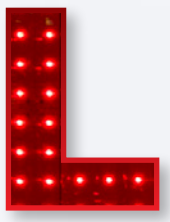
Bright ideas

to speed up lighting and electrical repairs

Experts offer tips to help solve common and uncommon electrical and lighting issues on commercial vehicles.

By Seth Skydel

[WIRING ELECTRICAL]



ighting and electrical system repairs on trucks, tractors, and trailers are a high priority for service operations due to their impact on safety and uptime. The maintainers of fleets must be lightning quick when trying to figure out why a trailer light is out and how to fix it in order to avoid a CSA violation. At the same time, tests and diagnostic procedures required to speed up repairs can be time-consuming and highly detailed.

Fortunately, technical experts and experienced technicians across the industry have developed best practices and tools to improve the speed and accuracy of electrical and lighting repairs. What follows is a series of tips that detail procedures these subject-matter experts have found effective to facilitate the diagnosis and repair of these vital systems.

Identifying electrical and electronic faults

There are three faults to look out for in electrical and most electronic circuits, noted Terry Rivers, senior manager of vehicle services training, Cox Automotive Mobility Fleet Services.
These include:

High Resistance: This is the opposition to the flow of an electric current. "If there is no current flow, then there's no resistance, which also means no voltage drop," Rivers said. "Typically, you would diagnose this high resistance fault with a voltmeter. Today, you could diagnose this with an infrared temperature gun or a thermal infrared camera." This is the most common fault.

Open Circuit: This is caused by an electrical circuit that is not complete due to a break in the wire, a spread terminal pin, or an interrupted circuit. This is the second-most common fault.

Short Circuit: This is an undesirable condition where the current travels along an unintended path with little to no impedance. "This will lead to the circuit being on all the time with the switch off when there is no blown circuit protection (fuse), or the circuit being off all the time even with the switch on with blown circuit protection," Rivers said. This is the least common fault.

The first and most important step is to determine if a circuit is power- or ground-side switched. If it is a power-side switched circuit and the customer complains the dome light stays on all the time, it's impossible for this to be an issue on the ground side. Secondly, determine inputs, processing, and outputs. These steps can reduce the length of wire you need to find the fault.

» First, always determine if a circuit is power- or ground-side switched.

Cox Automotive

Effectively using a digital multimeter

Use a digital multimeter to test voltage when a lamp or other electrical component is operating at a reduced output, noted Dean Kennedy, corporate training manager, Aim NationaLease. "If the voltage available at the device in question during operation is not equivalent to the supply voltage, begin troubleshooting the circuit traveling upstream toward the source," he said. "Once you locate the point in the circuit where supply voltage is present, you can further isolate the root cause.

"Using your DMM on a voltage scale, begin comparing two points in the circuit," Kennedy went on. "Connect one lead to the location where you earlier measured supply voltage and the other lead downstream toward the device where

"A multimeter is a better tool because it will tell you if you have the right voltage, not just whether or not voltage is present."

Dan Miller, field service manager, Peterson Manufacturing

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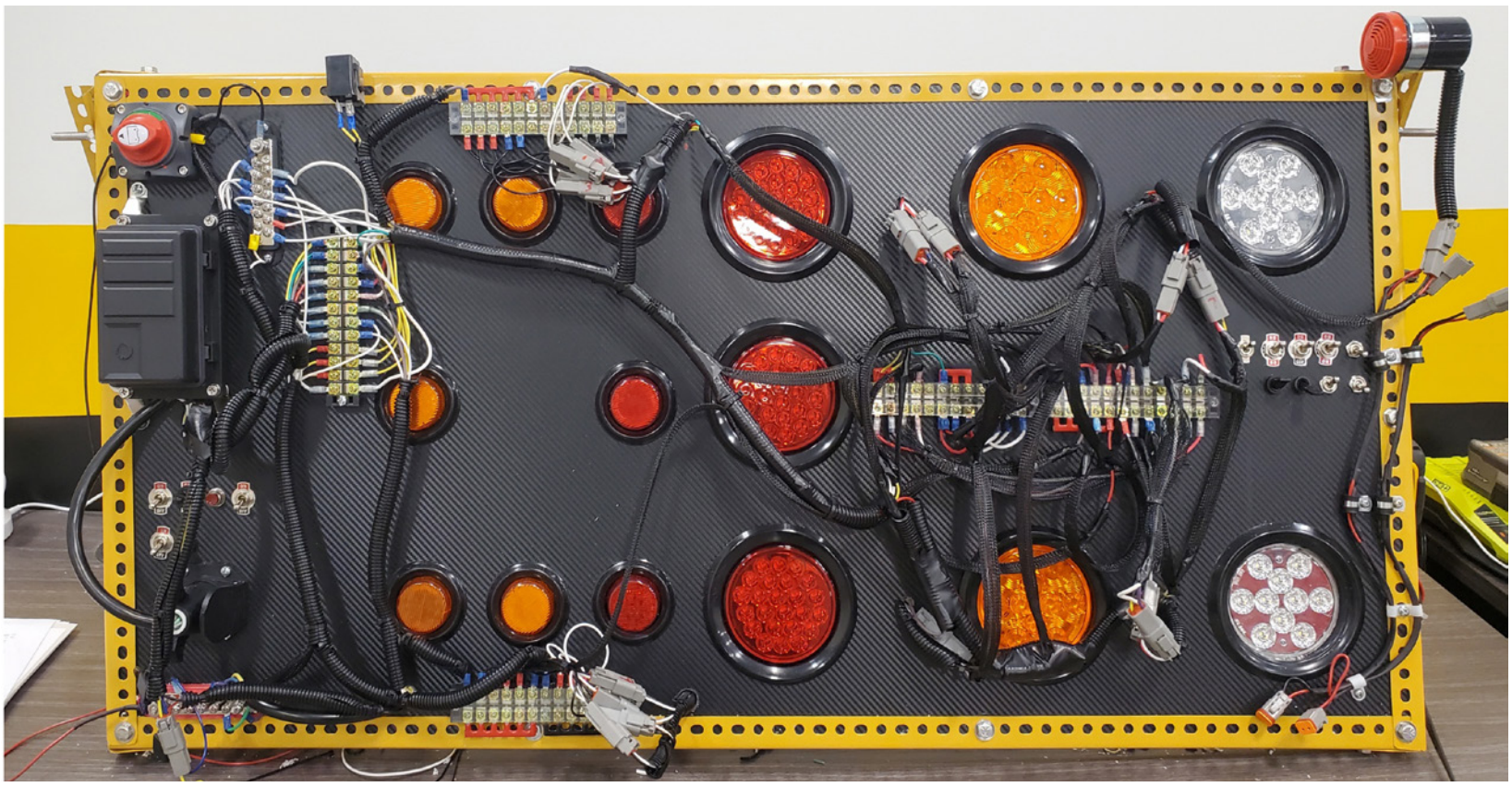

» Check fuses and relays whenever you have circuit issues to ensure that nothing has blown or is faulty.

Diesel Laptops

Streamlining electrical system repairs

According to Michael Whitman, director of product management at Optronics International, here are some tips to help you streamline the process and accuracy of electrical and lighting system repairs:

UNDERSTAND COMMON PROBLEMS AND SYMPTOMS

- Dim or flickering lights indicate a potential issue with the battery, alternator, or wiring connections.
- Total loss of lights could be due to a blown fuse, faulty switch, or broken wiring.
- Intermittent electrical issues suggest loose or corroded connections, damaged wiring, or a faulty component.
- Faulty turn signals or brake lights may point to a malfunctioning relay, broken wiring, or a defective bulb.
- Wiring and harness problems usually come in three categories, each with its own signs and troubleshooting procedures to follow:
  - » Failure due to a grounded circuit
  - » Failure due to an open circuit
  - » Failure due to a short circuit

DIAGNOSTIC PROCEDURES

Step 1: Gather information and perform a visual inspection, interview the driver to understand the symptoms and any recent changes they may have observed, and inspect the affected lighting system components, looking for visible damage, loose connections, or signs of overheating.

Step 2: Test the power source using a multimeter to measure battery voltage and check for proper charging from the alternator, ensure battery terminals are clean and secure.

Step 3: Check the fuses and relays using a circuit tester or test light to check for blown fuses or faulty relays.

Step 4: Inspect wiring and connectors for damage, loose connections, or corrosion. Look for wires and cables that are bent sharply and those that contact metal edges, such as where wires pass through walls or into body cavities. Use a multimeter to check for continuity and measure resistance.

Step 5: Test the lighting components, using a test light or multimeter to check if power is reaching the bulbs and connectors.

"Remember to consult the service manual or wiring diagrams for the vehicle you are working on as procedures and electrical system designs can vary," Whitman concluded.

» A digital multimeter is key to diagnosing an electrical component with reduced output.

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reduced supply voltage was noted. Using this method, you can isolate the portion of the harness causing the voltage drop."

Do no harm while diagnosing

Corrosion occurs when moisture enters at points such as connectors, damaged wires, or improperly repaired wires and spreads, shorting out the light, related Dan Miller, field service manager, Peterson Manufacturing. "One of the common ways moisture enters wiring is during diagnostic testing when technicians use a piercing probe that can create an open path for moisture to enter the wiring.

"A multimeter is a better tool because it will tell you if you have the right voltage, not just whether or not voltage is present," Miller continued. "When a tech goes through troubleshooting steps, voltage information will be available with the use of the multimeter."

Intermittent turn signal failure

With an oscilloscope, noted Michael Eilbracht, trainer, Diesel Laptops, you can look at multiple circuits at the same time, which gives you a better chance of finding faults faster.

"For example, let's say a bus comes in with a complaint of left turn signals working intermittently," Eilbracht offered. "In this case, the turn signals are multiplex controlled, meaning a module controls how long the turn signals are on and off. Using three low-amp probes with three wires in each, turn on the left turn signals and look at the currents coming from the clamps. The one channel that has the most current is the culprit."

Voltage drop test procedures

In situations where the wiring is not contained in a sealed harness and you are able to access both the positive and ground circuits, you can use a multimeter to determine voltage drop, related Andrew Summers, director of fleet sales at Phillips Industries.

"First take the voltage on the positive side wiring from the power source to the component to read voltage drop," Summers continued. "Check the allowable drop for the size and length of wiring you are testing and if the reading is outside this range, work your way back between connections until you find the section of wire where the issue is located."

If no problems are found, Summers said to repeat the test on the ground side starting at the main ground for the component and working your way through the ground path. "Pay special attention to any frame grounds, as corrosion, paint under the connection, and loose connections can all create voltage drop," he advised. "If voltage drop is minimal on both sides of the circuit, then the issue is likely the component."

For voltage drop tests on a sealed harness system, Summers noted, use a multimeter to read the voltage at the power source for the component. On tractors, it will usually be at the batteries, the alternator, or power distribution panel. On trailers, unplug the 7-way cord at the trailer, and measure the voltage at the plug on the cable of the circuit you are testing (running lights, clearance, brake, etc.).

If the voltage is acceptable, then plug the cable back in.

NOTE: To determine how much voltage drop is acceptable in a cable, use an online calculator.

Diagnostic and repair steps

"Sometimes there is more wrong than has been reported, and it can help narrow down where the fault is located," said Phillip Pinter, sr. technician, FedEx Freight. "With most circuits having multiple lights attached, if more than one is having the issue, it allows for points of commonality to be looked at and get you closer to the problem."

» The purpose of electrical diagnostics is to ensure that technicians deal with the root cause of the problem, otherwise a quick fix may cause new issues.

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» A good electrical diagnostic kit needs more than just a digital multimeter. It should also include safety tools and hand tools.

Peterson Manufacturing

Electrical workstation essential tools

Here is a list of common tools that should be readily available to complete lighting repairs:

- Safety glasses and gloves
- Needle-nose and slip-joint pliers
- Wire strippers (10-24 gauge)
- Crimping tool
- Heat gun with shrink tubing (various sizes)
- Utility knife
- Multimeter
- 12V power supply
- High/low amp clamps
- Insulated splice with solder
- Electrical tape
- Potentiometers with different resistances to substitute sensor values
- TMC RP 186 Wire and Cable Repair Guidelines

To verify complaints, Pinter recommended hooking up the trailer to a tractor or a trailer testing unit and inspecting all lights. "If no other issues are found, use a multimeter and check for power and ground at the light," he said. "If either is missing, work your way back through the harness until the problem is found.

"If everything measures correctly with a meter, use a circuit loading device and verify the wiring can carry the load required," Pinter continued. "A partially damaged wire may give you correct readings when no load is on it but fail if trying to operate something. If the load test fails, move the ground to a known good spot and test again. If it still fails, the problem is in the power supply. If it passes, the issue is with the ground circuit."

Finally, Pinter said to use an external power supply to put energy directly to the light and verify if it operates.

Quick fixes are only a short-term solution

When lights go out on the road, a quick roadside fix may require butt connectors or terminals, noted Larry Rambeaux, sales application engineer, Purkeys. "However, generic connectors are prone to water intrusion and corrosion, so they need to be replaced," he said.

Rambeaux went on to provide an example of issues with roadside repairs involving liftgate charging systems:

A technician moves the wiring until they get a light and assumes it's working, but that doesn't mean the system is charging. In order to hurry the repair along, the technician may change the liftgate batteries, but if the charging system wasn't repaired, the new batteries will drain and cause another issue.

Follow established guidelines

Follow TMC RPs for effective diagnostic and repair procedures, Rambeaux advised, including several that show proper wire repair procedures, how to select the right kind of wires, etc. RPs also apply to setting up lighting and electrical repair workstations.

"If TMC RP repair procedure guidelines are followed," he added, "fleets can use them and established procedures to successfully repair electrical systems."

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