Gearhead

The Inverter Shorepower Equation

By Steve D'Antonio

Inverter installations can be complex. Regardless, they should always meet both the manufacturer's and ABYC's guidelines for reliability and safety.

The first time I was asked the question, during a Trawler Fest lecture, I was somewhat taken aback. After all, who doesn't understand how an inverter works and how it interfaces with shorepower, right? By the third or fourth time the question was posed I realized the subject was ideal fodder for a Gearhead column. If the manner in which this gear works and interfaces is unclear to you, rest easy, you aren't alone.

THE INVERTER CHARGER

At the risk of boring those who do understand the function of an inverter, this now ubiquitous piece of shipboard gear is capable of converting the voltage supplied by a vessel's batteries, into the same type of voltage produced by generators and utility companies. That is, 12 or 24VDC to 120 and/or 240VAC. In most cases, this occurs nearly seamlessly. In a typical installation, when an inverter senses that no AC power is available, from the dock or an onboard generator, it automatically goes into invert mode, producing 120 volts that is most often sent to an inverter "bus," a set of circuit breakers on the main or sub panel that supply equipment designed to be powered by the inverter. This usually includes some, if not all, receptacles, refrigeration equipment, microwave ovens, entertainment systems, and a burner or two on an inductive electric range.

Today, the quantity and type of gear that can be operated from inverters is nearly limitless. Where just a few years ago it would have been unheard of to consider operating an air conditioning system or range via an inverter, today it's both possible and becoming more common. For larger vessels, 240-volt inverters are also becoming more common, enabling operation of larger motors and compressors as well as full electrical panels, albeit with some load management, rather than dedicated inverter buses. To an extent, the primary factor limiting what an inverter, or "stack" of inverters can power is the capacity of the battery bank to which it's connected.

CHARGING FUNCTION

When standard shorepower or generator power is available, an inverter senses this as well. Most moderately sized inverters now available also incorporate the ability to act as a battery charger, often with considerable output capability, using multi-step modes and with temperature compensation. In this mode, the inverter is essentially running in reverse, shorepower applied to it, 120 or 240VAC, is converted to voltage that can be used to recharge a battery bank, 12 or 24VDC, and often very efficiently.

Installing a bypass switch offers a belt and suspenders approach in the unlikely event of an inverter failure. In some cases, such a failure may prevent the operation of gear that otherwise operates from the inverter, even when it's powered by shore or generator power.

AUTOMATIC OR MANUAL MODE

Typically, the default for this process is for it to occur automatically and with little or no input from the user. When shore or generator power is available, the inverter is charging, when it's not, it's inverting. Manual control is also possible, and many users opt for this arrangement. Manual control may be used, for instance, in cases where a vessel is unattended and left with AC equipment such as operating refrigerators. If shorepower is lost, if a circuit breaker trips, or a shorepower cord is unplugged, the inverter will pick up the load, which works well until the batteries are depleted. Thus, the lesser of two evils may be spoiled food rather than a large bank of expensive batteries that have been allowed to go dead and remain that way for some time, potentially causing permanent damage. When a bank is depleted in this manner, it's also incapable of supplying power to bilge pumps—another potential liability.

While in charge or idle mode, inverters are also in what's known as a 'pass-through' condition. This enables shorepower to pass through the inverter, energizing the inverter bus, enabling items powered from it to operate via ordinary shore or generator power. It's worth noting that in order for the pass-through relay to operate, the inverter must be on or its AC circuit breaker must be energized. This confuses many users (and generates many frantic calls to boatyards and dealers), in that the inverter isn't being used per se. However, it's necessary if circuits otherwise supplied by the inverter are to be used on shore or generator power.

The pass-through relay is located within the inverter and while typically quite reliable, failures are not unheard of. Some are uncomfortable with this potential point of failure—one that prevents shore or generator power from reaching any appliances or equipment that normally operate from the inverter bus. The solution to this concern involves the use of a bypass switch, which may be in the form of a rotary switch or a set of slide lock-equipped circuit breakers.

With this arrangement, the user is not at the mercy of an internal, and therefore difficult to troubleshoot or repair, relay. If the inverter fails to properly pass shore or generator power, it can be bypassed.

FOREIGN POWERS

With the advent of large inverter systems, more and more vessels are turning to this technology to enable them to utilize 'non-native' shorepower. That is, vessels set up for 120 or 120/240-volt, 60Hz operation (common in North America) can rely on their inverters to supply some or all of their energy needs while dockside in a 240-volt 50Hz environment (common in Europe, Australia, and other parts of the world). The process involves the use of a battery charger or chargers that are capable of accepting a range of shorepower voltages and frequencies (now very common); these keep the batteries charged as they supply the needs of the inverter, which, in turn, provides the vessel with shorepower-like energy.

Using this arrangement, two factors may limit the inverter's ability to supply the vessel with the energy it needs: the capacity of its chargers and shorepower amperage availability. However, because the house bank typically has substantial reserve capacity, not unlike water tanks that were traditionally used on the roofs of many apartment buildings, this arrangement can work well, with batteries being charged when loads are at their minimum, typically during the evening hours (assuming air conditioning isn't being used).

Today, very large inverter "banks"—this one is 15kW—can provide generator-like power for a vessel, provided the battery bank and charge sources are up to the task.

Inverter chargers offer both convenience and efficiency where shipboard power is concerned. Make sure you understand its limitations as they relate to output capacity and battery bank capacity, as well as the primary functions for both manual and automatic mode. If you have redundant bypass capability, be certain you understand how to use it should the need arise.

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Ask Steve

WIRES & CRIMP

Steve, your article "Don't Scrimp When It Comes To The Crimp" (*PassageMaker*, Jan./Feb. '13) was, as usual, very informative. Whenever I have used "crimp connectors" with "stranded wire" I have always "tinned" or applied solder to the wire before applying the connector. I thought that the solder would add connectivity between the individual strands and with the crimp itself.

Your comment on this procedure, pro or con, would be appreciated. I thought, when I read the article initially, that if one of the wires to be connected was a smaller size, that it could be doubled over before inserting it in the crimp, but I could not find it when I reread the article. Is this an acceptable procedure when other options are lacking?

Jerry Ciccone
Taylor, Michigan

You've posed an excellent question. While it may seem like a belt and suspenders approach, soldering or tinning a wire before installing a crimp connector is in fact counterproductive. When a stranded wire is soldered in this manner, it behaves as if it were solid, and solid wires are not designed to be crimped, nor are they fit for use aboard seagoing vessels.

While solder is softer than copper, it still immobilizes the wire and makes it more prone to stress fracturing, as well as hindering the bonding process, and desirable deformation that occurs between the inside of the crimp connector's barrel and a stranded conductor. If you wish, you can solder the wire to the crimp connector after the compression is completed, however, I believe this is unnecessary.

Regarding "doubling over" of conductors to allow them to fit a given crimp connector, I'll admit I've done it on occasion, usually while at sea, with no access to the correct terminal. However, ideally, this practice should be avoided. The most reliable approach calls for use of crimp terminals that match the wire size.—Steve D'Antonio