Bearhawk #164 “Three Sigma” Checkout Report

Date: 20 Apr 08

Objective:

Accomplish ground engine runs, low speed taxi test, brake conditioning, refuel, fuel gauge calibration, idle mixture check, maximum governed RPM check, other navigation checks.

Background:

The run-in procedures used were developed from Lycoming Service Instruction No. 1427B, 8 February 1993 and Lycoming Service Instruction No. 1241C, 18 April 1997.

Procedure:

According to Ground Engine Run Cards.

Results:

Warm Up

The engine pre-oil was not required since the engine had previously been run. The Hobbs meter showed 0.6 total run time from all of the previous engine runs accomplished. The engine was started and run at 1000 RPM until the oil temperature reached 140 degrees F. The elapsed time to reach this temperature was 15 minutes, which was the time required at this RPM.

Shortly after starting, the voltage indicated 14.5 volts, and the ammeter load was 18 amps. This verified alternator function.

The audio volume on the GNS 480 was checked and adjusted. The GPS Message volume was found to be turned down to zero, which is a possible explanation for why a previous test of message audio was unsuccessful. Re-accomplish the previous message audio test.

The sidetone volume was turned up to match the indication for the COM radio and found to be much too high. It was turned down, but may need some further tweaking.

The GPS found itself properly at L00. Selecting a Direct-To route to nearby L94 indicated a course in the proper direction. This was shown properly on the Dynon HSI, which matched the NAV page on the GPS. Selecting a non-direct course using CrsTo deflected the CDI on the HSI and NAV page as expected.

The VOR was tuned into two local VORs, PMD and LHS. Neither signal was strong enough by the hangar on the ground to be considered useable by the GNS 480, so the

CDI functionality or the automatic ID could not be tested. The PMD audio was barely audible, indicating that the VOR antenna appeared to be connected and functioning properly. The VOR reception on the ground should be checked in the air and also at other locations on the airport, such as the run-up areas.

Selecting VOR for the CDI input on the GNS 480 made no change on the Dynon HSI. However, the VOR was "flagged" on the GNS 480. It is possible that the GNS 480 did not change its output to the HSI because the VOR signal was not considered valid.

Other items that remain to be checked are the extra data displayed on the GNS 480 Maps 2, 3, and 4, and transponder interrogation. Check the additional data on GPS Maps 2, 3, and 4. Check transponder interrogation.

With the Master Arm switch on, the bomb and gun sounds worked and were audible above the engine noise.

Reports by observers indicated that the spinner was properly aligned and not wobbling. Propeller tracking was not checked. Check propeller tracking.

After the oil was warmed up, ignition function was checked by switching off one ignition system at a time and observing the EGTs. All EGTs remained essentially unchanged when either ignition was turned off, indicating that all cylinders were firing on both ignition boxes. There was a small decrease in RPM, around 50 RPM, as each ignition box was turned off. Lightspeed Engineering documentation stated that no RPM drop should be seen on a dual Lightspeed ignition system when one system was turned off. However, the implication was that this would be true at runup or flight RPM.

CHTs were below 400 degrees F at the end of the warm up period.

The engine was shut down. Inspection under the cowl found no oil or other fluid leaks.

Taxi to Fuel Pump

Taxi conditions were certainly less than ideal, with winds straight down the taxiway/runway at something like 20 knots gust 25 knots. Oddly enough, this was after the winds had come down from the morning. I guess I wanted to taxi test my Bearhawk in similar conditions to when budd first flew Proto II.

Taxiing to the fuel pump started pointing into the wind, with a right turn to a short distance crosswind, another right turn directly downwind for about 1500 feet, another right turn crosswind for a short distance, then a right turn into the wind toward the fuel pump.

For the downwind taxi, the flaps were lowered to full down. This was in anticipation of the tailwind blowing the flaps down and allowing them to slam against the up stop. Putting the flaps down kept them in one position with no unintended movement from the wind. As reported by other Bearhawkers, I was not able to easily reach the flap button when the flaps were full up. The flap quadrant had been modified as suggested in Bear-Tracks (January 2004) for the first notch, allowing me to grab the middle of flap lever and pull it up to the first notch without depressing the button. At that position, I was able to reach the button and lower the flaps the rest of the way. No noise was heard from the flaps moving during the taxi. Update the checklist to consider lowering flaps for downwind taxi.

While taxiing, several stops were made to season the brake pads. Stops straight ahead were made easily with no unusual compensation, indicating that both brake systems were evenly matched.

With the high winds and downwind taxi, a large amount of differential braking was required to keep the aircraft from turning into the wind. As such, an evaluation of the effectiveness of the steerable tailwheel was not possible. However, the brakes were very predictable and effective, and I was able to keep the airplane on the taxiways and pointed in the general direction desired, even with limited experience. Steering sensitivity was similar to other aircraft, including a Citabria and Cessna 180. No freeplay was noticed. Rudder forces were small, but the forces may have been reduced by the tail wind. No brake drag was noticed, and no control binding. There were no indications that the wheels were not properly aligned, so I concluded that the wheels are properly aligned.

The field of view was as expected from a tail dragger. The nose blocked any view of the taxi centerline. Field of view down the side of the cowl was reasonable, allowing taxiway tracking by maintaining a constant distance from the edge of the taxiway.

Heading values on the top Dynon were essentially correct for the direction of travel. The lower Dynon heading and RMI micro-Encoder heading were not checked. Turns were exciting enough fighting the wind that turn rate indications were not checked. GPS track was not checked. Autopilot display of GPS track was not checked, although this requires a minimum of 15 knots ground speed. Check heading indications on the lower Dynon and RMI micro-encoder. Check turn rate on Dynons. Check GPS track on GPS and autopilot display.

Fuel Gauge Calibration, Fuel Tank Leak Check

The refueling ramp area was not level. With the aircraft pointed into the wind, the ground was reasonably level front to rear, but the wings were banked left wing down. The left wheel was rolled onto a 2x4, raising it about 1.5 inches for slightly over a one degree change. This resulted in level wings to the accuracy that could be attained short of getting out instrumentation such as a bubble level.

To calibrate the fuel sight gauges, each tank was drained through the gascolator to take it down to unusable fuel for the ground attitude. With the tank drained, there was no fuel seen in the sight gauge.

Each tank was then filled 5.0 gallons at a time. After each 5.0 gallons, the position of the fuel was marked on the sight tube with a pen. Record the position of the calibration marks and affix a more permanent marking on the sight gauges. Marks were made for each tank at 5, 10, 15, and 20 gallons for the ground attitude only. At 25 gallons the fuel level was above the visible portion of the sight gauge.

The final capacity of the left tank was 26 gallons. The final capacity of the right tank was 25.78 gallons. In both cases, the fuel was up in the fuel cap flange and about to spill out into the scupper. In normal practice the tanks would most likely never be filled that far. Thus, the official fuel capacity for each tank will be listed as 25.5 gallons, for a total capacity of 51 gallons. Placard each tank for a capacity of 25.5 gallons.

It first hits you that you're a real aircraft owner when you stand at the pump and pump 51.82 gallons of fuel into your airplane and see that $243.50 bill added to your credit card.

The fuel caps were re-installed. To this point the fuel tank cover skins had been left off to allow inspection of the tanks for leaks. No leaks were found on either tank.

Taxi Back To Hangar

The engine restarted promptly with nothing unusual occurring. Since the fuel lines had been drained of all fuel prior to filling the tanks, this indicated that the fuel line design to prevent trapped air in fuel lines when filling dry tanks worked as designed. This was by no means an exhaustive test of this functionality, but it was shown to work this time.

The taxi back to the hangar was into the wind, so it was slightly less workload. However, the gustiness of the winds still made fairly active use of the brakes required. Turning crosswind into the hangar resulted in less than precise control, but the airplane remained on the taxiway.

In the hangar, the fuel tank cover skins were re-installed. Since this area is in the prop wash, I didn't want it exposed while making the high power runs.

The landing gear was noticeably more splayed (extended) after adding the fuel. Amazing that adding 310 more pounds will compress the springs noticeably. A check of the gear tread (tire center to tire center) showed 72.5 inches. This is still less than the maximum of 74 inches, but the airplane is still not at gross weight.

High Power Run Up

While taxiing crosswind, the wind was sufficiently strong to cause the tail wheel to release to full swivel. The resulting motion was arrested by brake application.

After taxiing to the run up area, the parking brake was set. The throttle was advanced to 1500 RPM for five minutes. During this time the propeller control was cycled at least four times. The first time the control was pulled out slowly, since I had been warned that it would take a while for the oil to move into the prop hub the first time. Even so, the propeller control was all the way out before any reduction in RPM was noticed. Each subsequent time the propeller control worked as expected without an unusual delay.

With the RPM at 1530 and the carburetor air temperature at 47 degrees F, the carburetor heat was applied. With carburetor heat, the RPM dropped to 1470 (60 RPM drop) and the carburetor air temperature increased to 65 degrees F. The carburetor air temperature may have continued to climb if the carburetor heat had been left on for longer. Any drop in manifold pressure was not noted. Measure manifold pressure change for carburetor heat.

The ignition systems were turned off one at a time. In this case, there was no drop in RPM when one system was turned off, as predicted by the Lightspeed Engineering web site. All cylinders were firing on both systems as shown by good EGT values.

At 1500 RPM, it was noted that there was sufficient airflow over the tail that the elevator would float to a horizontal position for a stick position of about half up.

After five minutes at 1500 RPM, the throttle was smoothly advanced to full while holding full up elevator. The RPM increased to 2510, the manifold pressure was 25.8 in Hg, and the fuel flow was 21 gallons per hour.

The maximum RPM was well below the desired redline of 2700 RPM. According to the prop governor manual, the maximum RPM on the ground for a 2700 RPM redline should be between 2600 and 2675 RPM. According to the governor manual, the high RPM stop screw should be turned four turns counterclockwise to bring the RPM up to at least 2600. This is all of the adjustment that should be made prior to flying and finding what the real in-flight maximum RPM is. It is not critical that this be perfectly adjusted before flight, because the O-540-A4D5 engine is the same engine with a redline of 2575 RPM. Even at 2510 RPM the engine is producing more power than some O-360 installations, so there should be sufficient power for flight.

The manifold pressure at full throttle was 25.8 in Hg. Pressure altitude was about 2400 feet, which equates to an ambient air pressure of 27.4 in Hg. This was a pressure drop of 1.6 in Hg. Considering an expected pressure loss of about 0.9 in Hg from the carburetor, this left 0.7 in Hg pressure drop to be attributed to the air filter and air box restriction. If desired to further investigate the pressure drop source and magnitude, the engine could be run at full throttle on the ground without the filter and without the airbox.

The full power fuel flow was 21 gallons per hour. However, it is possible that this was not at full rich mixture. Re-check full throttle fuel flow at full rich mixture.

The brakes held during the full power run up, with no aircraft motion noticed.

During the full power run up, some of the CHTs went slightly above the 435 degree F limit, setting off the appropriate alarms on the EDM-900.

The throttle was smoothly pulled to idle for an idle RPM around 600 RPM, which is the desired value in the Lycoming Overhaul manual. Pulling the mixture slowly to idle cutoff showed no increase in RPM, indicating an idle mixture that is too lean. Turn the idle mixture needle 1/2 turn towards rich and re-test.

With the engine shut down, the plan was to adjust the high RPM stop on the governor. Once I realized that this would involve not only adjusting the stop screw but also the length of the cable, I decided that this was too involved of a procedure to do in the run up area with the wind blowing. A check of engine temperatures showed that CHTs had cooled well below the limit temperature, so the engine was restarted and the airplane taxied back to the hangar.

Upon return to the hangar, a sizeable amount of oil was found coming out of the cowling. Investigation traced the source of the oil to the front of the engine. High on the suspicion list is a bad or even non-existent front crankcase oil seal. Investigate and repair the source of the oil leak before further engine runs.

Checklists

During the various engine runs for troubleshooting and checkout, it became apparent that the Engine Start checklist has a page turn at a very bad spot. Re-evaluate and change checklist pagination as required.

No Engine Data Recorded

For unknown reasons, there were no data recorded in the EDM-900 available for download after these engine runs. Data recording is supposed to begin whenever EGTs are above 500 degrees F or a data mark is entered. Add procedures for data marking to EDM 900 checklist page.

Conclusions:

Engine

The required ground engine runs were completed. The engine will be ready for flight after the squawks mentioned below are cleared up.

The alternator is functioning properly.

Both Lightspeed ignition systems are functioning properly. No drop in RPM was seen when running on one ignition system at run up RPM. The tachometer works properly with either ignition system on.

The spinner is straight and not wobbling.

Propeller tracking was not checked.

Carburetor heat is functioning as expected.

Maximum governed RPM needs adjusting.

The manifold pressure loss at full throttle RPM was 1.6 in Hg.

Idle RPM was 600. Idle mixture is leaner than desired.

During the high power run, a large amount of oil came out of the front of the engine.

No data were recorded on the EDM 900.

The Starting Engine checklist has a page turn in a bad spot.

Avionics

The audio volume for GPS messages was found to be turned down to zero, possibly explaining why a previous test of message audio was unsuccessful.

The sidetone volume was adjusted, but may require further adjustment.

The GPS properly found itself at its known location. HSI presentations were as expected both on the GNS 480 NAV page and the Dynon HSI.

The PMD identifier tones were heard, but no VOR signal was strong enough to be picked up. This was the first indication that the VOR antenna was connected properly.

Heading values on the top Dynon were essentially correct for the direction of travel. The lower Dynon heading and RMI micro-Encoder heading were not checked. Turn rate indications were not checked. GPS track was not checked. Autopilot display of GPS track was not checked, although this requires a minimum of 15 knots ground speed.

With the Master Arm switch on, the bomb and gun sounds worked and were audible above the engine noise.

The GNS 480 Maps 2, 3, and 4, and transponder interrogation were not checked.

Taxi, Landing Gear and Brakes

Taxi was successfully accomplished under challenging wind conditions with liberal use of brakes. The field of view was typical for a tail dragger.

Lowering the flaps to full down prevented the flaps from being blown against the stops while taxiing downwind.

The brakes operated as expected. The brakes were sufficient to hold the airplane in position during a full power run up.

The landing gear spread out more with the extra weight of the fuel, but is still within limits.

Fuel Tanks

The fuel sight gauges were calibrated. Empty fuel and full fuel are off either end of the sight gauge.

The fuel capacity of each tank was 25.5 gallons.

No fuel leaks were found on either tank.

The empty fuel lines did not trap air when the empty tanks were refilled.

Recommendations:

Engine

Check propeller tracking.

Measure manifold pressure change for carburetor heat.

The high RPM stop screw should be turned four turns counterclockwise to bring the RPM up to at least 2600.

Re-check full throttle fuel flow at full rich mixture.

Turn the idle mixture needle 1/2 turn towards rich and re-test.

Investigate and repair the source of the oil leak before further engine runs.

Re-evaluate and change checklist pagination as required.

Add procedures for data marking to EDM 900 checklist page.

Avionics

Re-accomplish the previous message audio test.

The VOR reception on the ground should be checked in the air and also at other locations on the airport, such as the run-up areas.

Check the additional data on GPS Maps 2, 3, and 4.

Check transponder interrogation.

Check heading indications on the lower Dynon and RMI micro-encoder. Check turn rate on Dynons. Check GPS track on GPS and autopilot display.

Taxi, Landing Gear and Brakes

Update the checklist to consider lowering flaps for downwind taxi.

Fuel Tanks

Record the position of the calibration marks and affix a more permanent marking on the sight gauges.

Placard each tank for a capacity of 25.5 gallons.