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HOW TO SPEC & PROTECT TRUCK ELECTRONICS

Protecting your electronic control modules is the first line of defense in keeping modern trucks running profitably.

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Truck cabs are crammed with integrated and add-on electronic systems and devices, many unheard of a decade ago. Pop open the hood and scan a modern diesel engine, and you'll quickly discover numerous sophisticated electronic control modules that dictate virtually every facet of the combustion and propulsion process – from skip-shifting automated transmissions down to sensors that adjust fuel spray patterns into a combustion chamber in milliseconds.

But that can create a problem: Electronics are not noted for being robust systems. They are susceptible to failure due to environmental conditions such as dust or moisture, extremely hot and cold temperatures, mud, grime and grit, anti-icing chemicals – all the things a truck deals during a routine day's work.

Truck OEMs typically design ECMs to meet a set of standards that define environmental and life requirements in three categories, according to Alan Steines, principal engineer, electronics and controls, Jacobs Vehicle Systems.

“The ECM must be capable of operating properly when exposed to various environmental stimuli,” he says. “For example, the ECM must operate properly and reliably when exposed to a specified temperature range. Similar requirements exist for things like vibration, shock, humidity, and



other environmental effects.”

Electromagnetic compatibility, which has to do with the ECM's ability to operate properly when exposed to static discharge, voltage variations, electric fields such as radio transmitters, and other electromagnetic phenomena, is another critical design consideration, Steines says. “ECMs cannot emit too much of these phenomena, in which case, it might interfere with the operation of other ECMs on the vehicle.”

Finally, Steines says, “The ECM must pass a life test, which is a long, endurance and performance evaluation designed to ensure the ECM will be able to operate for a long time under varying environmental conditions.”

OEMs do the best they can in preparing electronics for hard lives in trucking. But is your fleet doing enough to protect the electronic systems onboard your trucks?

Adding these critical items to your ongoing preventive maintenance schedule is a



fairly easy add-on for your technicians and can help you minimize electronics headaches.

Make electronic systems a priority

There are two initial steps a fleet must undertake in order to make a proactive maintenance program for your vehicles' electronic systems a reality, says Ryan Laskey, vice president, engineering for Vocis, a subsidiary of Dana Inc. that specializes in transmission and driveline control system engineering, software, hydraulic and electrical actuation systems.

The first step is to understand the importance of electronics system at the beginning of your equipment life cycle, starting with the spec'ing process.

"It is important that the electronic components themselves are designed and validated to the appropriate standards for their use location," Laskey says. "For fleet managers considering new vehicles, this includes keeping an eye out for features like appropriate enclosures with correct ingress protection (IP) ratings and appropriate thermal ratings. In other words, is the ECM tucked away nicely in the cabin, or in the engine bay next to an exhaust system? Keep in mind that these electronic systems need protection from all external elements, and OEMs should stipulate the required IP rating and temperature/vibration profile for where the ECM will be located. The supplier must then validate their ECM(s) meet those requirements."

"To prevent issues, one must first have the right specs," agrees Gerry Mead, executive director of innovations for Phillips Industries and longtime industry maintenance executive. There are guidelines available from the American Trucking Associations' Technology

& Maintenance Council that can help fleet managers make sure the electrical systems on new vehicles meet their requirements. "Recommended Practice (RP) 173 Design Guidelines for ECM Harness and Connectors offers design guidelines for ECM harnesses and connectors and are your best starting place to that criteria is met," he notes.

Your next step for implementing a more effective electronics protection and repair program is to make sure your technicians understand how important these systems are for modern trucks to perform properly on the road.

"Educating your technician force is the second step in prevention after the right spec," Mead says. "As we embrace the future of electronics in trucks, leveraging technologies for peak efficiency and safety by providing live actionable data, the components that allow for system integration that produce cross-functional data will be vital for success. And none of those things happen unless your technicians are on board."

"The ECMs will almost certainly be involved in critical vehicle functions, from engine control, transmission control, braking systems, and many others," Laskey adds. "And some of which will be safety critical, as well. So their importance cannot be understated. It is vital that your technicians understand that these systems are now priority maintenance items going forward."

Clean, contained and connected

Once electronics have been established as a critical maintenance item, you can move to the nitty-gritty in troubleshooting and repairing any problems as they arise. Steines says for most fleets, the primary responsibility


on this front is to follow the manufacturer's maintenance schedules and to respond to fault codes as they come up.

"Typically, not much special regarding an ECM would be required unless it was part of the manufacturer's scheduled maintenance," he notes, since most problems tend to occur because of external factors such as climate and operating environment.

As Mead points out, there are an awful lot of such factors out there daily for commercial trucks. "There are plenty of events that can damage an ECM," he says. "Some of these are out of a fleet's control such as age and acts of nature. Other items, such as corrosion, water damage, and surges in electricity, can be prevented through following proper recommended repair methods."

"With more and more sensors being added to a vehicle, warning signs can be from ghost failure codes to diminished performance or even a shutdown situation leaving you stranded on the side of the road," Laskey says. "To limit these problems, it helps to understand the data flow and monitoring key performance items looking for problems. Warning signs can include issues such as degraded functionality, or faults for open-circuit connections to sensors/actuators, which is typical of water ingress into connectors. But a sudden, inexplicable drop in fuel economy on a vehicle, for example, can be critical in determining early electronic failures and heading off the problem before it gets worse."

"Remember," Mead cautions, "any connection point is vulnerable for undesirable elements to enter the system and cause a nightmare to diagnose. Any place where a wire is exposed due to a poke, rub, or cut is the second place where you're vulnerable. Proper spec and repair inspection practices prevent poor performance. Fleets that follow best practices and spec the RP, as well as ensure proper wiring routing and connector care, while using dielectric grease and connector cleaner, will protect from all common worries."

The importance of establishing good electronic system maintenance programs now is critical, Mead notes. Trucking will only dive deeper and deeper into integrated connected systems in the future. And the need for seamless communication within the system is critical to its success. 

Light those lights, lift those gates

There's technology on the horizon that will improve trailer electrical system performance, but in the meantime, basic electrical maintenance, done right, will see you through.

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PHOTOS: JIM PARK

Drivers don't respond well to downtime, and your electrical maintenance and spec'ing acumen (or lack of it) could have an impact on retention rates.

As trailers become more complex, with telematics and diagnostics systems of their own, more auxiliary equipment and more sensitive electronics, the need to keep those systems running will become more challenging. We are already close to capacity in terms of circuits coming from the tractor, hamstrung by the limits of the traditional 7-pin trailer connector. But engineers are thinking beyond 7-pins to 15 pins, and even self-supporting trailer electrical systems that can power auxiliary systems onboard the tractor. That's a bit of a role reversal, and it may be closer than you think.

How often do drivers report an antilock braking system fault on the trailer, only to find in the shop that the center pin in the 7-way plug was not putting out any power? That pin is the only route to the trailer for power destined not only for the ABS, but also for automatic tire inflation systems, telematics, etc. At times there can be a lot of power traveling through that line, or not. If the fuse is blown, nothing on that circuit works. If the connector is badly corroded, voltages can be compromised, resulting in fault codes and poor component performance.

"When someone says they're having an

issue with their ABS, or they can't charge their liftgate, the first place I look is at that center pin," says Gerry Mead, executive director of innovation at Phillips Industries. "Everything except the lighting comes across that pin. About half of the trucks I check for trailer electrical problems are hooked to tractors with a blown fuse or a badly corroded center pin."

Corrosion on the J560 plug and the trailer pigtail is a big problem, especially in areas where a lot of road deicer is used in the winter. The tractor end of that cable is hardly ever pulled out and inspected, tested and cleaned.

Checking that connection is more important than ever with all the multiplexing and PLC (power line carrier) data going back and forth along those circuits.

There are wiring solutions out there that will solve a lot of these problems, but many fleets are reluctant to try something new. Even with all of the sealed connectors on the market, fleets still seem to prefer a metal plug on the J560 trailer connector, Mead says. "If it's price, the extra cost for a premium connector is only about 10%. That's not a lot to pay to reduce those sorts of problems."

And Mead believes loads on the current connector will increase as more technology is added to the trailer, which will make corrosion of those pins even more of an issue going forward.

"The 7-way J560 is antiquated and we're going to have to go to a 15 pin, the European standard, sometime soon," he says. "It's gotta happen. I mean, we're used up. There's a lot we could do with that 15-pin connector."

Power on the trailer

There's one big problem with liftgates. They are usually at the back of the trailer, while the alternator is way up front.

Typically, the liftgate batteries are charged from the tractor. Due to the length of the cable run, perhaps an under-sized alternator, and the inevitable corrosion in the cabling, the batteries – and ultimately the liftgate motor – may not be getting all the voltage needed for optimum performance.

Given that the J560 can be a truck's Achilles heel, what if the trailer was generating its own electrical power through solar panels, or perhaps power generated by an e-hub motor/generator of the sort ConMet announced at the North American Commercial Vehicle Show?

Power produced by a wheel-mounted generator and stored locally could solve many of those problems. While Conmet hasn't specifically targeted liftgates (it's focusing on powering electric refrigeration units in the early days), the company says it could be used to power auxiliary electrical systems on the trailer.

And trailers with short between-stop travel distances may not be able to optimize liftgate battery charging without idling. Solar



Trailer connectors that remain plugged into their sockets most of the time are not immune to corrosion. It may be even worse in there if you operate where corrosive deicing fluids are used.

can solve many of those issues and in the process, save batteries from the life-cycle-limiting deep discharge states.

Bob Doane, chief technology officer with solar energy solution provider eNow, says an auto parts distributor saw a big difference in battery life after adding a small solar panel array to its trailer roofs. "AutoZone was replacing its flooded-acid liftgate batteries about every 8-10 months," he says. "We have had the solar panels on a group of test trailers for 30 months now and they haven't had to replace a single battery"

Not only can solar keep the batteries topped up, but the associated electronics also can optimize battery charging.

"We can put in all the current possible in bulk charging mode until the battery reaches its optimum voltage of 14.2 to 14.4," says Doane. "Then we shift to absorption mode, where the voltage is held steady, but the current is dialed back. That ensures the battery plates do not become sulphated through overcharging."

According to Mead, an electric climate control system powered by solar cells on the roof of the trailer would cost less than half of what a diesel APU will cost over its life -- even less when you take maintenance into account.

"In my fleet days, I would keep a trailer for 10-12 years, versus four to five years for a tractor," he says. "That's twice the payback time for the solar cells versus the tractor mounted APU, and there's literally no maintenance for the solar cells. Even if a few cells are damaged in a tree strike or something, the rest

of the panel keeps working. With a 15-pin tractor-trailer connector, we wouldn't even have additional cables to hook up."

The importance of trailer electrical maintenance

Until we have 15-pin connectors between tractors and trailers and current flow both ways between the vehicles, correct cable sizing and the state-of-the-art electrical maintenance will continue to be the keys to reliable trailer electrical systems. These days, reliability means more than just keeping the liftgate operating. Drivers don't respond well to downtime, and your electrical maintenance and spec'ing acumen (or lack of it) could have an impact on driver retention rates.

Not to put too fine a point on it, but most electrical maintenance isn't rocket science. And let's not confuse basic electrical maintenance with electronic troubleshooting, which truly is a science.

"Basic electrical maintenance may seem pretty basic, but it requires disciplined techs following proper procedures," says Darryl Stuart, fleet maintenance consultant and frequent moderator at the Fleet Talk and Fleet Forum sessions at ATA's Technology & Maintenance Council meetings. "It's easy to take shortcuts, and since most techs don't really like doing battery maintenance, you have to require them to do the work properly. Whether or not to disconnect the cables, clean the connectors and load test the batteries should not be left to the technician's discretion. That work has to be done at each and every PM. No ifs, ands or buts." 