power engine with 160 HP was one possible way, but that engine is more expensive than the Jabiru. The engine Nick wanted for the next generation Lightning would be one that was readily available either new or on the used market for a reasonable price. He decided that the perfect choice would be the O or IO-320 Lycoming of 150 or 160 HP. That engine is probably the most widely used engine in general aviation as it has been used in the Cessna 172 or Piper Cherokee, as well as many other aircraft, for many years. It is available on the used market from as low as about \$5,000 to \$10,000 which would be half the cost of a new Jabiru 3300 at about \$20,000. So designing a faster and higher performing Lightning around the Lycoming O-320 would allow a homebuilder to complete his airplane and save at least \$10,000 if not more, but powered by a used O-320 Lycoming. Now that should be a great marketing idea. A faster quick built Lightning on less money.

Besides the potential money savings using a used Lycoming, perhaps a few other comparison numbers between the 3300 Jabiru and the O-320 Lycoming would help to understand the thought process that Nick went through when choosing the latest engine option. The Jabiru 3300, at 120 HP, is 201 cubic inches which is 119 cubic inches less

than the 160 HP O-320 Lycoming. Therefore the Lycoming has 40 more HP and 119 cubic inches more displacement. The Jabiru 3300 is lighter at 184 pounds as compared to the Lycoming at 244 pounds. But if you look a little deeper you see that the Jabiru 3300 is .91 lbs/cu inch whereas the Lycoming O-320 is only .76 lbs/cu inch – advantage to the Lycoming. Comparing horsepower, the Jabiru is 1.53 lbs/HP and the Lycoming is 1.52 lbs/HP – that is pretty close to equal, but very minor advantage to the Lycoming.



O-320 Lycoming on the Lightning XS.

Of all the Lightnings I have flown, from the prototype and all of Arion's demo aircraft since the first one, many of the LS-1s, and many homebuilt ones, I like them all. However, I must admit that the prototype has always been my favorite. That is until now. The XS is now my favorite Lightning for several reasons. First, you can feel the additional power – the additional “cubic feet”. Whether on takeoff roll when you first add power, or climb out with higher climb rates, or in-flight acceleration when you push the throttle forward, or of course the higher speeds, you can feel and see improved performance and speeds. Second, with the shorter wings and wing tip winglet, the roll rate is like the prototype – excellent. At cruise speeds the roll and pitch forces are pretty well harmonized, but as the speed increases the roll pressures increase more than the pitch forces do. This was the same on the prototype even though the prototype had the original smaller stabilizer. Longitudinal and latitudinal stability were excellent and as would be expected, the wing tip winglets make the roll stability about the best of any experimental aircraft I have flown.

I'll go through some of the performance numbers that I saw, but first let me add a caveat or two. First, N320XS still is not in its final and optimum configuration. You can probably tell from the in-flight photo in the first part of this report that the wheel pants

that are currently installed are the “slow” light sport pants used on the LS-1 to keep it slow enough to meet light sport rules. Nick has ordered a set of the latest pressure relief wheel pants and will have them installed before Oshkosh. Second, there are no intersection fairings at all installed between the fuselage and the main gear leg fairings and none installed between the gear leg fairings and the wheel pants. I would guess that these new style wheel pants and the intersection fairings will add as much as 3 to 5 knots for all cruise speeds and maybe as much as 6 to 8 knots to the top end or wide open throttle (WOT). Your mileage may vary.



N320XS cockpit with a Dynon SkyView.

The June flights in N320XS were on very hot and humid days. At the Shelbyville Airport, with an elevation of 801 feet, the surface temperature for the all flights was between 89 and 93 degrees F. The surface density altitude varied between 2600 to 2900 feet. Definitely not a standard atmospheric day, but the XS performed amazingly.

The info and performance data below is a composite of all the June flights I made. I estimate the takeoff roll, using 10 degrees of flaps, on runway 18 with a wind about 40 degrees off runway heading and at an average of 6 knots was about 1000 to maybe 1100 feet. Those numbers were with full fuel (30 gallons) and me at 215 pounds on a very hot day. During the flights I tried climb speeds of 95 knots (2250 rpm), 100 knots (2280 rpm), and 115 knots (2350 rpm) and even though it was very turbulent below about 8000 feet MSL, I estimate the initial rate of climb was well in excess of 2,000 feet per minute at all speeds. Climbing through 5,000 feet MSL with a density altitude of just over 7,000 feet, the rate of climb was still in excess of 1500 feet per minute. Using a climb speed of 100 knots, climbing through 7,500 feet MSL (density altitude of 9,700)

the rate of climb was still about 1000 feet per minute. And when passing 8,500 MSL (DA of 10,500) the rate of climb was 750 feet per minute. I think that is pretty amazing. Again, because of the turbulence down low, I tested clean and dirty stall speeds at about 2,500 MSL (DA 4,000) and found that the average clean stall was about 59 to 60 knots. Dirty stalls in the landing configuration with full flaps (about 30 degrees) resulted in stall speeds of 49 to 50 knots. There was a slight tendency to roll to the left as the stall broke, but that was easily corrected with rudder. Stall recovery was always immediate when I released back pressure on the stick.

I recorded cruise speeds at various altitudes and RPMs in order to get a good feel for the actual cruise performance that Lightning XS builders might expect. See below.

At 2,500 MSL (4,5K DA):

2650 rpm = 159 KTAS

2700 rpm (WOT) = 163 KTAS

At 3,000 MSL (5K DA):

2450 rpm = 145 KTAS

2500 rpm = 150 KTAS

At 8,500 MSL (10K DA) – fuel flow numbers with leaning:

2300 rpm = 138 KTAS @ 5.8 gph

2350 rpm = 140 KTAS @ 6.1 gph

2400 rpm = 143 KTAS @ 6.3 gph

2450 rpm = 146 KTAS @ 6.8 gph

2500 rpm = 149 KTAS @ 7.3 gph

At 10,000 MSL (11.5K DA) – fuel flow numbers with leaning:

2400 rpm = 145 KTAS @ 6.1 gph

2500 rpm = 150 KTAS @ 7.1 gph

Note: Based on the above numbers, when the pressure relief wheel pants and the intersection fairings are added, I can see the Lightning XS making 170 knots at WOT. Cross country flights at 8,000 to 10,000 should be able to easily achieve 150 knots burning 7 gph or less.

Landing the Lightning XS is relatively easy for the same reasons the original Lightning is easy to land. It has good visibility, excellent control response and excellent throttle response. However, there is one difference that is more noticeable especially if you have been flying a draggy airplane. The Lightning is slick, and when landing the XS you

really have to anticipate the need for pulling the power back or you will find yourself fast on final. So why is the XS harder to slow down than a standard Lightning or the LS-1? The XS with the high pitch prop is hard to slow down because the high prop blade angle is much less draggy when you pull the power back. On a medium or low pitched prop when you pull the power back and the prop stops producing thrust, the lower pitched blades act like a speed brake. Imagine putting your arm out the car window with your hand flat to the airflow. But a higher pitched prop blade angle is not nearly as draggy and is more like having your arm out the window with your hand at an angle to the air flow. So once you get used to the lower drag profile of the XS in the landing pattern with the power pulled back, landing it is just as easy as all other Lightnings. My normal procedure is to lower the flaps on downwind, and then start slowing to a desired 1.3 times the landing configuration stall speed ($1.3 \times 50 = 65$) or 65 knots for final. Pull power to idle over the threshold (if not already at idle) and then hold it off for the smooth touchdown. Piece of cake, right?

Here are a few final notes on the Lightning XS. N320XS has the 15 gallon wing tanks for a total of 30 gallons. However, Arion has already developed new optional wing tanks that are now available and will have a total of 40 gallons (20 gallons per wing). These tanks will certainly appeal to the builders that want to use the O-320 engine, but some Jabiru engine users might want even more cross country capability as well, so I think they will be a popular option, even for the LS-1.

Nick is also still working on the Lightning XS flight manual, or pilot's operating handbook, so the final specific flight data, such as exact stall speeds, best rate and angle of climb speeds, charts for cruise speeds at various altitudes and fuel burns, best glide speeds, etc, will all be available for N320XS when that is completed. Of course each future EAB Lightning XS builder will be responsible for determining this data and developing a flight manual for their specific XS aircraft, but Nick will have a basic outline by then for builders to start with.

Once again, Arion has a winner, a fantastic airplane. For a homebuilder that wants a beautiful looking and sporty flying experimental aircraft with excellent flight characteristics and "excess" performance, and who wants to save some money by using a used engine, and who doesn't want to spend five years or more building, the Lightning XS is your answer. Yes, you really can be cruising at 150 knots in a build time of 150 days or less. Much less if you use Arion's builder assist program. The XS is truly an amazing accomplishment by Arion Aircraft – just another of their fantastic Lightning line of airplanes. Sierra Hotel!

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