Shooting Trouble

Generator Troubleshooting–Part 2

Continuing our series with the Permanent Magnet Generator (PMG), much of our troubleshooting is very similar to that of the Stamford Series 3 or Marathon Magnaplus (SER) generator *(vol. 10, online)*. Hang onto this for the day you have to confront your generator and need a little help making heads or tails of it when you're looking right at it.

Permanent Magnet-Excited Generators offer increased motor-starting capabilities of 10-15% with the close voltage control of the regulated-style units. Often used on vessels with large motor-starting loads and finicky electronics in the wheelhouse, PMG equipment [*Fig. 1, and (1) in Fig. 2*] can be retrofitted on many existing generators should larger motors be installed in the boat. The PMG bolts on outside the rear bearing (2), and requires a new Automatic Voltage Regulator (AVR)–they come with a basic unit but more elaborate digital AVRs are available, for example, for paralleling generators.

PMG-Generator Troubleshooting

For low or high frequency just reset the no-load engine speed until the cycles are at 60 Hertz for engines with electronic governors, 61.5 Hz for mechanical governors.

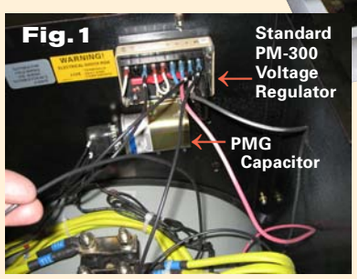
Likewise, if slightly low voltage is the problem, increase voltage as needed with the small voltage-adjusting screw on the AVR *(Automatic Voltage Regulator)* (3). The AVR controls voltage by increasing or decreasing the strength of the exciter's magnetic field. At no load the minimum voltage to exciter windings should be close to 6.7 volts and increase to 21 volts under load–although AVRs are capable of 63 volts maximum for starting heavy loads.

Check the PMG AVR for these three things: 1) power to the AVR from the PMG must be present; 2) power to energize the field must be present; and, 3) the AVR's sensing circuit must be working.

If all circuits work with correct voltages but brownouts continue, suspect either dirty air- or fuel filters, or air in the fuel.

The PMG can be tested as an independent generator. Disconnect the AVR power-supply leads from the AVR terminals. Run the generator at rated speed (the speed must be correct for accurate results). Check the PMG output voltage with a multimeter, set to AC volts. For 60Hz generators, voltage should be approximately 200VAC.

Important Safety Note: *When checking a generator, before starting it perform a voltage check of the generator leads (L1, L2, L3, & N) to verify they are indeed electrically dead & the unit is safe to touch. This protects you from shore-power current or the possibility that another generator is running.*



Marathon PMG Wiring

The Visual Check

Now look for burned wires or components. Running your fingers along the wiring, prod and pull gently to find anything that's loose or disconnected. Check continuity of the AVR's sensing-, power-, and control circuits–a burnt smell likely means burned wiring or insulation.

Check the appearance of the voltage regulator (3), followed by the regulator fuse (4)–the only fuse most generators have. Older units often have the fuse inside the cabinet on top of the generator, newer ones include it on the AVR. Note that the fuse holder can also cause trouble if one of the internal contacts is burned or broken–use your multimeter to verify continuity through the fuse & fuse holder.

Beginning The Electrical Testing

This will show us 1 of 3 conditions: *Low Voltage, No Voltage*, or *Residual Voltage*. PMG generators depend on their iron content to hold magnetism. All generators have some residual magnetism, which results in Residual Voltage when the generator rotor spins, even if the regulator is not doing its part to deliver voltage to the magnetic field. The PMG system, however, creates voltage to excite the field with the use of permanent magnets.

Permanent-Magnet Generator

Caution: *Start the generator & check voltage line-to-line* (Fig. 1). *Most fishing boats are 208 V but your system could be 240 or 480. Be sure to check.*

If Low Voltage, proceed to check AVR function. For a generator configured at 208 V, if the actual generator voltage is only 50-60 V line-to-line (L) or 25-30 V line-to-neutral (N), you are seeing Residual Voltage–this means the voltage regulator, fuse, or wires to-&-from are faulty.

Voltages line-to-line & line-to-neutral should be equal if the stator assembly and its individual coils (L1, L2, L3) are O.K. If not, replacing the AVR should set the system right. If one leg has low voltage suspect the generator stator windings (5).

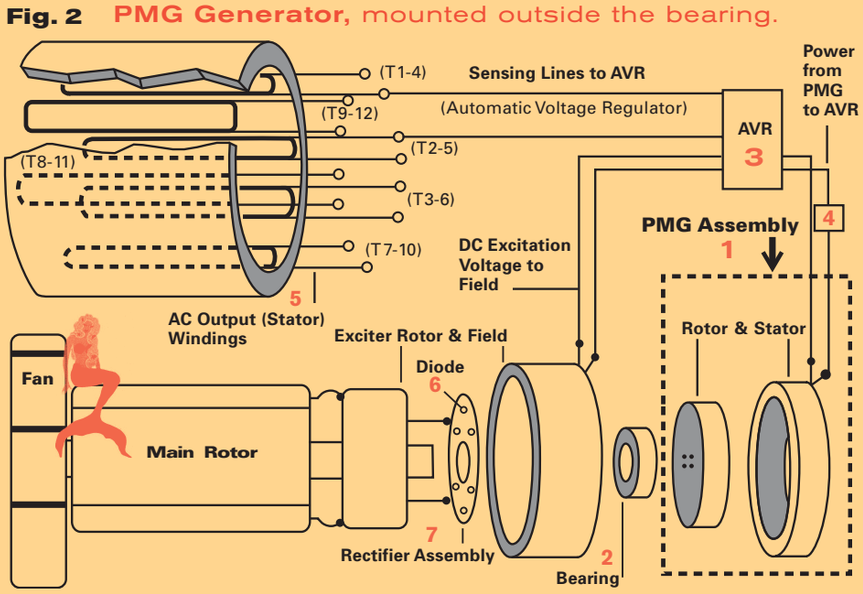
No Voltage usually means severe damage such as stator (5) or rotor winding burned open. Check stator windings by disconnecting the 12 leads, two for each of the six coils around the barrel of the generator housing. Check continuity on each coil, i.e., T1 to T4, T2 to T5, T3 to T6, and so on. You should have continuity on each coil but not to ground or another coil.

Diodes are located on or near the exciter rotor & the cluster of diodes make up the rectifier assembly (7). To get a quick idea of diode function (6) note that the generator may have full voltage with no load when a diode is faulty; however, the voltage will drop as load is applied–greater the load, lower the voltage dip. *continued in box below ...*

These guidelines are general; consult your manufacturer's wiring diagram.

by MER mechanic Ben Evridge & GM Mike Hoyt. Need help? Call!

Fig. 2 **PMG Generator,** mounted outside the bearing.



continued from above: If your voltage is low on one or two legs it's probably an unbalanced load. Check the current (Amps), & on each leg you should find the leg with highest current will have lowest voltage & the leg with lowest current will have highest voltage.

Smooth Operat

"Kristiana's" MERmade BEAGLE–Top Dog

MICHAEL OFFERMAN PHOTOS

For the first time in its 132-year history a beagle won Best in Show at the 2008 Westminster Kennel Club Dog Show. We knew it was best—when MER was first to marinize the JD-250 Series we called it the BEAGLE. Starting on the prototype in 2003 and rolling it out in '05, we said then that the JOHN DEERE engine helped make *our* beagle a leader of the pack: well-bred, well-tempered, low maintenance, fewer trips to the vet.

And reliable, just like *Kristiana's* John Crowley says.

The MER-made BEAGLE. Good dog.

MER

John Crowley has been in the fishing business 50 years now, and with all that history and experience behind him he went out and bought a MER-made John Deere for his hotel set last year–the new BEAGLE Series MG30JDT, with a Newage motor-starting generator. He replaced a cantankerous genset that for 3 years kept breaking down in-season, costing him quite a bit of time, money, and fish.

"I wanted to switch to a Deere," says John. "I understand it comes from the factory, tried-and-true, and Bob recommended it. He said that they were 'put together differently.'"

John found MER "just doing my shopping," he says, looking to beef up the electrical for a new autobaiter. "Started looking around, decided to go with MER."

"I liked the owner quite a bit," he adds. "I just like Bob, felt comfortable with him. Had a feeling he's a decent kind of person and ran a good operation there."

John agrees the genset runs smooth and quiet as touted. "All those things," he says: trouble-free, virtually no voltage droop when putting a heavy draw on it, glow plugs great for easy starting, the only required maintenance changing oil & filters. But he says it runs off the same fuel tank as the main so he can't measure the efficiency benefits.

Yet, all told, the No.1 criterion for *Kristiana's* hotel set was: **RELIABILITY**.

"The old generator, when it was running and not stopping, it ran good," says John, adding that everybody else seems to be happy with the brand but he just got a lemon.

"We lost a lot of days on the other one–one time had to fly an electrician all the way up to Alaska."

Where one expects to get 25,000-30,000 hours out of a genset, John says by 12,000 "we're just yanking our hair out."

"We surrendered."

"We have not looked back with one second of regret," he says, logging more than 3200 hours on the BEAGLE in its first year.

"I'm real happy with the Deere–it's running really good. We put more hours on it than we do on the main."

- owner John Crowley

"The main thing for us of course is that it's running," he says: "Nothing runs like a Deere." And runs quietly too.

"You hear it," says John, "but it's kind of soothing in a way. Most boats, to hear an engine running is more soothing than to not hear it running."

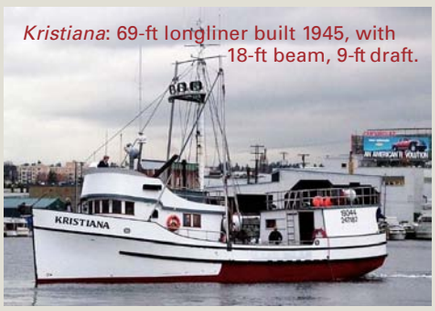
Michael Offerman

Replacing a genset of the same size, "The first 30-kW had quite a bit of spare room," he says. "We figured if you turned every single thing on–which we never did–we'd use 20 kW. We're closer to the max now." He talked about a 40-kW genset to have that extra cushion but, if too big, you're burning fuel to keep a bigger load on it plus he'd have to get a bigger keel cooler.

"We're using that engine for a lot," John says. In addition to the autobaiter that cuts and baits on electric, he says the 30-kW runs all the main big fishing lights, some indoor lighting's 110, the heater, microwave, TV, 2 bilge pumps, 4 battery chargers ...

"We run a lot off that genset," says John–including auxiliary power for the refrigeration system to run the compressor's hydraulic pump.

Crewman Michael Offerman backs him up. Now in his 8th year onboard, Michael lined out how the deck operation runs with a 5-man crew and a state-of-the-art autobaiter. To fill their halibut and black-cod quota they are definitely moving some gear–with some big capital investments at stake–and it's clear to see how No Power just shuts them down.



Kristiana: 69-ft longliner built 1945, with 18-ft beam, 9-ft draft.

PHOTO: MARY CROWLEY

Maintenance Matt

Preventing Corrosion–Zincs!

After our 3-part Corrosion series it's a wonder any boats still float at all *(online, vols. 8-10: chemical-, mechanical-, erosion corrosion)*. So what are ya gonna do.

Let's talk **ZINCS**–the galvanically less-noble metal *(anode)* sacrificed through electrolysis for the good of the boat and all its other metals *(cathodes)*.

Tips & Reminders

Don't overlook the obvious:

- To complete the electrical circuit, zincs must be connected to the items they're intended to protect.
- Weld or bolt clean zincs for electrical continuity. Maintain connections–check for corroded wires and contacts.
- Mount zinc directly on the protected metal fitting itself or as close as possible–zincs lose effectiveness with *distance* from protected metal. *General RULE OF THUMB: Zero protection at 50 feet and continuous decline in protection up to that point.*
- Size the *exposed surface area* of a zinc proportional to exposed surface area of the metal to protect. Not by volume or weight–it's the zinc's exposed surface that matters.
- Never trust the power supply at strange docks–*and always check the polarity*. Check your voltmeters for adequate voltage. *Low voltage–very damaging to electrical equipment.*

In the harbor you need to protect against poor electrical wiring of neighbors or the dock (could it be you?) and the highly corrosive damage stray currents cause.

- Consider using a **zinc fish** while at the dock. Large lumps of zinc, often fish-shaped, they're much cheaper and easier to replace than zincs on your shaft. Comes with a copper wire attached to hang it in the water–connect the alligator clip to the boat's negative bonding circuit. Here, sacrificing a temporary fish zinc is not a function of surface area but of *proximity* to metals being protected–hung next to a permanent zinc could extend its life by providing that extra layer of protection when shorepower or harbor strays go awry.

For long layups it's a good idea to hang fish zincs near your hull zincs–but remember what a hot harbor can do in a short time as well. *Wouldn't want to accidently take off with the zincs hanging over the side though; wind one up in the prop–not such a good idea.*

- A boat's not a house or a car–it sits in its own electrolyte! Use ONLY marine-rated equipment & materials *(shorepower cords, battery chargers, any wiring/plugs/outlet expanders)*.
- Don't moor a steel boat directly next to Aluminum vessels.

WHEN SIZE DOES MATTER

TOO MUCH ZINC: **overprotects–develops crust, gets fouled, quits working.** *Overprotecting an Aluminum hull is particularly destructive–alkali corrosion of metal, maybe blistering of paint.*

TOO LITTLE: **disappears too rapidly–leaves metals unprotected.**

JUST RIGHT: **half-wasted–doing its job; replace with new zinc of same size when 50% dissolved.**

Source shout-out to Michael Kasten's "Corrosion, Zincs & Bonding," M

TOOKIE WRIGHT

"We need dependable, reliable power. MER has a good reputation; heard through the grapevine the JOHN DEERE was a good engine. It ran great from Day 1. Turn the key & start it–no grief. Didn't burn any oil. It's on all the time except when we're in town and plugged-in."

- crew Michael Offerman

All in the Family

John Crowley's story reads like pedigreed fishing: On his mom's side, Grandad Oscar Oberg came from Sweden & started fishing in Alaska in 1911, hand-hauling & breaking ice off glaciers.

John's dad, Jack—a "misplaced farmer from Minnesota"—came to Seattle in 1941 the day Pearl Harbor was bombed, made his way to Alaska and broke-in fishing at 16 in the late '40s. Jack married Oscar's daughter, raised a family in Juneau, fished halibut (including a few years with his father-in-law) and took son John out in '59.

Ever since that first trip—11 years old, washing dishes—John says he didn't want to do anything but fish. And that's just what he did, for 50 years now—several fisheries, quite a few boats, in the Gulf, the Bay, and the Sound—as partners with his late father.

Come IFQs in '95 John bought Jack out & also stepped off the boat, with his own son-in-law Michael Offerman coming up behind.

MICHAEL OFFERMAN

Magnetic Pickups

Magnetic pickups have two purposes in engines: 1) with tachometers to indicate engine speed, and, 2) with electronic engine control systems to tell the engine-management computer how fast the engine is turning.

Mag PUs are located so that they count either the engine's flywheel teeth or timing-gear teeth. Although flywheel-mounted Mag PUs are adjustable, those mounted over engine timing gears are usually not. Adjustable Mag PUs normally come with fine threads and in a number of diameters.

You can easily retrofit adjustable Mag PUs to any engine by drilling and threading a suitable hole in line with the flywheel-ring gear teeth. When deciding where to drill it's best to remove the starter motor to take careful measurements for proper positioning of the PU.

The same in all other respects, different-sized Mag pickups take a different size mounting hole in the flywheel housing.

Looking through the Mag Pickup opening, move the flywheel teeth until they are centered in the hole.

Contaminating the tip of the magnetic sensor with magnetic material (such as when drilling and threading a Mag PU hole) will actually prevent the sensor from working correctly, so it's important to keep all metal cuttings out of the flywheel housing.

The best way is to squirt foam shaving cream (strange but true) between the flywheel teeth and the inside of the housing where the hole is to be drilled. The shave cream will catch and hold all metal particles as you're working. When you're finished threading the hole just vacuum up the shave cream and metal filings, then insert the sensor.

Before adjusting the depth of the Mag PU ***visually center one flywheel tooth*** in the hole–or the Mag pickup will be installed too deep and when the engine turns over the ring gear will damage the end of the Mag pickup (*most common cause of failure in new installation*). If possible, blow the PU hole and flywheel teeth clean with a blast of compressed air.

Next, wipe the tip of the PU clean and thread it into the flywheel housing, turning it gently until it bottoms in the hole. Now back it out one-half turn or according to specifications, and tighten the lock nut.

While the sensor has only two wires it takes three conductors to wire up the system correctly. This is because small-gauge coaxial cable is used to connect the sensor to the tachometer and the third conductor is used to connect ***only one end*** of the cable's so-called "shield" to an electrical ground. *Note: Marine electricians also call the shield wire the "drain."*

When engine-speed controls or tachometers fail to work, make four simple checks:

1) Verify the sensor is wired correctly and that the wires have continuity.
2) Remove the sensor and inspect the tip for damage or contamination.
3) Adjust the sensor to the specified depth.
4) Verify continuity through the sensor with a multimeter.

- by Ben Evridge

Good-to-Know Abbreviations:

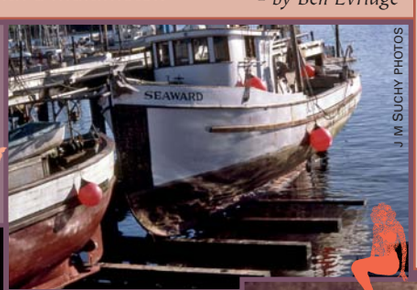
APM	Automatic Paralleling Module
AVR	Automatic Voltage Regulator
CBS	Current-Boost Excitation Support System
CT	Current Transformer
FCB	Field Circuit Breaker
Hi/Lo Wye	Diagram Incorporates Hi (Series) and Lo (Parallel) Wye connections
MVC	Manual Voltage Control
PIT	Power Isolation Transformer
PMG	Permanent-Magnet Generator Support System
VAR	Remote-Mounted Voltage-Adjust Rheostat

t e r s

- Get an isolation transformer for the boat's electrical system–takes your boat out of the harbor "battery" and sidesteps its strays.
- Copper-based bottom paints react severely to stray current and serve as "litmus paper" for electrical problems. When hauled out and you see large ugly burn patterns around all your underwater metals–you got a stray-current problem.
- Check Engine Owner's Manual for tips/suggestions re. your anode system(s).
- *Know where the engine zincs are & check frequently, especially if you've changed any major hardware on the boat. Carry spares.*
- Be vigilant. If you have corrosion there's a definite reason–stray current, bad polarity–something. Look for it. Before replacing any damaged components isolate the problem and fix it–or it'll corrode and eat your new metals too.

Coming up—*To Bond or Not to Bond: That is the Tricky Question. AC, DC Bonding Systems & Grounds.*

Check hull & engine zincs often; replace when 50% dissolved.



J M SUCHY PHOTOS

WHEN DOESN'T SIZE MATTER?

Zinc fish work by proximity to the metal it protects.

Mounted zincs work by sizing exposed surface area of zinc proportional to exposed surface area of metal to protect.

MER EQUIPMENT
338 W. Nickerson St.
Seattle, WA 98119

The MERmade Mechanic

PARTS DISCOUNT COUPON!

WWW.merequipment.com

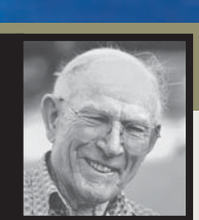
News You Can Use!
vol. 11 Spring 2008

MER EQUIPMENT

The MERmade Mechanic

MARINE ENGINES & REPAIR COMPANY, INC.

PMG Generator Troubleshooting
Magnetic Pickups • Zincs!
JD Beagle GenSet ... & *Ivan Fox*



From the Founder

IVAN FOX REMEMBERS ... THE SAD TALE OF THE DEEP SEA

Part 1: Last 2 issues told the dramatic story of the 105-ft Logger *when disaster struck while tendering salmon for San Juan Fishing & Packing Co.'s Uganik Cannery on Kodiak Island. The 1960 salvage ended with the* Deep Sea *towing her to Seattle for repairs. Sixteen years later, the* Deep Sea *would not fare so well when she met her own disastrous fate.*

In the Spring of 1945 the San Juan Fishing & Packing Co. announced that they had purchased the Uganik Fisheries Co. located in Uganik Bay, Kodiak, Alaska, later known as the Herring Plant. Included in the assets was a vessel under construction in Everett, Wash. This vessel was to replace a vessel named *Deep Sea* lost by the Army in World War II. This new vessel was to be used as a pile-driver tender for driving salmon traps as well as a tender for brailing the traps & tendering the seine fleet in Kodiak. The *Deep Sea* had not been originally designed for a top house & flying bridge but the new owners decided to bring it to Seattle to add the top house & flying bridge, as well as a heavy-duty tow winch to make the vessel more suitable for tendering the pile driver. The *Deep Sea* arrived at the Uganik Cannery late April 1947, the captain was John Smeland from Poulsbo, Wash., a retired halibut fisherman & a top skipper.

The Deep Sea became the pride of the Uganik Fleet. She tendered both the pile driver & the seine fleet. She came North early every year loaded with operational equipment & canned supplies for the summer salmon season. Captain Smeland skippered the *Deep Sea* into the late '60s. The Loss of the *Deep Sea* was a real tragedy. She went down in terrible circumstances, all hands & passengers perished. It was August 26, 1976, we had Crowley Tug with a barge loaded with vans at our dock loading canned salmon. As usual, I was up at 5:30 a.m. in the radio room. When I turned on the radio the Coast Guard was calling to advise that they had picked up a Mayday distress call from the *Deep Sea*. The message was brief: "Mayday, Mayday–*Deep Sea*, Whale Pass." The day before the incident I had dispatched the *Deep Sea* to the North Arm of Uganik Bay for the final pickup of salmon from the set-net & beach-seine fishermen with instructions to deliver the fish to Ocean Beauty Seafoods in Kodiak the following morning at 08:00 where they were to be processed.

The *M/V Deep Sea*—built 1945 at Everett, Wash., and remodeled at Seattle's Ballard Marine Facility in '46—went into service in Uganik Bay, Kodiak, Alaska, in 1947. 105 gross-ton, 78.4' length, 19.2' beam, 9.6' depth. Main engine 250-HP 6-cyl Atlas, 350 rpm, direct reversible, 10" bore, 13" stroke.

Next issue: Life & Death of a Grand Lady, continued ...