



Trailer Wiring

By Bill Hancock

Most all of us have a trailer to haul our prized boats. Also, most all of us have either had problems with the electrical portion of the trailer, or we are about to have problems. I used to joke that when I die, I will not be able to begin my final journey until I fix the lights on the trailer. When you think about it, the whole expectation of trailer lights being reliable is rather ludicrous. We are taking a low voltage current, hooking it up through a male/female pair of corroded connectors and then grounding the whole mess through a rusty, greasy hitch ball. Then, to make matters worse we routinely dunk the whole mess in salt water. Ironically, we get annoyed when the lights do not work every time. Aside from being unsafe and dangerous, non-working lights are a good way to get a ticket.

Let's examine the electrical system and try to understand it, then we will review what what's needed to ensure better reliability. We will start at the vehicle/trailer connector.

Connectors

Connectors are male-female plug and socket arrangements which allow the user to connect or disconnect up to 9, or more different circuits. The male plug is traditionally placed on a flexible length of wire at the nose of the trailer, while the female connector or socket is either tucked into the bumper or dangling below the frame of the tow vehicle. There are two types of connectors which we classify as light duty and heavy duty. The light duty versions feature 4 or 5 circuits (Fig 1) and serve the same function as the heavy duty ones, only with a reduced number



Figure 1: This is a basic light duty trailer connector. The white wire should always be used as an auxiliary ground.

of terminals and far less rigidity and protection. The heavy duty versions are standard equipment on over the road tractor trailer trucks and feature up to 9 separate connections, while the light duty connectors are often found on non commercial or occasional use applications. The heavy duty connectors come in two versions, round terminal and socket or blade or flat terminal versions, with the more popular being the blade or flat terminal one (Fig. 2 & 3).



Figure 2: This is a Pollack heavy Duty spade or blade connector



Figure 3: This is a Pollack Heavy Duty round pin connector

Circuits

In the simplest system we have three wires: Left turn, Right turn and running lights. Brake lights are merely the turn signal bulbs with the power constantly applied. In order to conduct current, the terminals within the connectors must be clean and tight. In order to function properly, the various light fixtures have to be properly grounded, and have working bulbs in clean sockets. When wiring your trailer, try to stick with the generally accepted color coding and connector positioning. (Fig. 4)

Trailer Wiring Diagram

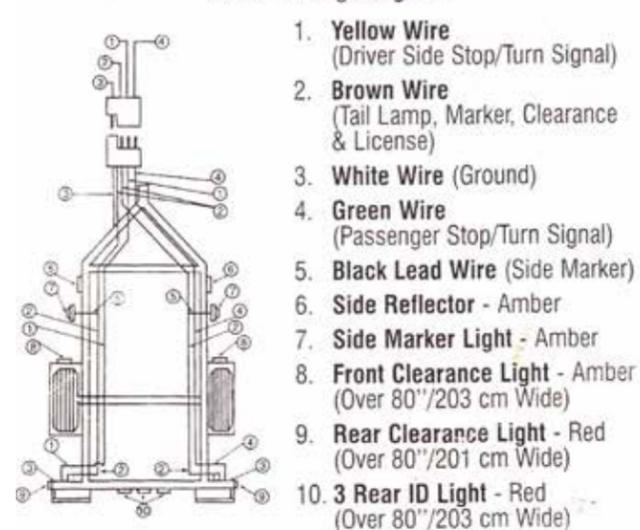


Figure 4: Here is the generally accepted color coded wiring diagram for trailer wiring

Brakes

Electric trailer brakes work by applying power to energize a magnet attached to the brake shoes. The electric magnet applies force to the brake shoes which in turn slow the trailer down. Without working trailer brakes, you are courting disaster. Working trailer brakes are not like a spare tire which waits in the background until you pull over with a flat and change it. Just like a properly inflated spare tire, when you need brakes, it is typically NOW!!! The brakes utilize a brake controller which is typically placed inside of the tow vehicle near the driver's hand and wired into the vehicle brake system. Under normal conditions the trailer brakes are automatically activated when the vehicle brakes are applied. In case of an emergency, the driver can reach down and manually apply the trailer brakes so they are energized independently of the vehicle brakes. This feature offers an excellent method to stop a trailer which has started to sway back and forth. Most states have adopted a law which requires any trailer equipped with electric brakes to utilize a small 12 volt back-up battery, permanently attached to the trailer which energizes the brakes if the trailer becomes disengaged from the tow vehicle. Trailers which have one of these auxiliary batteries will typically have a separate charging circuit which allows the trailer battery to be maintained at 12 volts.

In some cases, trailers which utilize hydraulic surge brake systems will have an electric solenoid valve which disengages the trailer brake system when the tow vehicle goes into reverse. This is a really nice feature since it relieves the driver from having to get out and engage the mechanical back-up lock out mechanism.

Well equipped larger trailers may be equipped with an electric tongue jack. These jacks are a life saver if you have to manually wind the jack up and down frequently. However, the electric jacks require a lot of current, as do electric winches. Most trailers which have an electric winch or tongue jack utilize a separate on-board battery due to the high current demands.

Grounding

Proper grounds are the backbone of any DC voltage system. Not only must they be established but they

must be maintained. Corrosion and vibration are the constant enemies of grounds. During the off season, loosen your light fixtures and take some sandpaper and shine up your ground wire, and the metal where your grounds are fastened. When reassembling, try



Figure 5: Conductive grease which inhibits corrosion

to use conductive grease. This offers the connection some protection, while still allowing current to flow. Conductive grease, sometimes called terminal grease, (Fig 5) can be found

at home improvement centers in the electrical section.

Connectors and Connections

Wires are typically connected and joined using one of several methods; which we will call: Mechanical,



Figure 6: Terminals and wire nuts

Solder and Irresponsible.

Mechanical utilizes crimped terminals, wire nuts, or set screw terminals (Fig. 6).

Solder uses solder and

is the preferable method if possible, since soldered connections are far less likely to fail or corrode. Irresponsible is simply two wires twisted together and possibly wrapped with tape.

Lights

There are two light bulb types: incandescent and LED. Today most of the preferred trailer lights are what are referred to as sealed LED units. These are sealed units and reputedly waterproof. However, as we all know, with boats, roofs, and rain gear, everything leaks, it is just a matter of when and how much. The real advantage to the sealed units is that they protect the hot bulbs when the trailer gets backed down the ramp and the bulbs are suddenly quenched in sea water. LEDs, while more expensive, are much brighter, last longer and burn cooler.

Trouble Shooting

The first thing all aspiring trailer jockeys should have in their tool kit is a test light (Fig 7). This will



Figure 7: 12V Test light and combination wire stripper and lug crimping tool

allow you to probe around the various points and pierce the wires to locate the power. It stands to reason that you must properly ground the test light before trying to use it.

Running light out

If all the rest of the running lights are working, start by looking at the non functional light. Is the bulb good, If the bulb works, use your test light to probe the socket and see if there is 12 V. If not, trace the wire to see where the power or the ground is broken or disconnected or non functional.

Turn signal not working

Again, remove the bulb and visually check the high and low filaments of the bulb. If they are good, power the bulb up using your test light and the vehicle battery. If it works, then probe the connector's internal terminals. If there is still nothing, start back tracking the circuit to the vehicle.

Newer vehicle turn signal wiring

Newer vehicles often employ a different wiring protocol and quite often they use what's called an isolator so they can employ separate brake lights and turn signals which work concurrently but independently of each other. These isolators will go bad and leave you without turn or brake signals at the trailer connector. Depending on the vehicle manufacturer, in some cases, these isolators are only available through the dealer and are therefore quite expensive. There are some isolators available in the after market. If you run into difficulty, the best bet here is to go to a specialty trailer repair business and have them diagnose and fix it.

The brakes don't work

Start at the connector, and have a helper apply the brakes, while you use your test light to search

the terminals in the vehicle connector for the trailer brake input. Assuming the signal at the connector is good, plug in the trailer connector and crawl under the trailer and see if the brakes are getting power. You will often hear a hum near the brake drum, since the brakes use an alternating DC signal. To be sure, jack up a wheel and spin it then apply the trailer brakes. Sometimes the failure is a mechanical one due to rusty brake linkage.

Tips

Maintain your grounds, keep your connections clean. And always remember to disconnect your trailer lights before dunking your trailer in the water, unless you have submersible lighting and feel lucky.

Tip #1

Keep a trailer first aid kit: Spare bulbs, fuses, electrical tape, test light, spare connector and spare wire, terminal kit and pliers. Also don't forget to take a

tire pressure gage and an infrared heat gun to measure tire and bearing temps at each stop. Tire and bearing trouble usually is preceded by rising temps; if you see the temperature in one area rising relative to the others, trouble is usually not far behind. Remember; always do a walk around check of all your lights each time you hook up your trailer and prepare to leave.

Tip #2

Turn on the running lights and engage the tow vehicle Hazard lights. This will allow you to do your walk around without having a helper. If the running or clearance lights are all working and both turn signals are flashing, everything will usually work.

Tip #3

Make sure your connector is wired in the conventional way so if you ever have to use a different tow vehicle your lights will all work properly.

Happy towing!

