

Alachua County Diesel Generator - Part One

by Gordon Gibby KX4Z

INTRO: The MOTIVATION

At our 2022 Field Day our ARES(R)/NFARC group enjoyed the 10kw Diesel ONAN Generator provided by the MARC UNIT (Region 3). (\$12,300 from this supplier: <https://apelectric.com/cummins-onan-commercial-series-10hdkcc-42345-qd-10kw-diesel-mobile-generator/>) We learned how *wonderful* these zero-RFI, diesel-sipping generators are!

Was there any way for our group to have permanent access to a Diesel Generator? Fuel is much less explosive. Fuel usage is typically much less. Fuel keeps much longer in storage (just keep water out). But they are TEN TIMES

more expensive than gas.... APElectric sells a 5kw unit for \$10,000. Northern Tool formerly sold a unit for \$5000. Several vendors list an open frame 5kw generator for \$4000+ (<https://www.electricgeneratorsdirect.com/Generac-6864-Portable-Generator/p50700.html>) One solution: Enterprising hams in other states have become adept at bidding on auctioned used "light trailers" that include a 6kw diesel generator and have done OK with getting them running. Still it is perhaps \$2-3000+ and a risky move...



THE OPPORTUNITY

I have overhauled *one* auto engine myself (only 1 serious & costly error!) but was quite nervous about going into the *used-light-trailer-repair business*. So over a period of time I became familiar with the Ebay offerings of diesel generators, generally confusing old military units. Then quite by chance, in July, I found a **Pramac ES5500X 5kW generator with near-zero hours** offered for \$2000 within driving distance. This generator was manufactured in Georgia by a reputable company, around the year 2000. **Manuals were available.** The engine is a **well-known Yanmar 10HP air-cooled one-cylinder diesel engine**, 3600 RPM. A carbon-copy Chinese clone of the diesel engine is available on Amazon in the \$600 range (with variable user reviews), for example: <https://www.amazon.com/Diesel-Cylinder-Cooling-Agricultural-Machinery/dp/B088D4Z491> Generator heads are widely available - the sticking point being choosing the proper coupling if both units have a cylindrical shaft. Some engines and generator heads are now being made with the "Chinese taper" so that the tapered shaft of one unit fits right into the tapered receiving hole in the other. Friction fit. Bolt the two together and you're done. With a variety of large-unit repair options available, and two friends who would pick up the unit, I bought it just from seeing the photos after the owner assured me that the crankshaft was not frozen. \$1900 out the door. As I was in North Carolina, Leland Gallup AA3YB and David Huckstep W4JIR did the driving the the unloading of this 250-pound unit under my pole barn.

I knew there would be some "issues." *That turned out to be an understatement....*

THE MONTH-LONG PROCESS

Diesel-compatible oil: No oil in the crankcase. Really did look like it had NEVER BEEN RUN. Diesel engines require oil that will solubilize soot. Deltron is a suitable oil; obtained from an auto parts store.

Compression. GREAT compression. After the compression release first revolution, the full compression is felt on the next turn -- NO WAY I could pull it through.

Starter Motor. *Never even wired.* I connected up a large battery, put diesel in the fuel tank, rigged up two wires to actuate the solenoid, and cranked. It cranked nicely. And cranked. And cranked. A couple of puffs of combustion That was storage oil firing in the cylinder. NO FURTHER combustion evidence....is it getting fuel?

Wiring Error. I discovered these generators had been contracted for the US Navy, used to work on the Cole during repairs after its attack. There was an official government document with a repair to a faulty AC wiring (shorted out two windings!) and other information. Sure enough -- found the same shorted winding error on ours...easily fixed. Manual: https://qsl.net/nf4rc/2022/cupdf.com_pramac-es5500x-55kw-generator-set-materialst460-ah-omi-010pdf-pramac-es5500x.pdf



Injector: 10mm wrench, two nuts freed, 17mm wrench to free the metal fuel pipe from the high pressure (> 2000 psi) injector pump and I determined **NO fuel was being sprayed.** (CAUTION: never put a hand near a diesel injector; it will inject deep into flesh and you'll be meeting a surgeon to save your hand.) Triple-square wrench needed to get apart...fuel pipe frozen to the injector; repair companies far away and uncertain price. Key measurement is the protrusion into the cylinder; clone injectors appeared identical. \$25 -- ordered! As well as a

replacement metal fuel pipe, pre-bent into the exact shape (advantage of clone engine!). **Upon delivery, measurements with calipers revealed the protrusion was identical.** Switched the all-important spacer from the old injector to the new (later brought a new spacer - also turned out to be perfect).

Result: Good injection! After learning the importance of BLEEDING AIR OUT OF THE LINES the hard way....the engine STARTED, and died, and REVIVED, *wash, rinse repeat without end.* No steady running. Is the Governor bad?



Governor: A week spent studying the external controls of the governor in the extensive Yanmar workshop manual easily downloaded. Governor appears flawless. Not the problem.

ASK FOR HELP: I put the word out to our local group....

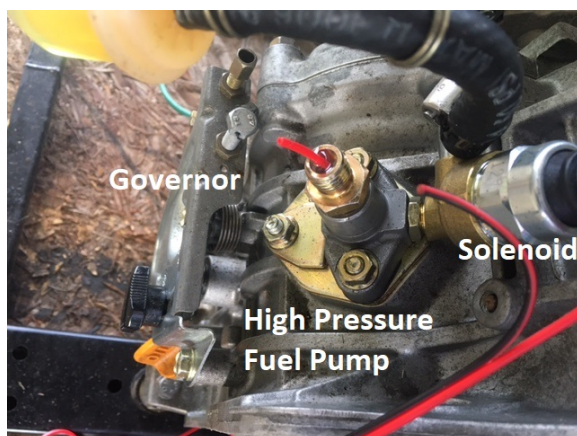
That's when Wendell Wright KN4TWS typed a one-word response: *"Timing?"*

The one part of the manual I had avoided. TIMING in this diesel generator is a **mechanical** affair, anathema to an electrical engineer like me. A lobe on a **camshaft** strikes a **tappet**, which conducts the impulse to the spring-loaded high pressure pump. Timing is set by adding or subtracting precision thicknesses of precisely stamped **copper shims** underneath the mounting bolts of the high pressure pump.....

Injector Pump: Despite having a low-pressure oil sensor (unwired) the generator's fuel pump had NO SOLENOID to allow it to cut off the fuel in the event of low oil pressure. \$25 got me a replacement (clone) fuel pump and new tappet with a SOLENOID.



Off came the recoil starter, and housing, and I found the all important timing stamps on the flywheel/forced air fan. A bit of plastic insulation made a "straw" in the fuel pump outlet so I could try to observe the onset of fuel delivery (which continues for several degrees of rotation). It was WAY WAY too early. (4 degrees is a lot in diesel engines). I needed to delay another 12 degrees or so.



TIMING: Shims are available from several suppliers; the Ebay supplier had most understanding ordering mechanism. Multiple 0.1mm, 0.2mm and 0.3mm shims ordered; each 0.1 mm gives approx 1 degree of delay. The tappets were also different -- the older tappet gave more delay. When the shims arrived, I assembled my setup, got the solenoid open, made tedious measurements for multiple tries and over an hour and finally settled that I was "close" to the proper timing.

The Big Moment: Reassembled everything, bled everything (for the UMPTEENTH TIME). Powered, the solenoid, hit the two wires together -- **and it started and ran perfectly!** 117 VAC output! No need to "flash" the core at all.

Heaviest load I had available was a circular saw with a huge startup current -- not a problem at ALL for this beast! No notable change in RPMs at all! Voltage dropped 2VAC, rose 4 VAC and steady at 119VAC.

Hooray! Alachua County ARES(R) has a diesel generator! At 50 cents on the dollar. And hours and hours of learning.

Part II: *creating a control system, final adjustments.*