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**NORTH AMERICA'S PREMIER HOW-TO RV RESOURCE**

**October 2022**

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- ***Tips to 'Bug-Proof' an RV Against Pest Infestations***
- ***Install Roadmaster's Exact Center Steering Stabilizer***



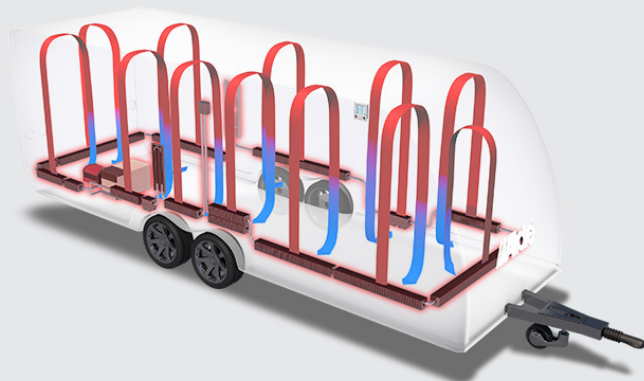


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# RV ENTHUSIAST

NORTH AMERICA'S PREMIER HOW-TO RV RESOURCE

October 2022

Volume 2, Number 10

## INSIDE



16

### Wrap It Up!

There are a lot of used RVs traveling America's highways — but the environments they exist in aren't really conducive to maintaining an optimum appearance. Burlington Graphics Systems, the country's premier supplier of factory graphics, can help — with everything from full-body wraps to supplying replacement factory graphics from its design archives.



20

### Solid Footing

The act of getting in and out of a trailer or fifth wheel is sometimes not very graceful. Installing Lippert's SolidStance Step Stabilizer takes the wobble and flex out — and that sinking stomach — when entering and leaving a conventional trailer or fifth wheel not equipped with an entry step system that extends to the ground. All safety additions should be this easy.



24

### Pest Control

Dealing with unwanted guests — from ants to raccoons — is an inevitable part of camping. But when you're visiting their "home" you don't need to welcome them into yours. There are a lot of unintended entry points in your RV — you would be surprised at how and where critters can enter your rig — and sealing them off needs to be Job One.



31

### Singing in the Shower

Let's face it: we humans love our shower time. Unfortunately, the 6- to 12-gallon water heaters installed in most RVs don't enable anyone to linger under the shower. Truma's AquaGo instantaneous water heater — installed on certain rigs — provides all the hot water you could reasonably want. And you can have it retrofitted to your existing RV.

## DEPARTMENTS



### 6 Publisher's Notes

Many years ago, *RV Enthusiast* Publisher Bob Livingston studied how RVs impacted our carbon footprint after attending a symposium on environmental conservation. The results, he learned, were eye-opening. The symposium speakers actually touted RVing — because RVs are "greener" than most homes.



### 8 News & Notes

Technology is coming at the RV industry fast and furiously. This month, we took a look at Lippert's new ABS (anti-braking system) that works with trailer brakes to prevent wheel lock-up and enhance control, Toyota's prototype "hitchless towing" system, the addition of SumoSprings as standard equipment on Roadtrek ProMaster Class Bs, and a lot more.



### 12 Technically Speaking

Errant readings for an RV holding tanks is one of the biggest complaints owners have — but few have the tanks professionally cleaned annually. Meanwhile, other readers ask for assistance on how to check LP-gas pressure, when to utilize 12-volt batteries, why their clutch fan sounds like a commuter jet taking off and how to mount projects to an RV's thin walls.



### On The Cover

Jason Lafoon, an installation specialist at Burlington Graphic Systems, applies a wrap on a Forest River travel trailer for a company Halloween-themed event. Photo by Bruce Hampson

### 57 Advertisers Index





## 60

### Curing the Wander Woes

There's not much in the RV lifestyle that will make a driver cringe quicker than the "death wobble" caused by certain tow vehicles' unwanted harmonic steering oscillations. Roadmaster's new Exact Center Steering Stabilizer civilizes handling while reducing driver fatigue — and improving control.



## 40

### Special Section: RV Electronics

#### Power Loss Puzzle

After the refrigerator and electrical devices in the slideout quit working, the search for the short causing the breaker to flip was on. In the end, a failed Molex connector — damaged by moisture — was found to be the culprit. A little creativity restored the "juice" to the fifth wheel.



## 42

### An Electrifying Experience

Unlike your home, RVs have dual electrical systems — and chasing down gremlins can be difficult. Not everyone can mimic Thomas Edison, but using this simple guide to diagnosing electric problems unravels the mystery of how 120-volt AC and 12-volt DC power integrate with the inner workings of an RV.



## 52

### Hot Skin

A certain amount of stray voltage on the exterior of your RV is normal — but anything in excess of 30 or 40 volts is potentially life-threatening to anyone that comes in contact with it under certain conditions and circumstances. Here's what a "hot skin" problem is, what often causes it, where that voltage comes from and how to measure for it.

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By Bob Livingston

Historically, when life pivots in the United States, the RV industry takes it on the chin. However, when the COVID-19 pandemic shut down the country, the industry got lucky — it prospered beyond belief. Getting out in an RV was one of the best ways for people to find relief from the pandemic stresses, and those who embraced RVing were able to enjoy a little chunk of normalcy and stay relatively safe from the bug. And the lifestyle caught on in a big way.

Now we're faced with new challenges — including one of our old nemeses: fuel. Continued bad news about fuel could send shock waves. Or will it this time? I suppose the answer is a little more complex than a simple “yes” or “no.”

Granted, fuel can have a seriously negative affect on our mental well-being — and our wallets — but it's best not to get hung up on reading the posted fuel prices at service stations. When you do the math, RV vacations are still more affordable. While I still stand by the premise that fuel prices can be reckoned with — and Europeans proved that years

ago — a new fly in the ointment may require some lifestyle adjustments and possibly more practical decisions when enthusiasts select the best RV that fits their needs. An article, “Bottleneck Fuels Record Gas Prices” in the May 28, 2022 issue of the *Wall Street Journal (WSJ)* was troubling. Fuel prices will likely be impacted by reduced refinery production and a looming ferocious global appetite for fuel as driving

routines are normalized and the world climbs out of pandemic shutdowns and restrictions. According to the article in the *WSJ*, when demand plummeted during the height of the pandemic, older refineries were shuttered. Getting back to normal, if that's even possible, may be painful. Alas, are we looking at a repeat of the long lines of the early 1970's? Maybe. The misguided energy policy in this country will undoubtedly continue to fester controversy.

Don't get me wrong; going “green” is a worthy goal. I bought my first electric car six years ago and loved it. But fossil fuels will still be in high demand for many years while technology evolves, thereby making electric vehicles more feasible for heavier-load service — and, of course, as the charging infrastructure continues to expand. I'm not sure how the power grid is going to be able to keep up with demand, considering rolling blackouts are becoming more prevalent in certain areas. It's like expanding communities without building roadways to handle the uptick in traffic. For now, I'll defer that argument to the opinion pages.

We should all be concerned with our carbon footprint, and kudos to the RV industry for working toward that goal. Many

years ago, I studied how RVs impacted our carbon footprint after attending a symposium on environmental conservation — and the results were eye-opening. The speakers actually touted RVing. Why? Because RVs are greener than most homes. True, RVs consume more fuel on a per-mile basis than the average car, but RVs are not used for commuting. And while fuel consumption is only part of the equation, from a livability standpoint, RVs are the ultimate conservation machines.

Consider, for example, that the average household uses around 300 gallons of water per day. RVers can get along with 50 gallons of water (average) stored in an onboard holding tank for a few days while boondocking — and even when hooked up they still consume much less than a stationary household. Beyond a natural desire to conserve on the part of RVers, the fact remains that it takes less water to flush the toilet and fill up smaller sinks. Then, too, RVs rarely have multiple showerheads to promote lingering — and there's no

outside landscaping to maintain.

Energy conservation is equally as important. The average household consumes around 30 kWh of power on a daily basis, which is about 30% more than RVs when hooked up in an RV park. As more RVers turn to self-containment, employing robust solar systems that make it possible to shun the power grid, the positive impact is greater. And obviously, when a home is vacated during an RV vacation, the power savings are substantial.

Nevertheless, there is still more work to be done. For example, higher profile motorhomes and fifth wheels are more spacious, but are they necessary for most enthusiasts? Probably not if smaller, lighter models are on the horizon; save the extra weight for mandatory dual-pane windows and added insulation. My wife, Lynne, and I live full time in a lower profile fifth wheel with these window and insulation features, and the HVAC efficiency is excellent.

Creative space utilization also makes it possible to live comfortably in less square footage as illustrated by the Class B motorhome segment. And the trend toward all electric systems supported by onboard power grids is breathtaking. The thought of powering an air-conditioner without running a generator or hooking up in an RV park was fantasy just a few years ago. So was towing with an all-electric truck!

I think we're poised for an evolution in the RV industry. There will always be a market for more conventional RVs — especially for the full-timing crowd — but creating contemporary RVs in response to current events will keep the buzz alive. The concept of living large without the bulk is exciting, and I believe the industry is up to the challenge. **RVE**



*RVers have learned to do more with less, especially in well-thought-out floorplans in smaller Class B motorhomes.*



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Low Profile



High Profile





# Slow Down, You Move Too Fast



The Lippert ABS was tested extensively at the Navistar Proving Grounds under various conditions.

Given the ever-increasing sizes — and weights — of contemporary towables, it's not surprising that consumers are asking for better braking systems. In mid-October, Lippert introduced its all-new Anti-Lock Braking System (ABS), engineered and designed to fully integrate with the electric braking systems in Lippert's Spring Axle offering.

The Lippert ABS, tested exhaustively over multiple grueling scenarios, combines the technologies of Lippert's time-tested trailer axles with cutting-edge connected RV systems, delivering a comprehensive safety mechanism for all trailer types, particularly travel trailers, fifth wheels and cargo and equestrian trailers.

Lippert anti-lock braking system



This integrated system works with the trailer's brakes to prevent wheel lock-up and enhance control over the vehicle-trailer combination, particularly in slippery or abrupt braking situations. When the driver encounters an emergency braking situation, instead of the trailer fishtailing off to one side and pulling the vehicle into a dangerous drift, the Lippert ABS system helps the driver maintain control and assists in bringing the vehicle and trailer safely to a stop.

The Lippert trailer ABS system also is prepped to work with the company's OneControl app, so it can be paired with the driver's phone to monitor speed, status, and more. The system also operates independently from the vehicle's brake controller. Whether the truck is outfitted with a factory or aftermarket brake controller, the new Lippert ABS will function to keep the trailer wheels from locking up, and the non-intrusive system also will not interfere with the controller's gain settings.

While the Lippert ABS is not available for aftermarket installation at this time, it's one more reason for current or potential RV owners to upgrade to a new model!

## Towing — Without Hookups



Two vehicles explore the feasibility of "hitchless towing." While both of these vehicles have drivers in them for safety during evaluation, everything is being controlled by the lead vehicle.

Described in a video as "still a little bit out there, a little bit of science fiction — but people are encouraged by seeing where we're going," Toyota Motor North America Research & Design (TMNA R&D) has been researching the possibilities of towing...albeit without a solid connection between tow vehicle and trailer.



It's known as "hitchless towing" — and it appears to be a lot closer to reality than you might think.

According to Paul Ganson, senior manager of TMNA R&D Advanced Product Planning Office, hitchless towing is "a very interesting new concept that is a pair of vehicles where the rear vehicle acts somewhat like an autonomous vehicle, but it basically allows the two vehicles to play 'follow the leader.'"

As Hanson explains in the video ([youtube.com/watch?v=aj-s57ELvPiM&t=38s](https://www.youtube.com/watch?v=aj-s57ELvPiM&t=38s)), the lead vehicle would be driven by a human, and the follow vehicle would naturally follow behind as a trailer would — but there would be no physical connection between the two.

The idea for hitchless towing, added Jeff Makarewicz, TMNA R&D group vice president and executive advisor, came from a team member who submitted the idea through an innovation system Toyota calls Hype. "This idea was judged to be a key priority, so we were able to allocate the funding and resources to make it happen."

In the past year, the concept has gone from "just an idea, done in simulation," to an operational two-vehicle system. Still in its early stages, Toyota plans to take it to the next level — seeing how it performs in a highway situation — in the next year or two.

## Building a Silver Bullet

One of the most interesting aspects of RV ownership is taking a guided tour of a manufacturer's assembly plant. These facilities are a swarm of activity — and visiting one can provide a lot of insight into the extremely involved manufacturing process of a product that is still, by and large, labor-intensive.

Unfortunately, the pandemic spelled a temporary end to these tours due to the demands of self-quarantine. However, as we learn how to cope with COVID and its variants, more manufacturers are again opening their doors to consumers. That said, not everyone can plug in a trip to their favorite RV brand's plant. So, Airstream is bringing the process to you. In October, the iconic builder of what's known as the "silver bullet" due to its polished aluminum luster released a video (see it here: [youtube.com/watch?v=fS57jlaVJTc](https://www.youtube.com/watch?v=fS57jlaVJTc)) wherein Airstream Vice President of Sales Justin Humphreys takes viewers on a tour of the company's 750,000



square feet of manufacturing.

Building an Airstream, said Humphreys, is "a labor of love" — one that's

lasted for 90-plus years. The video isn't nearly as long — about 12 minutes — and is well worth the time spent.

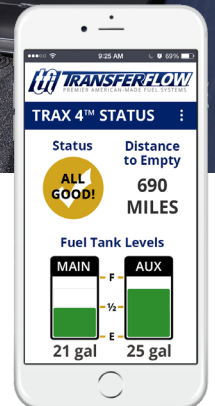


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## Winnebago Debuts Online Shopping Tools



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Winnebago Industries Inc. recently debuted enhanced online shopping tools that help consumers shop for an RV more effectively and efficiently.

According to a Winnebago representative, the company developed these tools as part of its continuous effort to improve the online shopping experience. With these tools, consumers now have access to more information, helpful tips and other resources to make purchasing decisions easier and more convenient. Winnebago is said to be the first RV manufacturer to offer such robust online shopping tools, which include:

- The Dealer Selection tool is now featured on every model page so consumers can easily see the closest three dealers to their location.
- The Dealer Selection Tool displays more information, including dealer website links; dealer reviews; available retail and rental inventory; and even live inventory links. As consumers explore these links, they'll see dealer-specific branding and pricing.
- The Digital Retail Tools Drawer allows consumers to receive an online estimate of the trade-in value of their existing vehicle, make an appointment and get a quote.
- The Shopping Concierge tool provides additional assistance by helping direct customers to their closest dealer. For more information, visit [winnebago.com/insider](http://winnebago.com/insider).

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# SumoSprings Now Standard on Roadtrek Class B's



A new Roadtrek Zion, built on the RAM ProMaster chassis.

After offering SumoSprings as an optional suspension upgrade on its Class B lineup for more than a year, Roadtrek has announced it will be making the SumoSprings rear suspension upgrade a standard equipment component on all Class B vans built on the popular RAM ProMaster chassis. The current models are Play, Play SRT, Play Slumber,

Chase, Zion, Zion Slumber, Pivot, Pivot Slumber, and Zion SRT. These models will be fitted with the well-known yellow SumoSprings rear suspension upgrade.

According to a representative of SuperSprings International (SSI), SumoSprings for the RAM ProMaster is SSI's No. 1-selling product — and for good reason. With the growth of

van builds in recent years — especially on the ProMaster chassis — there has been a growing demand to create a better driving experience without having to sacrifice build quality and weight. The SumoSprings suspension upgrade has become the go-to solution because of the load-leveling capacity, ease of install and vibration reduction. Additionally, these components are maintenance-free, USA-made and come with a lifetime warranty.

## Ford Expands Transit Lineup with Transit Trail



Given the reception that's greeted Ford's Transit van since inception — it's currently America's best-selling commercial van — it comes as no surprise that Ford wants to capitalize upon that success. Now, apparently, that will happen. After teasing consumers about the possibilities for some time, Ford



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announced in October that it is bringing the Transit Trail — originally introduced in the United Kingdom in 2020 — state-side.

And, in a strong nod to the vehicle's popularity with van upfitters, the company released a video (a night shot, so you couldn't really see what the van looks like...yet) captioned "On the road of van life, a few simple lessons can lead to many big adventures. Get ready for the new 2023 Ford Transit Trail. Coming Soon."

In November, Ford will introduce the new 2023 Transit Trail van, equipped with its new adventure-seeking capability alongside interior and exterior enhancements providing do-it-yourselfers and motorhome distributors a turnkey canvas direct from the factory. The Transit Trail will be available with 4WD. Scheduled for assembly at Ford's Kansas City (Missouri) assembly plant, the Trail will be built right alongside Transit and E-Transit vans. We'll provide more information as it develops.



In the market for a new RV? Consider the following manufacturers, each coming out on top in the RV Dealers Association's 28th annual Dealer Satisfaction Index survey.

These brands/manufacturers received at least 15 dealer responses and scored 4.25 or above on a 5-point scale in overall dealer satisfaction in the association's survey conducted June through September.

When rating their brands/manufacturers, RVDA asks dealers to express, confidentially, their level of satisfaction on four core issues:

- Reliability/quality
- Parts
- Warranty
- Sales

*Towable RV manufacturers receiving awards are (in alphabetical order by manufacturer and, if applicable, cited brands):*

- Airstream
- Alliance RV (Avenue, Paradigm, Valor)
- DRV (Mobile Suites, Full House)
- Dutchmen (Aspen Trail, Kodiak)
- East to West (Alta)
- Forest River (Flagstaff travel trailers and fifth wheels and Shamrock expandables; Rockwood travel trailers and fifth wheels and Roo expandables; Sandpiper; Sierra; Cedar Creek; Riverstone)
- Grand Design RV (Imagine, Momentum, Reflection, Solitude, Transcend)
- Gulf Stream Coach (Vintage Cruiser, Vista Cruiser)
- Jayco
- Keystone RV (Cougar, Montana, High Country, Raptor, Carbon)
- KZ RV (Durango, Durango Gold, Venom, V-Series); Starcraft; and Venture RV (SportTrek, Sonic, Status)

*Motorized RV manufacturers/product categories receiving awards are (in alphabetical order):*

- Airstream
- Dynamax
- Entegra
- Gulf Stream Coach
- Jayco
- Leisure Travel Vans/Triple E
- Newmar
- Pleasure-Way
- Winnebago (Class A's, B's and C's).

## Grand Design to Offer CURT ABS



Anyone pulling a travel trailer or fifth wheel is no doubt familiar with the more cringe-worthy aspects of towing. And, they also are likely already familiar with ABS on their vehicles — and have probably wondered why such a system isn't available on towable RVs.

Now, for the first time, they can attain the same increased performance that ABS provides on their 2023 Grand Design Solitude, Reflection or Momentum.

In vehicles and RVs, ABS helps decrease stopping distance in various conditions. It can also prevent sway caused by braking suddenly while towing an RV, giving customers increased steering control. Grand Design Recreational Vehicle Company announced in early October the launch of an anti-lock

braking system (ABS) on select Grand Design RV models — a first in the North American RV Industry.

Currently, Grand Design's Solitude, Reflection and Momentum are the only RVs on the market with ABS, according to the company. The new ABS package utilizes the CURT Axle Platform which features an upgraded suspension, forward self-adjusting brakes and greasable wet bolts as well as upgraded, heavy-duty hardware. The ABS system with CURT axles has, said a company representative, been thoroughly tested in wet, icy and regular simulations, as well as in live icy conditions. All testing results have demonstrated increased braking performance for eligible RVs.

## RVDA Fetes Quality Circle Award-Winners



Keystone Cougar fifth wheel



2022  
RV BUSINESS  
TOP 50  
DEALER AWARDS

Recognizing North America's Top RV Dealers

Perhaps the most critical part of making an RV purchase is one that a lot of potential buyers don't consider. Sure, they painstakingly research their options between a motorhome, fifth wheel and/or travel trailer. And, once that's decided, they spent copious hours viewing floorplans and making a budget.

All too often, though, they zero in on a specific model at a specific price — and head off to buy it.

What's wrong with this picture?

They may not have spent the time to research their dealer, as well. Let's face it: When you drag your home-away-from-home across untold miles of suspect roads, things have a tendency to shake loose and even break — and how your dealer treats you after the sale is at least as important as when it rolls out the red carpet to welcome you.

The question remains, though: How can you choose a good dealership? Word-of-mouth recommendations from friends are great, but their dealer may not carry the brand and/or model you've selected — and a smart buyer will take anything read on social media sites with the proverbial grain of salt. Fortunately, *RVBusiness* — the nation's premier RV trade publication — has, for the past 11 years, named its Top 50 Dealer Awards, a program that goes a long way to helping consumers identify the nation's best-run retailers.

The program, which begins with dealer recommendations made by the manufacturers of products each carries, requires each dealer to respond to an extensive application. Each application is then rigorously reviewed by a panel



Alpin Haus RV



Giant RV

of 12 independent RV industry experts brought together by *RVBusiness* and marketing firm BJ Thompson Associates (BJTA), which together oversee the bar-raising Top 50 program. The two-day process reviews the dealerships on everything from the number of service technicians on-site to customer service and even programs the dealer implements as a "good neighbor" at their locations.

The publication recently released its 2022 Top 50 Dealer Awards roster — and anyone in the market for a new RV might well consider visiting one of the locations on this list.

Note, too, that select dealerships have an asterisk (\*) following their name. This denotes those five retailers (known as **Blue Ribbon** dealers) deemed worthy of special recognition



Mount Comfort RV

for having gone the extra mile in exemplifying "best practices" in areas such as customer care, service, staff training, marketing and community service.

The *RVBusiness* Top 50 Dealer Award-winners for 2022 are (in alphabetical order):

- Advance Camping Sales, Milwaukee, Wis.
- Affinity RV Service, Sales & Rentals, Prescott, Ariz.
- Airstream Adventures Northwest, Gladstone, Ore.
- All Valley RV Center, Acton, Calif.
- Alpin Haus, Amsterdam, N.Y. (\*)
- ArrKann Trailer & RV Centre, Edmonton, Alta.
- Bama RV, Dothan, Ala.
- Beaver Coach Sales & Service, Bend, Ore.
- Bent's RV, Metairie, La.
- Bulyan RV, Duluth, Minn.
- Byerly RV Center, St. Louis, Mo.
- Camperland of Oklahoma, Tulsa, Okla.
- Campers Inn RV, Jacksonville, Fla. (\*)
- Colonial Airstream & RV, Millstone Township, N.J.
- Colton RV, North Tonawanda, N.Y.
- Country Roads RV, Lexington, N.C.
- Crestview RV Center, Buda, Texas

- Curtis Trailers, Portland, Ore.
- Fraserway RV, Abbotsford, B.C.
- Fun Town RV, Cleburne, Texas (\*)
- General RV, Wixom, Mich.
- Giant Recreation World, Winter Garden, Fla.
- Giant RV, Montclair, Calif. (\*)
- Gib's RV Superstore, Coos Bay, Ore.
- Good Life RV, Webster City, Iowa
- Great American RV SuperStores, Hammond, La.
- Greenway RV Sales & Service, Wisconsin Rapids, Wis.
- Hartville RV Center, Hartville, Ohio
- Hemlock Hill RV, Southington, Conn.
- Hilltop Camper & RV, Fridley, Minn.
- Lewis RV Center, Oklahoma City, Okla.
- Midwest RV Center, St. Louis, Mo.
- Modern Trailer Sales, Anderson, Ind.
- Moix RV Supercenter, Conway, Ark.
- Mount Comfort RV, Greenfield, Ind.
- Pan Pacific RV Centers, French Camp, Calif.
- PleasureLand RV Center, St. Cloud, Minn.
- Princess Craft, Round Rock, Texas
- Rangeland RV & Trailer Sales, Rockyview, Alta.
- RCD RV Supercenter, Heath, Ohio
- Rich & Sons RV Headquarters, Grand Island, Neb.
- Ron Hoover RV & Marine Centers, Rockport, Texas
- Sicard RV, Smithville, Ont.
- Steinbring Motorcoach, Fridley, Minn.
- Travelcamp RV, Jacksonville, Fla.
- Veurink's RV Center, Grand Rapids, Mich.
- Voyager RV Centre, Winfield, B.C. (\*)
- Walnut Ridge Family RV Sales, New Castle, Ind.
- Wilkins RV, Bath, N.Y.
- Woody's RV World, Calgary, Alta.

Meanwhile, **Greenway RV Sales & Service** was also singled out this year as a recipient of the *Gaylord Maxwell Innovation Award* for creative business strategies while **Bama RV** was recognized with the *Arthur J. Decio Humanitarian Award* for excelling at charitable endeavors.



Voyager RV Center

continued on page 57



## Peeling Off the Walls



Pressure-cleaning holding tanks should be part of your annual RV maintenance.

to my black tank after every dumping and flushing; my go-to chemical is Thetford Aqua Kem blue, which does have formaldehyde, but seems to be best for odor control. Odor control is especially important when the weather is hot — most chemicals without formaldehyde do not stand up well to the hot weather.

I also use a tank cleaner periodically and have the tanks professionally pressure-cleaned once a year — about the time that passes

Bill, do you use a type of chemical in your holding tanks and, if so, what do you recommend for the black and gray tanks? Do you use any type of cleaner or holding tank chemical that would strip the walls inside the tanks? My monitor lights are not providing accurate readings. They used to read fairly close, but now the black tank reads 3/4 all the time and the gray tank reads 1/2 until it starts to get above that level and

then it's somewhat accurate. I'm assuming there's a buildup of something on the holding tank walls. I tried a couple of tank bombs that I found on the Internet, but they did not work.

— **Diane Waterhouse**

*Diane, great question — and the answer is “yes” I do use chemicals in both the black and gray tanks, but less often in the gray tank. I add chemicals*

*before the monitor becomes erratic. Cleaning the tanks with high pressure will strip water deposits and other materials that have become stuck to the walls over time. There are companies throughout the U.S. that specialize in this procedure and offer mobile service. After cleaning, your monitor should be restored to accuracy, which has always been the case in my fifth wheel that I live in full time.*

## Got Gas?



Manometers can be purchased online from Amazon and other sites. This Camco gas pressure test kit was located at [etrailer.com](http://etrailer.com).

on the campground. I do not have any way of checking the gas pressure nor are there any repair shops in the area. I don't understand why the gas pressure would change in altitude. Can you clarify for me?

— **Pete Johnson**

*Pete, your fellow campers are correct when they say that gas pressure is directly affected by altitude. Unless you carry a manometer there's absolutely no way of keeping track of the gas pressure as you go up and down in altitude. Water heaters, stove tops and furnaces are less affected than the refrigerator, which depends on proper gas pressure to maintain its BTU output. Something to keep in mind, too, is the age of the automatic changeover gas regulator, which should be changed every five years regardless of whether it's functioning properly or not. You should set*

*the regulator at approximately 11½ inches of water column — and as you go up in altitude, it technically should be adjusted if you want the refrigerator burner to function optimally. This requires resetting the gas pressure as you go up several thousand feet of elevation gain. If you have a manometer, the gas pressure can be reset. Just make sure you reset again when going to lower altitudes.*

*Resetting every time you change altitude is not practical, but this practice should be reserved when you stay in areas for a while that are above 7,000 feet. Purchase a dial manometer and learn how to use it, which is actually quite simple if you have a 3/8-inch flair to 1/4-inch barb fitting that can be inserted in the gas line going to the stove regulator. If you haven't done so, I would also service the refrigerator to include cleaning the burner orifice — which could be part of your problem.*



## The Ripple Effect



We have lived in our travel trailer for the last six years; it's set up in a park and we do not intend to move it anytime soon. The batteries, of course, went bad over time, so we took them out of the system and everything seems to be functioning on just the converter. However, when I was talking to one of my neighbors he said that it's not a good idea to run 12-volt DC appliances without at least one battery installed.

— Dexter Johnson

One of the reasons to keep a battery in the system is to prevent AC ripple, which is a variation of DC voltage coming from the converter that has been derived from AC power. This ripple effect can damage your control boards. Another reason for the battery(ies) is that they act as a giant capacitor to smooth out voltage spikes. If you're concerned about access in order to add water to an open cell battery(ies), consider going to an AGM battery so you won't have to keep track of the electrolyte level. You will need to check for corrosion on the terminals periodically. Theoretically, you could even use a starting battery since you're not going off the grid.

## Reading Material



We've used self-drilling drywall anchors in a number of areas in our RVs to help provide better mounts and increase storage capability

Bill, I mounted a magazine rack on the wall near my sofa in my motorhome and, after about a year, it came off the

wall as there was just simply not enough backing behind the thin paneling. I tried a couple of plastic anchors I had laying around, but they also pulled out of the wall. Okay, maybe the rack is overloaded with too many magazines, but do you have any suggestions for a type of a wall anchor that could support a heavy magazine rack? If there is a solution, I would love to mount another magazine rack on the other side of the sofa to store even more magazines. Obviously, we love to read.

— John Eichenberger

John, where there's a will there's a way. One of the things that I found very effective is to use drywall anchors. These anchors come in various sizes and materials, such as pot metal or plastic. A lot of them are self-drilling so you will not need a drill bit to have them installed. If the wall is flimsy, you may need to use the drywall anchors and a couple of furring strips to support the drywall anchors before mounting your magazine rack. Furring strips could be something like a

1 x 2 that is mounted horizontally. The furring strips could even be mounted with four strong drywall anchors, which I believe would prevent the magazine rack from ever coming loose again.

## Blowing in the (Hot) Wind



I own a 2016 Ram 2500 truck with the Cummins turbo diesel. When I'm pulling my 13,000-pound fifth wheel trailer, the Cummins diesel is absolutely wonderful — but the first time I was climbing a long grade in 110-degree F weather, the fan clutch engaged and I was blown away by how loud it really was inside the cab. I believe that you also own a Ram truck with a Cummins diesel. Does yours make such a loud noise or is my fan clutch somewhat defective?

— Sam Winchester

I own on a 2017 Ram 3500 with the Cummins turbo diesel and, yes, the fan is extremely loud when engaged while climbing steep grades and pulling my 17,000-pound fifth wheel. The first time it happened I was alarmed at the decibel range, so I researched the situation and found that the high noise level is typical of the fan clutch on a Cummins turbo diesel. If you think about it, the Cummins is a big diesel engine and it needs a lot of air movement to cool it down when pulling a big fifth wheel up steep grades in hot weather.

**Bill Gehr**

Are you stymied by a technical problem with your RV? Write to RV Enthusiast Technical Director Bill Gehr at [bgehr@rvemediagroup.com](mailto:bgehr@rvemediagroup.com). Bill will answer inquiries as space permits. **RVE**



# WRAP it up!



*Burlington Graphic Systems moves into the retail side of RV graphics, including wraps and replacement designs for pre-owned RVs. “Our library of designs and parts and shapes and sizes for the RV and marine industries is extremely large. There’s a good possibility that for any retail consumer who calls, we have what they need,” said BGS vice president Doug Graham Jr.*

By Bruce Hampson

Given the escalating prices of new motorized and towable RVs fueled by pandemic-related parts shortages and rising manufacturing costs, it’s not surprising that owners are opting to hold on to their current motorhomes, fifth wheels and travel trailers well past the time they otherwise might have traded up for a new model.

Older RVs come with their own set of problems, though, and while it’s fairly easy and relatively inexpensive to update interior layouts — especially when tackled one project at a time — exteriors present sometimes seemingly insurmountable hurdles to restoring an

RV’s former appearance. When you consider the harsh environment the outside of your RV is forced to endure, it’s understandable — from the oftentimes bitter winters of the north to the unrelenting summers of the south and west, virtually no RV is immune from being ravaged by weather conditions. And we haven’t even touched on the toll taken on exteriors by everything from bug splatter to road debris.

Unfortunately, you can’t just restore an exterior in phases unless you want to stand out in the campground for all the wrong reasons. If the weathering isn’t extreme, exterior surfaces can

sometimes be restored by anyone knowledgeable about cleaners, cutting compounds and waxes — but even then, the original factory graphics usually can’t be brought back from the grave. That’s when RV owners usually discover that their dealership — and their manufacturer — don’t normally stock older replacements.

But Burlington Graphic Systems (BGS) does. In a manner of speaking, anyway. The premier supplier of graphics to the RV industry, the Racine, Wisconsin-based supplier has archived all of the graphics it has designed for use by RV manufacturers and recently





*Doug Graham Jr., BGS vice president and general manager, inside the Elkhart, Indiana, facility's warehouse area where orders await shipping out to RV manufacturers for use on new models. BGS, said Graham, works with and touches almost 100% of the industry at some level.*

opted to offer its services — including wraps and replacement graphics — to the public.

“We’ve been in business almost 40 years, and I can get you designs dating back 40 years ago,” said Doug Graham Jr., BGS vice president and general manager of the company’s Elkhart, Indiana, facility. “Our library of designs and parts and shapes and sizes for the RV and marine industries is extremely large. There’s a good possibility that for any retail consumer who calls, we have what they need. We will have instant access to that design.”

That’s a big deal, because many OEMs and dealers only stock designs for three years after the specific RV is produced. The continuing technological improvements of digital printing, however, allow BGS to meet requests for out-of-date designs “rather quickly.”

beyond that, it was to help train manufacturer technicians hone their skills on the production line when they’re installing graphics. But looking at our volume of vinyl and the ability of our installers, it’s a natural fit for us to go into the installation part of this, as well.

“The world of vinyl is growing tremendously,” he added. “The technology’s gotten incredible — to where it truly can take the place of paint, in most instances. In fact, in some cases it provides superior protection to paint. And with the surge in the RV market of painted towables and motorhomes, there’s really not enough capacity to get RVs painted. That’s why we started looking at presenting wrap designs and graphics to the market — and with our ability to design, print and now install the product, we’ve opened this up to consumers that want their vehicle wrapped.

And the company has the staff to get the job done. “We’ve always been the designer and supplier of graphics, never the installer,” Graham explained. “But over the last few years, we’ve built a really strong team of trained professional installers. The primary reason we added them to our team was to assist our OEM customers when it comes to prototyping units before they go to production. Be-

“Vinyl just offers a quick, clean and, in many cases, less-expensive alternative to paint.”

Obviously, however, not every consumer in the U.S. can bring their unit to the BGS facility in Elkhart. BGS also is developing a program to educate RV dealers with the ability to install wraps and graphics, either at the BGS facility in Elkhart or at the specific dealerships.

“But here again, that speaks to one of the strengths of wrap versus paint — in every town in America, you could find a vinyl shop of some sort with people that have the ability to install graphics,” he said. “On top of that, we have been actively working with the OEMs to get their dealer body aware and ready and trained to be able to install wraps.”

While it’s not recommended that a consumer attempt to tackle a wrap, replacing or updating graphics is another story. While contacting the specific manufacturer should always be the first move, consumers faced with an out-of-date unit can reach out to BGS. After determining it has graphics on file for a specific make, model and year — the company, said Graham, works with and touches almost 100% of the industry at some level — the order is placed and the graphics are printed and shipped to either the customer’s selected installer or the owner themselves. For do-it-yourselfers, the package includes easy-to-follow installation instructions.

Customers also can work with BGS designers to update or personalize existing graphics.

“You can freshen up the entire look of an RV just by wrapping the front cap,” Graham said. “Typically, that’s where RVs suffer the most damage — and it can be difficult to get paint repaired out in the field. But beyond that, maybe someone bought a new tow vehicle and they have a blue graphic on their coach



*Known for its stylish stainless-steel exterior, the BGS facility in Elkhart includes a design center, product warehouse and 7,500-square-foot showroom, where vintage automobiles attract visitor’s attention. Soon to come: a massive 50-foot video screen with 3D capability for displaying life-size designs for RV OEM clients without having to physically install them on a unit.*





When *RV Enthusiast* visited the BGS facility in Elkhart, installation specialists were putting the finishing touches on a host of Forest River products wrapped in various themes for a company-wide Halloween event. The printing capabilities of BGS are amazing, as is the fine detail found in the finished vinyl.

that doesn't match their new truck. In less than a day, they can refresh the entire look of the coach and match it to whatever they might be towing it with."

Full-body wraps are another story and should only be undertaken by a professional shop — or performed at the BGS facility in Elkhart. Known for its stylish stainless-steel exterior, the Elkhart location houses its design studios and warehouse — but less-known is the fact that adjacent to this 35,000-square-foot facility is another 30,000 square feet of enclosed space that previously was used for painting. BGS has eliminated that aspect of its production — and rededicated that space to retail product applications.

"This facility had, at one point, five downdraft paint booths we used to paint front caps and supply them to the RV industry," Graham said. "We made the decision to eliminate paint and shift our focus completely to vinyl."

Regardless of the facility selected, Graham recommends that owners undertake some initial cleaning of the unit before delivery.

"In that respect, it's no different than paint — the devil's in the details," he said. "The prep work before you do a wrap is very important. You could wrap over the current decals that are on a coach if you wanted to save time and money, or you could bring it to us. We would design, remove, prep and then install either new graphics package or a full wrap. Preferably, the unit would have the old graphics removed to present a clean sidewall, but a new wrap will hide some blemishes, paint fade — anything that doesn't look right on the side of a coach. Now, if the RV has dents and cracks and things like that, they might show through the vinyl — but overall, it gives the RV an instant new look."

Consumers also will have the option

of selecting a color change or creating a custom design.

"There will be some preset templates — from one for a laminated travel trailer to a stick-and-tin, fifth wheel, motorhome — that somebody could just buy off the shelf, so to speak. But our design services and the ability to print whatever someone might reasonably want is available as well," Graham pointed out. "It's important to note that there are really two types of wrap — there's a custom-printed wrap, and then there's what is referred to as a color change wrap where we don't need to print anything, we just use a specific vinyl in a color and give it a color change. I see that becoming popular in the RV market — in particular, on a front cap."

While a custom design adds to the time element, the process of fully wrapping an RV is a four- to five-day project, from drop-off to pick up.

Graham also touts the ability of the vinyl used by BGS to stand up to the elements and its ease of installation, something home installers will appreciate.

"Arlon is our partner in the RV world for vinyl," he said. "It was the first to pioneer 'air egress' technology, which is the material that releases air pockets and bubbles during application. Made in the USA, Arlon also is much more focused on vehicle wraps — and wrap material is another of its strengths." The company has upwards of two dozen stock colors, while its screen-printing process allows for virtually unlimited colors through the ability to apply multiple colors onto white vinyl.

Graham, for one, sees the ability to restore or change an RV's appearance central to the ongoing popularity of the RV lifestyle.

"As the customer base continues to



As this additional Forest River travel trailer illustrates, the sky really is the limit when working with BGS designers on a custom wrap. As an alternative to paint, wraps are oftentimes less expensive and easier to repair should the tough vinyl experience a rip or tear due to an accident.





Full-body wraps can be designed to cover — or not cover — windows and doors. Installation specialists carefully trim the vinyl around critical areas such as electric hookups and water heater vent doors.

grow — either through new or pre-owned RV sales — customers are going to need resources to take care of their coaches. It's really no different than an owner of a car who wants to change it from, say, white to silver. The power of wraps in the automotive market has gotten really strong over the last five to eight years — and it's starting to trickle its way into the RV market. It's an inexpensive way to create an entirely new appearance."



While the screen-printed process is done at its Racine, Wisconsin, headquarters, the Elkhart location cut the no-ink vinyl shapes often used on RV exteriors. Most original-equipment designs are a combination of printed and non-printed pieces.

**Interested in wrapping your RV, or needing replacement or new graphics? Contact:**

**Burlington Graphic Systems**

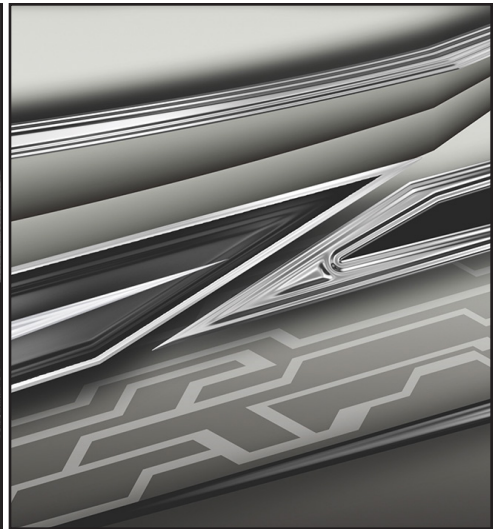
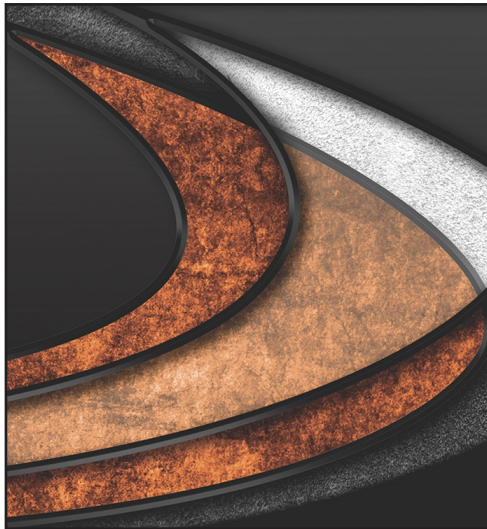
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[Bgsv.com](http://Bgsv.com)

Ellen Damron

(262) 554-8808

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BGS stocks about two dozen stock colors, while its screen-printing process allows for virtually unlimited colors through the ability to apply multiple colors onto white vinyl. **RVE**

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# Solid Footing



*Installing Lippert's SolidStance Step Stabilizer takes the wobble and flex out — and that sinking stomach — when entering and leaving a conventional trailer or fifth wheel not equipped with an entry step system that extends to the ground.*

By Bob Livingston / Photos by the author

The act of getting in and out of a trailer or fifth wheel is not very graceful. Until recently, with the advent of entry step systems like Lippert's Solid Step and MORyde's StepAbove that fold down from the doorway and contact the ground to create a stable platform, egress and ingress was relegated to two or three rungs — and, on occasion, sometimes four — that extend from a well under the doorway. Unlike steps that fold from the doorway, the retractable versions can create angst when they flex and wiggle while just hanging in space. While these quintessential steps have provided good service over the years, people still have to watch their footing and acclimate to differences in spacing and step width. The rungs are supported only by a retractable framework and all that flexing can create uneasiness for occupants and even weaken the structure to the point of failure, which can lead to injury.

Owners have devised several ways to stabilize these steps, including the use of blocks, and there are a few commercial products on the market that help somewhat. Recently, Lippert (LCI) introduced the SolidStance Step Stabilizer, which changes the paradigm when it comes to devices designed to provide stability when entering and exiting a towable. The SolidStance bolts to the existing bottom step permanently and its clever design makes it possible to simply fold the legs when it comes time to travel. The entire installation process takes less than an hour and is do-it-yourself friendly.

Before you invest the \$45.95 for the SolidStance, spend some time on Lippert's website ([lci1.com](http://lci1.com)) to make sure your steps are compatible. First off, it's not compatible with quad steps, but it can be installed on LCI's OEM two- and three-rung models. It may be possible to install the SolidStance on some non-LCI three-step units, but frankly, the

steps on your trailer or fifth wheel are likely supplied by LCI. For this project the SolidStance was installed on a Alumi-Tread triple step, which is made by LCI.



*In order for the SolidStance Step Stabilizer to fit, the lowest step must have 5-14 inches of clearance to the ground. The device works on Lippert step systems for towables and may be installed on some other brands with additional modifications.*





*The stabilizer was installed on Lippert's Aluma-Tread triple-steps. It can also work on double step configurations but is not designed for four-step models. Before starting the installation, the SolidStance was held in place and the steps retracted to establish proper clearance.*

Prior to starting the installation, familiarize yourself with the instructions, because ultimately you'll be drilling four holes in the steps and doing it over will result in unsightly extra holes. The instructions may seem overwhelming for such a simple installation, but don't get hung up on too many details — just be sure to understand orientation. It's best to hold the hardware in its final location while a helper retracts the steps just to make sure it will close without interference. If it works, you're ready to measure for the center point on the bottom step and the SolidStance bracket.

Keep in mind that you'll be working under the lowest step, so when looking at it folded over the SolidStance must be placed against the front lip (which is backwards when viewing from the bottom). Depending on the step rung configuration, you may have to deviate

the positioning slightly to provide clearance for the drop legs. Just make sure the spring-loaded pins are facing the rear when the step is deployed.

Clamp the SolidStance in place or have a helper hold it steady when marking the locations for drilling the holes to accommodate the provided nuts and bolts. There are two holes on each side of the SolidStance frame that are predrilled.

Once the holes are drilled, it's simply a matter of bolting the SolidStance to the step using the fasteners, which include locking nuts. Additional larger washers are included if spacing is needed to accommodate any extrusions that might impede proper seating of the stabilizer frame. In this case, the SolidStance fit perfectly in the channel nearest the front of the step. This is not a particularly difficult job as long

as you have a helper to hold things in place when tightening the bolts. Figure on less than one hour to complete the project using common hand tools.

Setting up the SolidStance is simple. You just pull the quick-release pins from one of the drop legs to establish initial footing. If it hits the ground, you can deploy the other leg; if the drop legs don't reach the ground, the spring-loaded pin is pulled to release the inner leg until the foot pad hits the ground. After a couple of deployments, you'll get comfortable with establishing the proper angle and length of the legs in relation to the ground. Lifting up on the bottom step slightly can provide a little wiggle room for setting the legs. Just make sure the spring-loaded pins are seated fully in their respective holes and the fastener pins are pushed in from the back to eliminate catching the wire lanyard with your foot. We tested the validity of that requirement at first and the lanyards did get in the way when the pins were installed from the front.

There are four drop-leg angles and the inner legs can be extended up to 5 3/8 inches. Before retracting the steps, makes sure the SolidStance legs are in their stored positions and all the pins are secure. Except for the additional weight, the installation of the stabilizer hardware has little bearing on the opening and storing process. The legs will get dirty over time, requiring cleaning with soap and water.

The additional support afforded by the SolidStep is dramatic — something most users will immediately realize if the legs are not deployed after arriving in camp. There's no flexing of the steps, even while negotiated by heavier-footed people, and that lack of unwanted movement will likely prolong step longevity. Plus, you won't miss that stomach-sinking feeling that something's going to give when using the steps.



*Center points for the bottom step and the SolidStance frame were measured and marked to make sure the hardware could be oriented properly.*





**3**

Before moving on with the installation, a piece of wood was placed between the folded bottom step and the second rung to provide a backing while drilling holes. This prevented an errant drill bit from going through the middle step.



**4b**



**4a**

With the SolidStance positioned as close to the front lip of the bottom step as possible, the predrilled holes on each side were marked for drilling. In this case, the bracket fit perfectly in a channel in the Aluma-Tread step. Positioning will differ slightly depending on the step model.



**5a**



**5b**

The location for the holes to be drilled were clearly marked with a Sharpie. It's important that the hole locations are accurate; you don't want to be reaming out the holes for the bolts. In this case, drilling through the aluminum step was easy and the holes lined up perfectly. Double check orientation before drilling; we discovered that the SolidStance was backwards the first time around; double-checking circumvented drilling extra holes.



**6a**



**6b**

The four bolts, washers and locking nuts were installed and tightened. While the procedure is not difficult, balancing the SolidStance while locating all the fasteners took some patience. Additional larger washers (not shown) are provided for spacing if the SolidStance is installed on a non-Lippert step system.





7

Deploying the stabilizer requires that the drop legs are unfolded to establish whether the jack feet will touch the ground. There are four drop-leg angles that allow for positioning on undulating terrain. Make sure the quick-release fastener pins are pushed through from the rear to prevent catching the wire lanyard. This requirement was tested, as shown here from the front, and it does make a difference.



8

If the drop legs do not reach the ground, the inner legs can be released via spring-loaded pins. The legs can be extended up to 5 3/8 inches, but make sure the spring-loaded pins are fully seated in their respective holes.



9

When the legs are folded and pinned in place, the steps can be retracted for travel with no clearance issues. The only difference is the weight, which makes the bottom step a little heavier to open and close. **RVE**



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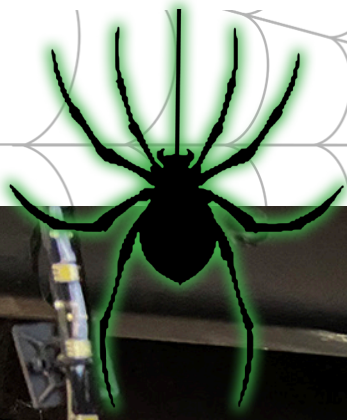


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# Pest Control



*This damage occurred when a wild raccoon was trapped inside a RV while in storage. Unable to escape it destroyed all the wiring, plumbing and carpet in the entire storage area. The smell was even worse than the physical damage.*

*Dealing with unwanted guests — from ants to raccoons — is an inevitable part of camping. But while you're visiting their "home" you don't need to welcome them into yours.*

By Don E. Smith

Getting away from big cities or even suburbs is a big part of why many RV owners choose this lifestyle. It doesn't matter if you are a full-timer, an any-timer or even a some-timer — there is nothing like the serenity of taking your RV to a remote area and enjoying nature. The closer I can get to a forest, lake, river or ocean the better I like it.

When we go to these areas, however, we often forget that we are now invading the territory of hundreds — if not thousands — of potential wildlife that find your RV just as great a place to live as you do. These critters don't care if you are in a million-dollar bus or a pop-up camper — your RV is dry, warm and very inviting to them.

The goal of most campers is to enjoy Mother Nature without having Mother Nature enjoy them or their RV too much. That's often easier said than



*Nothing will spoil a trip faster than discovering your electrical bay has turned into a playground for hundreds of carpenter ants. Notice the white eggs that are everywhere. Luckily this infestation was caught before major damage was done.*





*Gaps like this in the storage area of a RV make it very easy for bugs and even larger rodents to pass freely from bay to bay and eventually into the living quarters. Find these and block them with wire screen to restrict their access to your RV.*

done. If you have been camping long enough, you have likely had or heard of someone else having their rig infested by bugs, ants, rats, snakes, or a much larger animal like a raccoon or opossum. In fact, the insurance industry reports that rodent damage is one of the largest reasons for RV insurance claims. Since RVs often sit unused for weeks or months at a time, these long periods of storage are often the time when these infestations begin or grow wildly as owners are not there to see the signs of infestation — or, more importantly, take measures to stop the damage.

I have seen many instances of rodents damaging RVs over the years and, in most cases, the damage and the infestation could have been prevented. As a RV owner, you have undoubtedly heard or even read on social media platforms or through word-of-mouth all sorts of preventative measures on how to discourage insects or rodents from inhabiting your RV. I, too, was misled over the years by using things like dryer sheets in cabinets or drawers to keep mice away, or peppermint oil on cotton balls, or various

other items such as scented bath soap. The truth is those things do make your cabinets smell nice; heck, I may likely continue using dryer sheets for that reason alone. However, they do not really deter rodents. After spending an excessive amount of time watching videos of amateur researchers testing these homemade preventions in a controlled environment, I am convinced that almost none of these things do much, if anything, for prevention.

By far the best method to avoid RV damage by bugs or rodents is simply to prevent them from entering the RV. That is not as easy as you may think; bugs, in particular, are so small they can get in through the tiniest of cracks. Even mice or rats will get through holes that are far smaller than you imagine. Therefore, if you want to prevent rodent damage you have to keep them out and away from the RV. For bugs, it is easy to form an outer barrier around your campsite. Upon arrival to any campsite, it is a good idea to walk around the area and inspect for signs of bugs — look for mounds or any other signs that a threat exists.

After this, use an exterior bug solu-

tion in a pump sprayer or a smaller one-gallon bottle (some even have a battery-powered sprayer built in) and walk around the entire site spraying visible ant mounds and whatever else you noticed on your walk. You can also spray an outer band around the whole pad as a first line of defense against bugs and ants. Then you need to go around the entire RV and spray another protection band — this time, paying attention to all the areas where your RV contacts the ground. Focus on the area around the tires, leveling jacks, and any water or drain hoses as well as the cable TV line and power cord. Bugs will use these as a pathway to crawl into your coach. Another method to repel ants is to sprinkle food-grade Diatomaceous Earth (available at pool supply stores or online) around anything from the RV that touches the ground. This technique works well and is environmentally safe.

If your stay is longer, you may need to do an external spray more than once and especially after each rain. If you are a full-timer or stay in the same location for long periods, there are also bug bait stations available and some in ground devices so they are not easily disturbed. Some owners have had good luck keeping rodents away by stringing LED lights under their rig. Since rodents are nocturnal, the lights become an annoyance and help discourage them from hanging around your RV.

For rodents such as mice and rats you can also place a few traps of your choosing behind the wheels or another inconspicuous area. There are, of course, many different types of traps ranging from glue pads to traditional spring traps. Some only capture the rodent, allowing you to relocate it and release it, but most of them are designed to exterminate critters. You can let your conscience guide you on the type of rodent protection plan for your situation. You should, however, keep in mind that using poison of any kind could have unwanted effects by endangering pets or other less-harmful wildlife.

Next, focus on the RV itself — and that includes basement storage bays. Sealing a RV completely is virtually impossible, but the first thing is to make a serious attempt to seal and/or block every accessible entrance point. On most RVs, there several holes, cracks and gaps between the outside and the storage bays (if so equipped) and between the storage bays and the living quarters. There is no easy way to do this, because the only way to find all these small cracks and openings is to crawl or roll around on a mechanics creeper





*Here is a good example of how to properly seal a sink drain. First the area around the pipe was stuffed with steel wool, then spray foam was sprayed on top and around that. This is to prevent rats and mice from chewing through the foam and crawling in the bathroom from underneath your RV.*

under your RV, then crawl inside the storage bays (if possible) and look for openings. That said, anywhere a hose, drain or LP-gas line, or any plumbing or wires pass through the walls or floors, there is likely space around the component that's big enough to allow bugs or rodents to pass. Enlist the help of someone in the living quarters with a bright flashlight and have them shine it around bathroom drains or other openings as you crawl in the basement; you should be able to see the light to help identify potential cracks that need to be sealed.

Stopping a bug or ant is a bit easier than a rodent, as it is done with caulk or spray foam that usually does the job very well. However, rats and mice are not easily deterred — and they have no problem chewing through traditional products like spray foam. In fact, they will chew through most anything — and they will then use the material they chew to make their nest inside your RV. In order to seal out rodents, you need to use something metal. Products such as steel wool or fine-gauge metal screen work much better at blocking rodents from chewing. One popular method of closing a hole is to first fill it with steel wool, then use spray-foam insulation around and on top of it. This method not only helps make an airtight seal, but it is also very resistant to chewing rodents. A side benefit to sealing your RV against bug and rodent entry is increased insulation— so all the work put forward to deter pests can actually help

in two ways because a better-insulated RV is more comfortable and less likely to freeze in the winter.

Keep in mind that after you have searched your rig for every possible entry point and sealed them in the best manner possible, there is still a good chance unwanted guests will find a way inside to your living quarters or storage bays. The next layer of defense we suggest is to spread around some bug bait stations. You will have to pick the type you use based on what bugs are common in your area; for most of us, it will be ants and/or roaches. Select the bait station that is most suited to your area and hide them around the RV in areas that are close to doors or other entry points as well as bathrooms because those typically have plumbing



*Inside the RV it is safest to use these sealed bait stations. They can be placed in multiple areas near doors, under cabinets or anywhere you see signs of bugs. Follow the manufacturer's instructions on how often to replace them.*

lines running through the floor and offer easier access for bugs to enter. The same type of rodent traps and/or glue strips placed on the outside can also be utilized inside— again, keeping in mind that inside your RV it's best not to use exposed glue boards, as they are a nuisance if your pet finds them or they get turned upside down. We prefer the glue traps that fold into a little box or triangle so that the glued portion is not easily touched by people or pets. Those are easily hidden most anywhere and are easy to dispose of once they are used.

If you have a pet (dog or cat) living inside with you, there is also a much greater risk of fleas and ticks. Most exterior bug sprays control both fleas and ticks, but you should protect your pet with a topical repellent (such as Frontline Plus) that is available at pet stores or your veterinarian. These products help keep the fleas off your pet and, as a result of that, help to keep them out of your RV.

When looking for products of this type, you can usually find many types of sprays, traps and bait stations as well as repellants for other undesirable creatures (such as snakes, skunks and others) at big-box home improvement centers, hardware stores and at farm supply stores. Survey your situation and determine what the most likely intruders are in your area and then pick the products aimed at those specific animals and bugs. Crawling around under or inside your RV is not the easiest project around, but if you (or someone) doesn't do a good job, your next call may be to your insurance agent to handle a damage claim. Rodents and bugs can do major damage to an RV in just a few shorts weeks if allowed to continue unrestricted. It's better to do a little preventative work now and not become their next victim.





Any good brand of indoor/outdoor bug spray can be used around the perimeter of the RV or the whole campsite. This will discourage bugs from breaking through the barrier and gaining access to you, your kids, pets, or the RV. Just make sure you follow the directions concerning restricted access to sprayed areas until the product dries.



Glue traps are effective for bugs as well as mice or rats. This one folds into a "box" which prevents kids or pets from easily getting stuck to the glue portion of the trap. Just place these in dry areas inside the living area or in storage bays. Check them regularly and dispose once they have caught a rodent.



Another type of ant bait is liquid- or gel-based. Liquid ant baits like these can be used inside the RV or in the storage bays to attract and kill ants. They also can be used outside. Just make sure they are placed on a level surface so the liquid doesn't leak out.



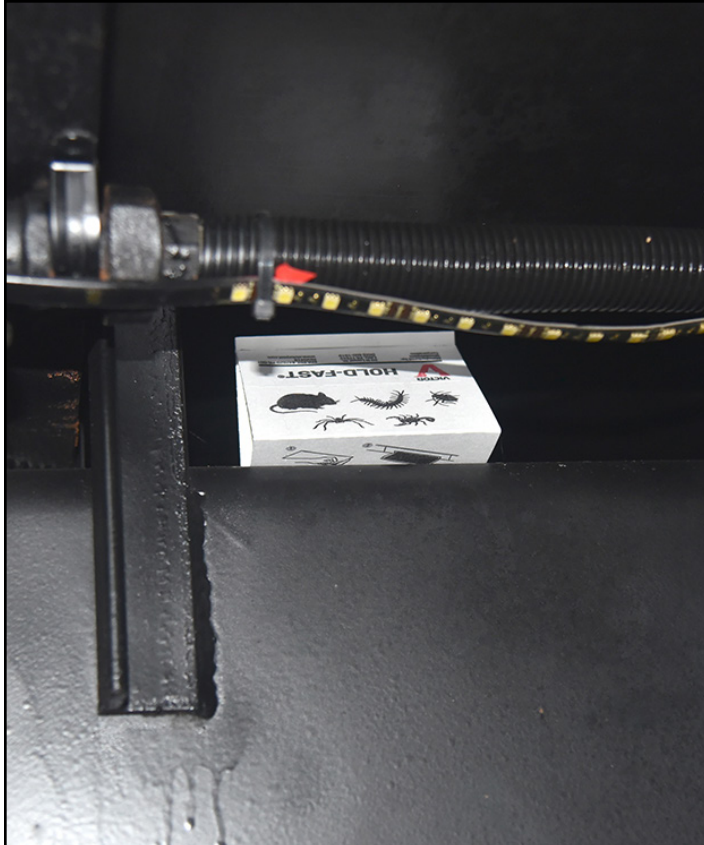




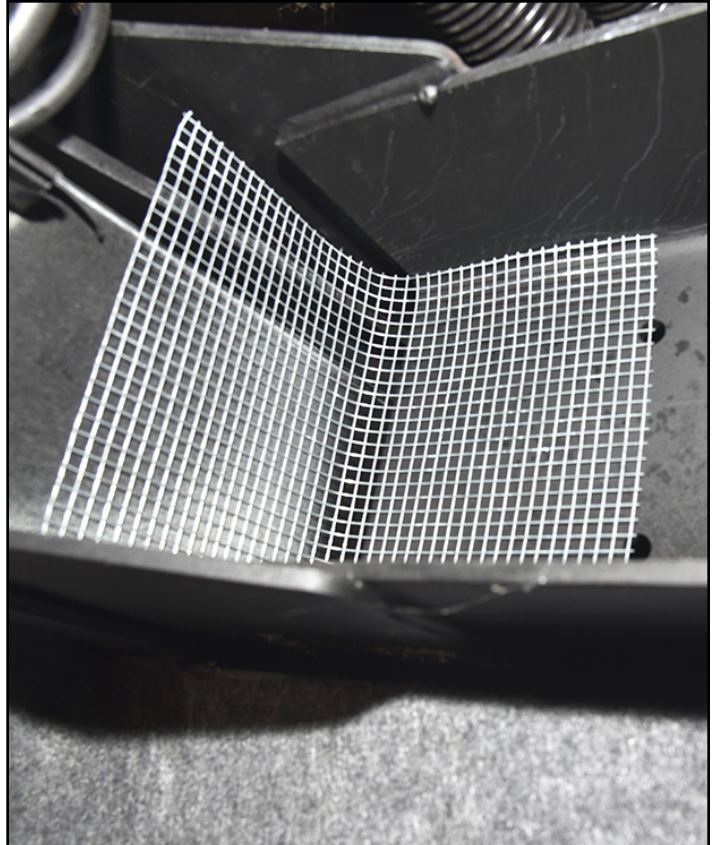
*Diatomaceous Earth is a natural, food-grade insecticide that's safe for applying outside wherever your RV touches the ground (some RVers also have been known to use it in exterior storage compartments). Try not to inhale it; it can irritate the lungs. If you have a respiratory condition, apply it while wearing a dust mask.*



*These gel bait stations from Amdro are stakes that you can strategically place around the RV. This attracts ants and kills them before they can move in. Remember, the prevention of bugs and rodents needs to be done when you are camping as well as when you store the unit.*



*This glue trap has been placed on the frame rail in the basement of a motorhome — an area where there is a "paved highway" for rodents to run along. These glue boards from Victor are pre-baited with a peanut butter smell to attract mice.*



*Use wire screen available at local hardware stores to cover large open areas between frame rails or gaps in storage bays to close these passageways. The metal wire will prevent rodents from chewing through it. **RVE***



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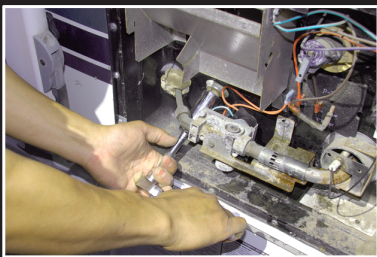
continue to enjoy your RV for years to come. In fact, there are nearly 50 pages of 'how-to' stories in this issue — just imagine the wealth of topics to be covered and the knowledge gained in a year's time!

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## ***Coming in the November issue:***

With winter fast approaching and most RVs off the highways until next spring, it's the perfect time to start any projects you may have put off.

The November issue can help, with step-by-step procedures for installing new window awning fabric, a unique way of repairing belly pan cuts (hint: it uses a hot nailer and tape!), Freightliner chassis maintenance tips and everything you need to know about servicing and repairing Schwintek slidout mechanisms. There's more, to be sure, so watch for put this issue — and put it to good use this winter! **Available November 20**





# Singing in the Shower



*Truma's AquaGo instantaneous water heater is designed to fit in the same opening provided for all RV counterparts. No modifications need to be made to the opening and surrounding sidewall.*

## *Upgrading to Truma's AquaGo instantaneous water heater is a game-changer for those who love to linger under a stream of endless hot water*

By Bob Livingston / Photos by the author

**H**umans love their shower time. Maybe it's the comfort afforded by personal time standing under a brisk waterfall of soothing water or maybe it's a place where new songs are tested. In a stationary home, there's plenty of water to linger under the shower — but that's not the case in an RV. Conventional RV water heaters have limited supply, controlled by a LP-gas burner or electrical element. Most can provide 6 to 12 gallons of water, but there's always down time if back-to-back showers are taken by multiple occupants. Truma's AquaGo instantaneous water heater overcomes that annoyance by providing all the hot

water you want — without interruptions.

There are several manufacturers who include the AquaGo as part of their build, but for those who would like to upgrade, one of these sophisticated water heaters can be retrofitted by Truma at its Elkhart, Indiana, facility or by one of its certified dealers scattered throughout the country. Truma ([www.truma.net](http://www.truma.net)), a company with a huge presence in Europe (headquarters in Munich, Germany), does not sell the AquaGo to the aftermarket unless the unit is being installed by one of its trained technicians.

German engineering really comes into play with the AquaGo. The Ger-

mans have a reputation for building sophisticated machines (think cars) with redundant features that assure quality and longevity. In that vein, Truma also designed this unit so that it can be retrofitted into any opening that housed a 6, 10 or 12-gallon RV water heater without making any modifications to the original compartment and/or sidewall. What's really impressive, though, is the manufacturing process — where every component is coded and captured on a computer program that keeps track of each water heater built and its respective parts. If something goes wrong (which is rare), the water heater can be connected to a diagnostic computer





**1a** *The original hot water tank in this motorhome was in good shape, but the owners were full-timers and wanted the convenience of on-demand hot water. The door was removed from the original water heater to begin the process releasing the housing from the side-wall.*

that will identify the issue on the spot and pinpoint the offending component by serial number so that, if need be, a technician can take immediate corrective action. Every unit also is bench tested before being boxed for shipping.

The operation of the AquaGo is straightforward. When water is detected by the volume-flow sensor (which responds to an open faucet), the LP-gas burner is fired up and the water is heated instantly; there is no reservoir that holds heated water that eventually cools and needs to be heated again. The water temperature is regulated not to exceed 120 degrees F., which prevents scalding as long as your skin is not exposed to unmixed (with cold) hot water for more than five minutes. This safety feature was tested multiple times to assure compliance.

The AquaGo only operates on LP-gas, other than the control board that requires 12-volt DC power. I had one of the original units installed five years ago and not only is it still working perfectly under full-time service, but propane consumption is also amazingly low. Based on my usage, a 7-gallon cylinder will last for at least three months (the LP-gas furnace is rarely turned on and all the other appliances in my rig are powered by electricity).

The exterior door of the AquaGo is also designed to flow fresh air to the burner and exhaust any gas in an efficient manner via an integrated ventilation grid. And it looks nice, too — trim plates are used to provide an OEM look.

Beyond the water temperature regulator, a number of other features are integrated into the system for safety, including provisions to monitor voltage, current, fan operation and flame con-

dition. If current goes too low or high, the unit will shut down, and there is even freeze protection built into safety programming. If there's a problem, like LP-gas interruption (empty cylinder or tank), a light in the control panel knob will flash to provide a code, which can be cross-referenced by legends on the Internet or in the instruction book. This same knob will also tell you when the unit needs to be decalcified, a process that's required every year in our fifth wheel based on notification from the control panel. Decalcification frequency, of course, depends on water quality and usage of the RV.

Truma offers the AquaGo in two models: the Comfort and Comfort Plus. In the Comfort model, users can choose

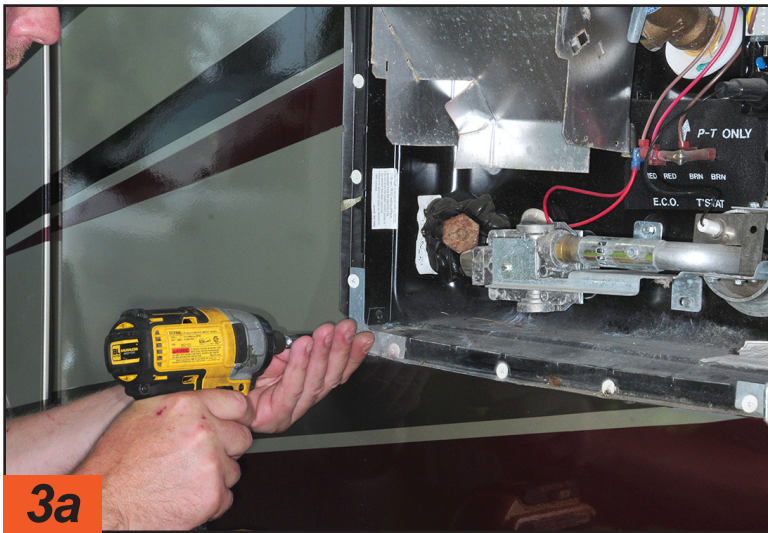
Eco or Comfort modes. When in the Comfort mode, water is automatically held at 102 degrees F, which provides hot water to the faucets more rapidly. The Comfort Plus model is only available to OEMs; the system allows hot water to be maintained at full operating temperature for a super-quick flow to the faucets. In this mode, the unit will automatically heat the water in short bursts throughout the day to maintain the proper temperature. If you want to conserve 12-volt DC power and LP-gas while boondocking, leave the switch in the Eco mode but you will use more water, depending on distance from the water heater to the faucets/shower-head.

Other than the decalcifying process,

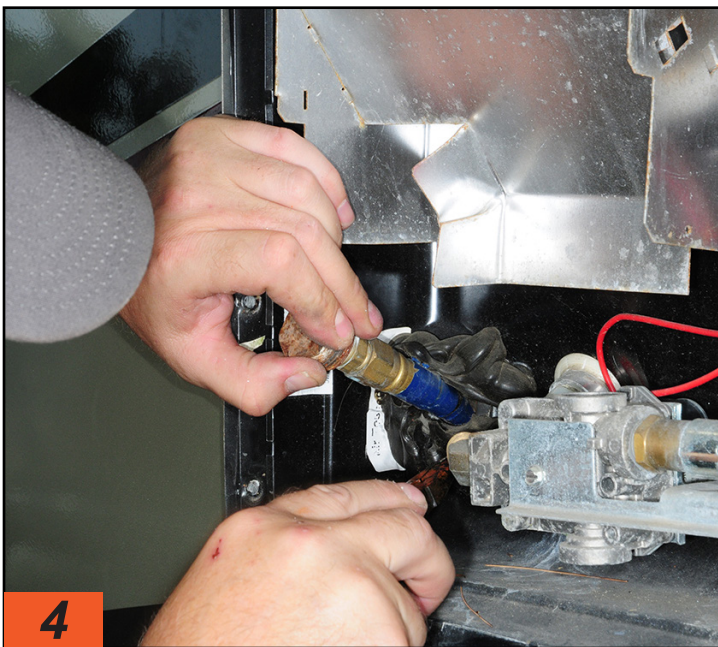


**2** *Once the original water heater was turned off and allowed to cool down, the drain plug was removed and the pressure-relief valve opened to empty the water from the tank into a bucket.*





**3a** The screws were removed from the frame and the old sealant was cut with a scraping tool to release the water heater from the opening in the sidewall.

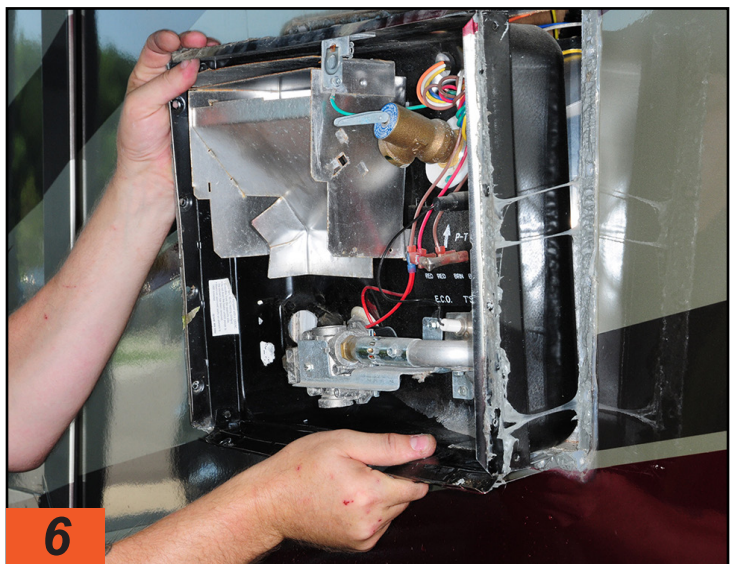


**4** After closing the LP-gas tank valve, the line to the water heater was removed. This line was modified later since the connection for the LP-gas is on the right side in the AquaGo.

**5** All water lines in the back of the old water heater were disconnected before pulling it out of the opening in the wall—of course, after all water sources were closed.

there's not much to service — and what there is to do is really simple. Water can be drained from the tank via a “snout” that is released and rotated down. Since there is no tank to speak of, don't expect too much water to be drained. Just make sure the water heater is in the Off position and that the water has had some time to cool — if you don't follow this procedure, expect to get wet from pressurized water. Also, there is a reusable filter in the snout that can be cleaned. When performing decalcification, tablets (available online from Truma) are stacked into the filter opening and the knob is turned to the Clean detent in the remote panel. The whole process is fairly simple once you've done it; following the overwritten instructions provided online or in the

owner's manual can be confusing. The AquaGo is a product you'll likely never stop bragging about. Granted, it's more costly — about \$0,000, plus \$000 for labor — but the reliability factor and convenience afforded by endless hot water are well worth the investment. Who knows — you probably will have enough time in the shower to learn new songs.



**6** A little tugging was all that was needed to release the old water heater from the opening in the wall.





7

As you can see, the original water heater has a tank where the hot water is held until used. Once the water starts to cool, the burner starts up to bring it back to the set temperature. This process is eliminated with the AquaGo.



8a



8b

The Truma technician spent some time scraping off the old putty, which can be a tedious job but is necessary to seat the new trim. Any residue was wiped off with alcohol to make sure the surface was squeaky clean.



9

A remote panel used to control the AquaGo functions can be installed in any convenient location. The one in my fifth wheel is in the galley area, while this one was cut into the sink cabinet in the bathroom.



10

The remote panel makes it easy to turn the AquaGo to On or Off and set the operational modes. A blinking light in the knob provides the codes for any function problems; it also lets the owner know when the unit should be decalcified. Turning the knob to the Clean detent starts the decalcification process.



11

Sealant was applied to the trim plate to make sure it was watertight when the AquaGo was installed.





12a



12b

The trim was carefully applied to sidewall surrounding the original opening. It covers any gaps to compensate for any differences in sizes between the original water heater and the AquaGo. After proper placement of the trim plate was established, it was attached to the wall with screws.

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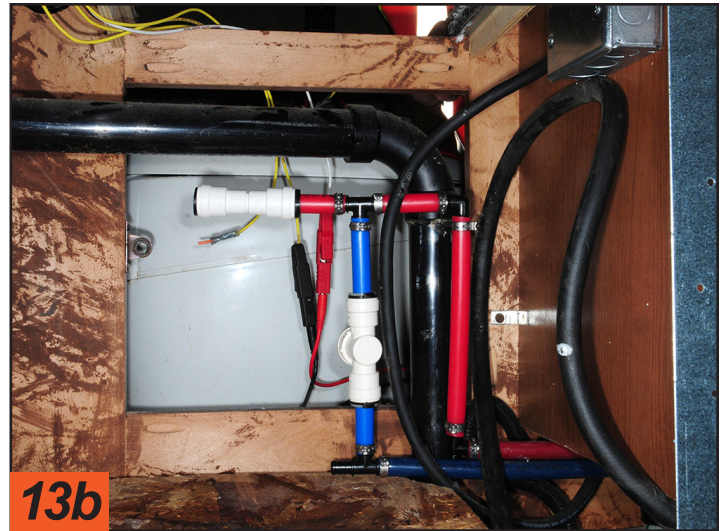
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**13a**



**13b**

All the necessary water and LP-gas lines were modified and rearranged inside the opening to accommodate the different hookup scheme. New lines were sized and the proper ends crimped into place.



**14**

The original 120-volt AC power line for the electric element in the old water heater was capped and placed in a junction box that was mounted on the wall inside the opening and out of the way. This is a much safer way to handle the old power wires.



**15a**



**16**

After all the water and propane lines were completed and routed neatly, the flange around the AquaGo housing was covered with butyl tape.



**15b**

In order to make sure the water lines were sized accurately, several Watts AquaLock (Sea Tech) slip-on fittings, including valves to turn off the water, were configured into the system.





**18**

Finally, the AquaGo was permanently attached to the wall with self-drilling screws. The technician is pointing to the mechanism (snout) that can be unlatched and rotated down to drain the water and access the cleanable filter. This is also where the tablets are loaded for the decalcification process.

**17**  
The AquaGo fit perfectly, looking like an original installation. All the components, including the control board, are accessible from the outside.

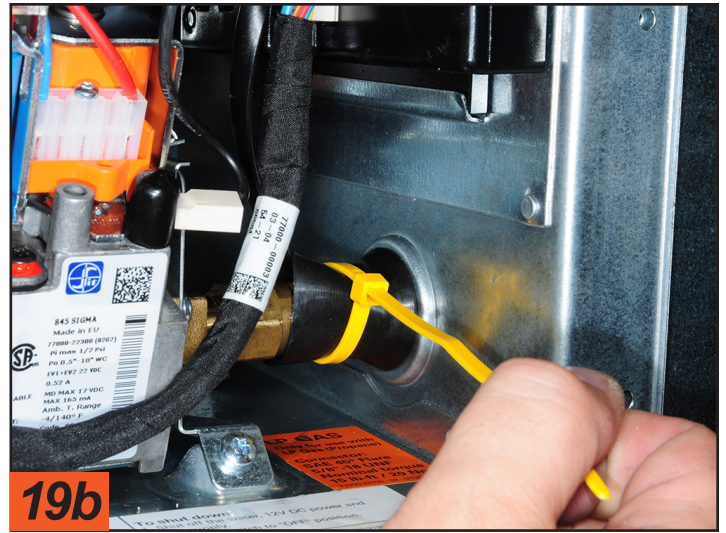
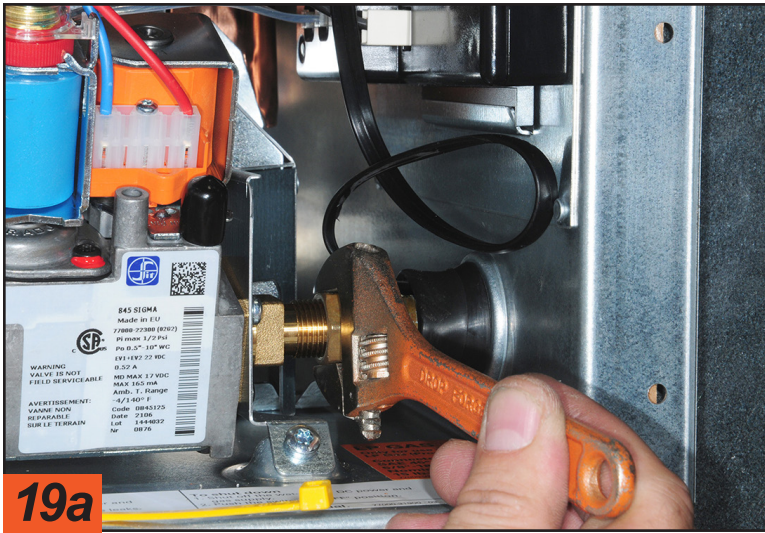


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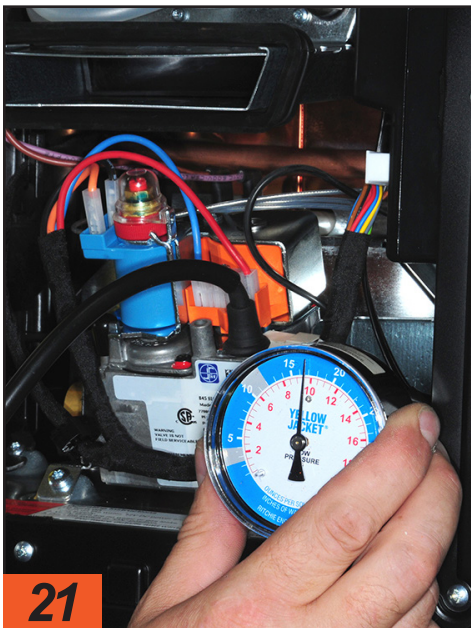




**19a** **19b** Before attaching the new LP-gas fitting, a special boot was slid over the line and secured with a cable tie. This makes it unnecessary to glob on a bunch of silicone rubber to seal off the LP-gas connection from the inside of the RV — in compliance with code.



**20a** **20b** The last installation step was to install the access door, which not only looks nice but is also designed to flow fresh air to the burner and exhaust any gas in an efficient manner via an integrated ventilation grid.



**21** A pressure drop test was performed to ensure that there were no LP-gas leaks in the system. This is required anytime the LP-gas system is opened for repairs or the installation of new appliances.

**22** In the unlikely event that something malfunctions, the components can be scanned after plugging in a computer with proprietary diagnostic software. All the parts have bar codes specific to respective water heaters.

**23** There is also a power switch located in the backside of the water heater that must be turned on to operate the water heater. This switch is left on so the water heater can be controlled at the remote panel. A green light here will flash a code if there is a malfunction. **RVE**





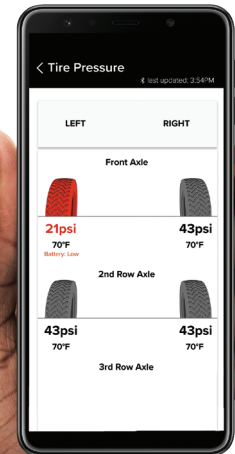
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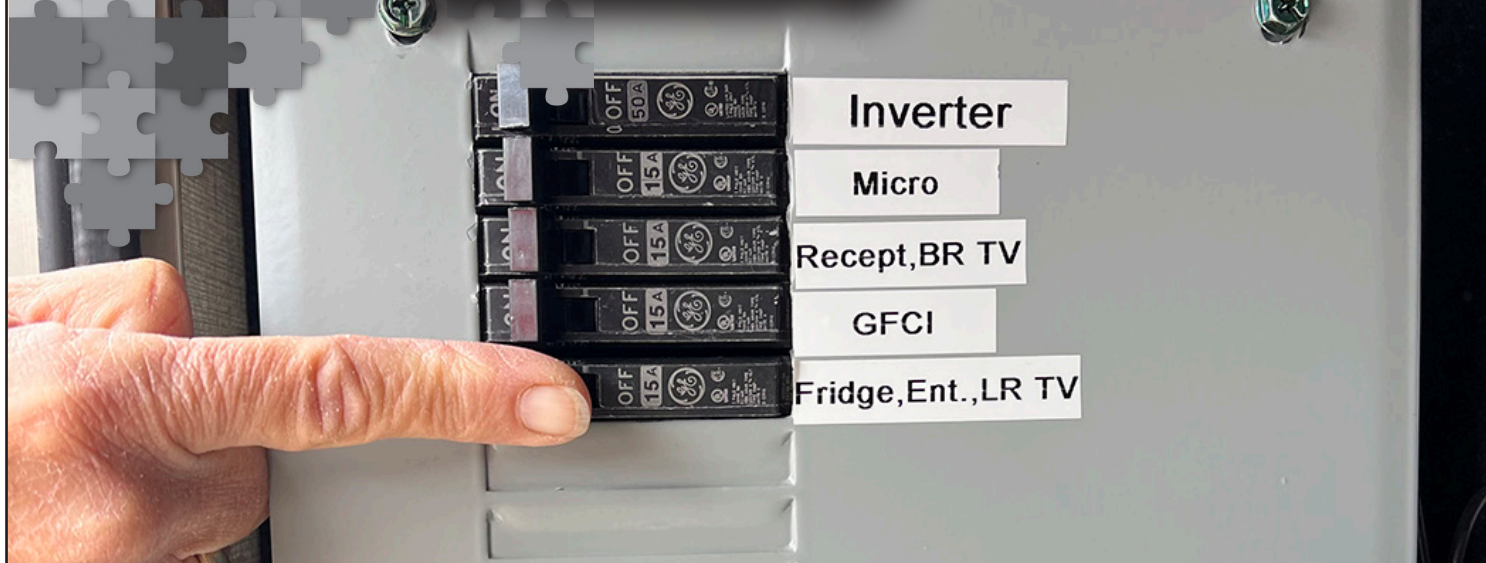


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# Power Loss Puzzle



*After the refrigerator and electrical devices in the slideout quit working, the search for the short causing the breaker to flip was on. In the end, a failed Molex connector, damaged by moisture, was the culprit. A little creativity restored the “juice.”*

By Bob Livingston

It happened — as is so often the case with an RV — without warning: All of a sudden, the 120-volt AC power went off at the outlets inside the slideout room of my fifth wheel that were powering the refrigerator, TV and other electronic devices. As I discovered, the breaker in the subpanel for the solar inverter was flipped and multiple attempts to reset it failed. A thorough search for the culprit eliminated all the other circuits in the fifth wheel — and resulted in the discovery of a shorted Molex connector under the belly pan out back. These connectors are commonly used to make it convenient to disconnect power to the slideouts, but they can be exposed to moisture and many times are not secured properly.

So, they burn up.

Of course, the failure was while in an RV park located in a small town, precluding us from locating a new Molex connector quickly; it was going to take a few days via Amazon. Rather than wait to restore power — we didn't want to go without our refrigerator and TV — I improvised by purchasing a few elec-

trical parts at a local hardware store. They included a waterproof junction box and strain relief fittings, along with a few wire nuts. Total cost was around \$45; these parts are commonly found in hardware and home improvement stores.

Gaining access to the Molex connectors required opening the edges of the underbelly to locate the failed part. It was immediately obvious that the Molex connector had failed since the wires and plastic casing were blackened from the short. Unfortunately, all these connectors were laying loose on the belly pan, clearly indicating that exposure to moisture created the failure. Molex connectors are convenient to wire and make disconnection a snap, but they are not waterproof.

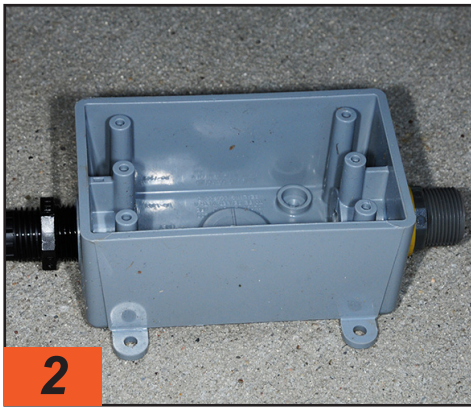
Before attempting the fix, make sure the power to the RV is disconnected; while the breaker in the “Off” position is supposed to shut down power to the circuit, it's best to simply make sure there is no power to the rig. Romex wire was routed from the sub panel in the front storage compartment to the vicini-

ty of the slideout room, and the cable to the slideout receptacles was comprised of three stranded wires. Cables routed to the Molex connector were cut off on both sides to begin the re-wiring.



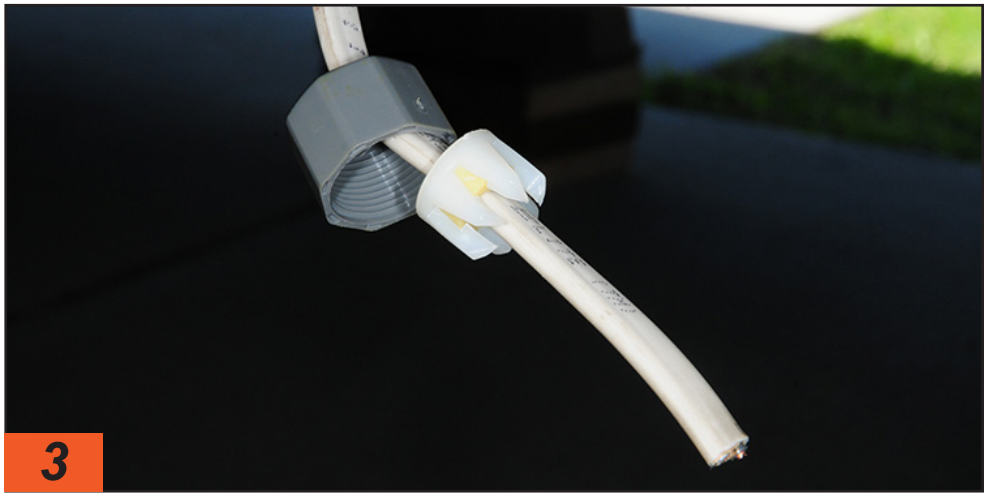
*The Molex fitting that connected the 120-volt AC wires to the slideout room receptacles was shorted due to moisture. This connector was laying on the belly pan floor and damp from recent hard rains and road splashes. While this type of connector is easy to wire and disconnect when service is necessary, it's not waterproof.*





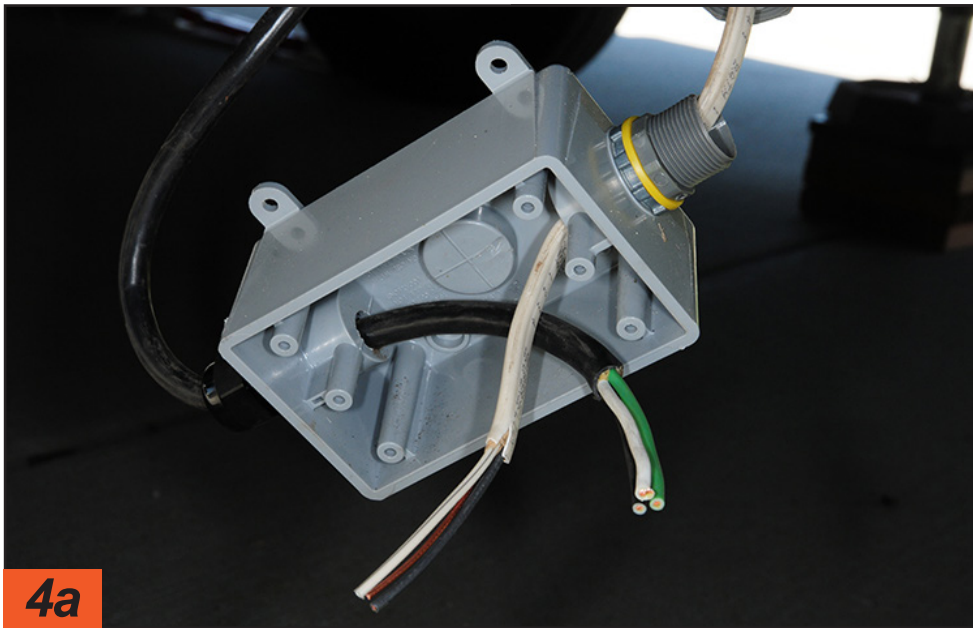
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At the time, a replacement Molex connector was not available locally. We didn't want to wait for an Amazon delivery, so basic electrical parts were purchased from a nearby hardware store. The junction box here is waterproof, as are the cable fittings, which double as strain relief.



3

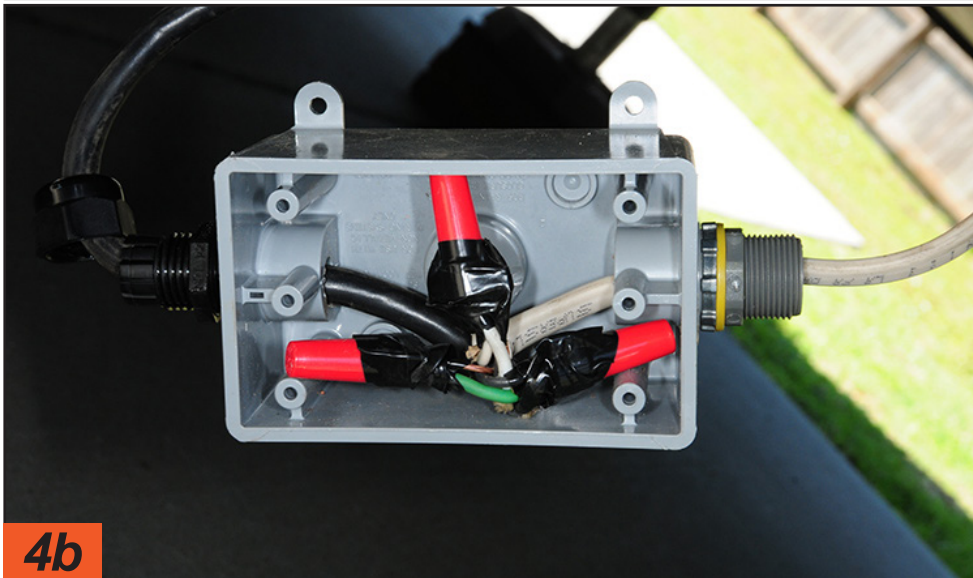
Once the failed Molex connector was cut away from the wires, a nut and ferrule — which provide strain relief — were slid onto each cable. The cable from the slideout room is made from stranded wire, which allows for more flexibility during movement; the cable from the subpanel is Romex.



4a

After installing the waterproof fittings, the wires were routed into the junction box — leaving enough slack to make sure there was room to strip the insulation, twist the color-coded wires together and install the wire nuts. Normally, wire nuts ensure continuity, but we have always wrapped them with high-quality electrical tape for extra insurance. The new junction box was cable-tied securely off the belly pan, which is something you might consider doing for the other Molex connectors in the area while you're in there making the repair.

Granted, it will now take a little longer to disconnect the wiring inside the new junction box should it be necessary to remove the slideout or work on the circuit, but the chances of that are slim — and the wiring is better protected. Once everything was tucked in place, the fifth wheel was connected to the hookup power, the breaker was flipped back on — and we were back in business.



4b

Enough slack was provided inside the junction box to make it easy to strip the insulation and connect the cable leads using wire nuts. As part of our personal routine, we sealed the wire nuts with high-quality electrical tape for another layer of insurance against separation and shorting.



5

Once the wiring was done, the lid for the junction box was attached using two screws and — this time — was cable-tied off the floor of the belly pan. **RVE**



# AN ELECTRIFYING EXPERIENCE



*Not everyone can mimic Thomas Edison, but using this simple guide to diagnosing electrical problems unravels the mystery of how 120-volt AC and 12-volt DC power integrate with the inner workings of an RV.*

By Bill Gehr / Photos by Bob Livingston

Unlike your home, RVs have dual electrical systems: a 12-volt DC (direct current) circuit to operate appliances like the furnace and demand pump and 120-volt AC (alternating current) power to run air-conditioners, washers/dryers and refrigerators,

among others. The network of wiring, connectors and outlets is fairly complicated — and when something goes wrong, chasing down the gremlins can be difficult. That's why most people rely on professional help, but with some understanding of how these systems

work, do-it-yourselfers can fare well when diagnosing and/or repairing electrical issues.

#### **AC or DC**

Electrical systems can be identified via their respective distribution panels.





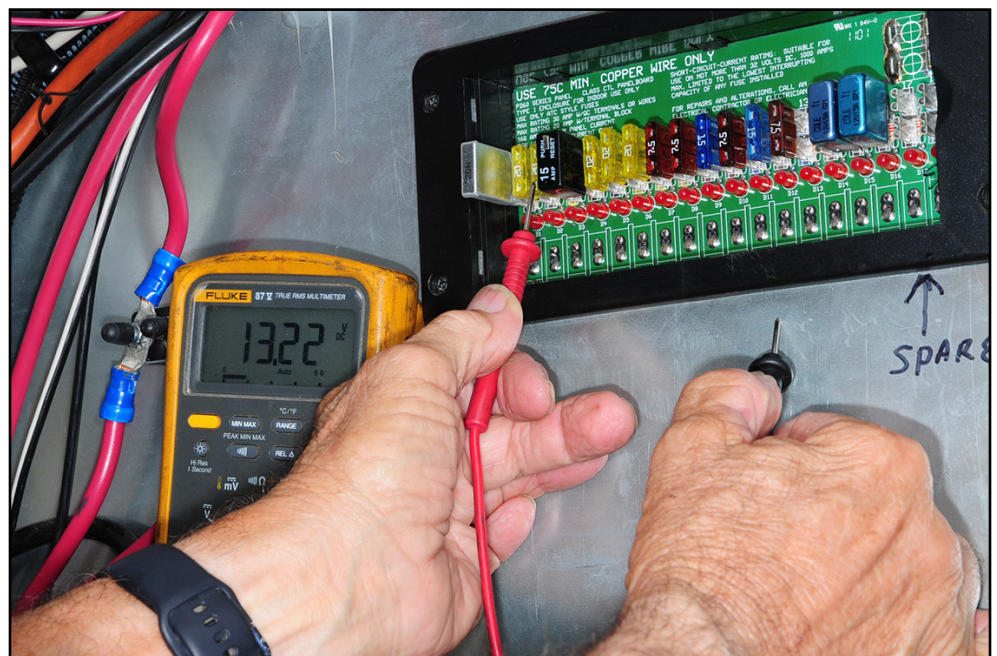
You can identify the 120-volt AC distribution panel by the home-style circuit breakers that snap into a frame. There are a few different styles that are used for this purpose. Circuit breakers wear over time, depending on how often they are tripped. Replacements are easily found in hardware or home supply stores.

If the panel is fitted with home-style breakers, it's feeding the 120-volt AC appliances and accessories and will be labeled accordingly. Those systems tied into a box or panel with fuses or small (push-in) breakers will operate on 12-volt DC power, and should also be marked clearly. One exception is the use of a 12-volt DC-style fuse within a circuit board, even though it's powered by 120-volt AC current.

Direct current travels in a loop from the negative terminal on the battery, through the appliance and back to the positive battery terminal. If the loop is interrupted for one reason or another, the 12-volt DC light or appliance will cease to function. Unlike alternating current, DC current can be affected by corrosion or a bad connection on either the positive or negative side.

Alternating current, on the other hand, travels in a straight line. If, for example, the ground (or copper) wire fails, the appliance or an outlet will most likely continue to function but you'll lose the safety factor. Should the white (common wire) or the black (hot wire) fail, a light or appliance will cease to

function. A multimeter is used to diagnose AC or DC issues, and the process is similar. When testing for 12-volt DC power, you hold the appropriate leads



Panels for the 12-volt DC system can be identified by the push-in fuses or small circuit breakers. Fuses and/or breakers can be tested using a multimeter set for DC power.

on the positive and negative wires/terminals to get a reading; with AC, you will use the meter probes across the black and white wire and they do not need to be polarity-correct while taking a reading with your voltmeter. With a little knowledge on how to use a multimeter correctly, diagnosing can be much easier — and save your camping trip should a problem arise.

### 30- or 50-amp Service

Basic 30-amp AC service in RVs is far less complicated than the 50-amp (technically 100-amp) systems found in larger units. The 30-amp system is just like it sounds, providing a maximum of 30 amps before the breaker trips in the park's pedestal. (This, of course, can be plus or minus 10% and as the breakers get older — primarily due to the fact that most RVers use them wrongly as On-Off switches at the pedestal, which accelerates the effectiveness of the circuit breakers.)

The plug for the 30-amp cable has a three-wire system: two angled blades connected to white (common) and black (hot) wires, while the ground has a round or U-shaped terminal. All 30-amp power cords, extension cords or adapters have the same wiring schematic and configuration. Some owners are tempted to plug their RV power cord into the dryer outlet in their home garage, which shares the same plug configuration. However, in a residential environment this outlet is connected to 240-volt AC power, which will fry all the appliances and accessories in their RV.

One-hundred-amp service (commonly known as 50-amp service in the RV





An amp meter (shown here) or multimeter with a clamp-on induction ring makes it easy to test for low or high amp draw. An adapter can be used in lieu of spreading the wires for testing. The induction clamp can only read one wire.

world) is more complex. The power distribution center on the utility post has two 50-amp breakers with a total capacity of 100 amps that is routed to the RV. This is where it gets a little bit confusing, as some people think that there's 240 volts AC when, in fact, there are two pairs of 120-volt AC power that are out of phase. This means that there are two power leads and only one common wire and one ground. The two power wires, one black and one red, need to be out of phase so that the single white common wire is prevented from being

overloaded. If the system was wired as 240 volts AC, serious appliance/ accessory damage would result. If you need to use a 50- to 30-amp adapter, simply eliminates one of the hot wires, normally the red wire. They do make 30- to 50-amp adapters, which are rarely needed since pedestals in most parks with 50-amp service also have a 30-amp provision.

Before hooking your power cord to the park service, it's good practice to check voltage at the 50- or 30-amp service just to be on the safe side. If



All RVers should carry several power adapters to allow electrical hookup when the pedestal is not equipped with the standard 50- and 30-amp outlets. When these adapters overheat, the prongs can become compromised and will need to be replaced. Always use adapters with pigtails.

using an adapter, check to make sure the terminals have not overheated and started to melt the plastic or rubber. If the terminals are corroded, dirty or black from friction, take the time to clean them with sandpaper so that the brass color is restored.

### Adapting to Available Power

Adapters and power cords can be difficult to plug in and unplug because the terminals need to be very tight to avoid excess heat and melting of the adapter or the power cord end. I suggest using dielectric grease (Permatex 22058 Dielectric Tune-Up Grease on Amazon for \$8.99) to coat the terminals; this is commonly used in the automotive industry for connections under the hood to make them waterproof. Dielectric grease, for example, is also used for spark plug boots so they can be released easily after many miles of heat and dirt build up.

I found that it does not pay to buy cheap electrical adapters because the terminals can be too short and the material used to make the adapter can be inferior, which can lead to overheating problems. Marincos ([marincos.com](http://marincos.com)), for one, makes high-quality power cords, extension cords and adapters. Replacement ends for power cords are also available should your terminals and surrounding casing become damaged. Adapters with pigtails are your best bet.

Another common problem is the end separating from the power cord, thereby exposing the internal wires. Installing a replacement end should be done before you go out on a camping trip to eliminate surprises. When installing these replacement ends making sure that all of the wires are in the correct positions is critical — if you are not sure of the process, leave this job to professionals to avoid electrical malfunctions or, even worse, electrical shock.

### Need an Extension?

Adequate-size extension cords can be very important, especially when pushing them to their rated limit. Ten-gauge wire should be used for 30-amp extension cords while 50-amp cords are typically comprised of 8-gauge wire in order to handle their respective rated loads; do not use a 12-gauge extension cord for 30-amp. When using extension cords, length matters; the longer the extension cord, the more voltage loss. Normally, I do not recommend any more than 25 feet of properly rated extension cord for either 30- or 50-amp service. Voltage loss due to extension cord issues can lead to damaged electrical appliances such as the micro-



wave, air-conditioner or other sensitive components.

### Keeping Informed

It is a good idea to keep a voltmeter, preferably digital, plugged into one of your outlets for a quick glance of what's happening in your AC system — some RVs are equipped an electrical management system (EMS) with a remote readout. The EMS shown on these pages, EMS-LCHW50 from Progressive Industries ([progressiveindustries.net](http://progressiveindustries.net)) is a valuable tool that allows you to track the loads placed on the available hookup power; it comes with a remote monitor. An EMS can protect appliances/accessories from low or high voltage and some models even protect from lightning strikes. It's well worth the money when you consider the damage this can do to your RV appliances. These devices are also available on the aftermarket and can be installed by do-it-yourselfers with electrical experience. Portable surge protectors can also be equipped with readouts to monitor power output.

Another item that I would not be without is a Hughes Autoformer ([hughesautoformers.com](http://hughesautoformers.com)), which also protects your system from low voltage by boosting the voltage to a normal level. The Autoformer comes in either 30-amp or 50-amp capacities. The Autoformer provides several functions beyond boosting power: it protects the system from power surges resulting from electrical storms or faulty hookup power, and it has an onboard diagnostics feature to help solve common voltage variation problems. Low voltage can damage air-conditioners, leading to compressor overheating, which can shorten service life. Normally, air-conditioners can function on the low side at around



*Marinco, a supplier of electrical components to the marine industry, offers high-quality adapters that last a long time under harsh conditions. Shown is a 50-amp plug that goes into the RV's receptacle and has a 30-amp female connector on the other end. Employing this adapter makes it possible to use a 30-amp power cord rather than lugging the 50-amp version when only 30-amp service is available.*

106 to 109 volts AC, depending on the make and model. This is where the readout from either an EMS or voltmeter plugged into an outlet can help you.

### On a Pedestal

Using a handheld voltmeter (multimeter) will allow you to test the power at the park's pedestal, the circuit breakers, ground fault circuit interrupters (GFCI) and circuits that may or may not be overloaded. Use your voltmeter to test the static voltage before plugging into and loading the park's service. If the voltage is too low from the outset, it's only going to get worse when you

plug in and start to add heavy loads. Always discuss problems with the park manager and ask for a site relocation if the pedestal cannot be repaired in a timely manner.

There are dozens of handheld volt/ohm meters on the market. While you should refrain from using a cheap multimeter, it's also not necessary to buy an expensive Fluke meter (commonly used by professional electricians and auto mechanics). A multimeter with a clamp-on induction DC-voltage capability is most versatile for RVers. One thing that's quite handy is the ability to read resistance or ohms when testing wire or terminal continuity; most have audible tones to help with diagnosing continuity. You should be able to find a decent meter for around \$40 or \$50.

Polarity can also be an issue with park power — and some appliances/accessories may not be resistant to reverse polarity and lead to failure/damage. Unfortunately, voltmeters will not diagnose reverse polarity. Your best bet is to use a simple plug-in device,



*A 50- to 30-amp adapter is one of the most commonly used pigtails among RVers who have 50-amp service. There are many situations when only 30-amp service is provided.*



like the Bastex Socket Tester (available on Amazon for \$8.99) that will show whether polarity is correct, if one of the power legs is dead and provide other pertinent information depending on the model of the device. I recommend plugging this device into a wall outlet and leaving it there permanently, making it easy to check every time you hook up — or want to monitor at a glance.

### Who's at Fault?

It's not uncommon for an RV to have ground-fault circuit interrupter (GFCI) problems and sometimes these safety devices — which can be located in obscure places — can trip and interrupt two or three other outlets, including the refrigerator and/or power converter. GFCI outlets should be tested and reset periodically. The basic reason for this is to make sure that they will prevent electrocution when using appliances around water or moisture. These safety devices are more susceptible to failure if they've been tripped several times. GFCI outlets come in 15-amp or 20-amp versions, so make sure that you get the proper model and type for your particular application if replacement should be necessary.

If a GFCI needs replacement, pay close attention to the Load and Line terminals; if they are wired backwards, the GFCI will not function. It is not uncommon for RVs to also have a GFCI in the power distribution panel along with the other breakers, as well as one in the wall in the galley area and/or the bathroom. It's never a good idea to replace a GFCI with a standard outlet.

### Distributing the Power

Power distribution panels are often overlooked and can become dangerous if they become cluttered with heavy lint, pet hair and/or a huge amount of dust. Every circuit breaker has a black (hot) wire attached via a clamp with a screw at the bottom of the breaker. Depending on the installation of the breaker, the wires can come loose and, with enough amperage, they'll build a lot of heat — which will melt the insulation around the black wire and burn the wire itself, causing a poor connection. It's good practice after the first couple of years of ownership to remove the cover to the distribution panel annually (after making sure that the power is disconnected) and check the screws that clamp the black wires in place. While you're there, check all the set screws that keep the white (common) and the copper (ground) wires in place; these can come loose and create a poor connection, which can result in high heat and



*Over time the molded ends of the power cord can pull apart and fail due to water intrusion or wire separation. Replacement ends are available online and at some RV supply stores and can be easily installed.*

consequential failure of appliances and/or accessories.

Rigs that have a large inverter (2,000 watts or more) typically require the use of a subpanel with breakers for the appliances that are powered by the inverter. These subpanels are usually close to the main distribution panels and the breakers should also be inspected annually. The inverter often has its own GFCI, which can cause service interruptions. Get familiar with the rather large inline fuse, which should be close to the battery bank — the closer to the

battery the more effective the fuse in providing a safety cut-off

Most inverters have controls built into the housing that can be used in case the remote panel ceases to function for some reason or another. Periodically test the voltage coming from the inverter supplying the RV to check for high or low voltage. This is where an accurate voltmeter is useful, because only two or three volts can make a big difference. Use caution when testing and working on an inverter; they supply household voltage, which can result



*Adapter ends can be difficult to pull apart from the power cord or pedestal outlet. Coating the prongs with dielectric grease not only protects against corrosion but makes it easier to plug and unplug.*





Power cords that are connected to the side of the RV need some type of strain relief to prevent premature failure. Here, a bungee cord is attached to the slide-out frame and does a good job of reducing strain.

in a shock. When troubleshooting the inverter with a voltmeter, be sure to check battery voltage when the inverter is in the On position and powering an appliance; check the owner's manual for the parameters for high and low voltage — low voltage generally will cause the inverter to shut down. If that's the case, leave the inverter segment off while charging the batteries.

Inverters have come a long way from the old days when they were only capable of producing a modified sine wave. Computers and sensitive electronics require the use of true sine wave power (similar to household power), which is now provided in RVs. Troubleshooting an inverter can be extremely complicated; some remote panels will give you an idea of performance using codes that can be deciphered and cross-referenced with repair guides. Other than testing to determine whether it has the proper 12-volt DC input, it's going to be very difficult to troubleshoot issues without a background in the inner workings of an inverter. If the inverter has the proper input voltage and fails to provide power, consult the owner's manual for the reset procedure. If the inverter refuses to come on, try disconnecting it from the battery for 30 minutes to see if it will reset.

### Let's Be Direct

The 12-volt DC system in your RV is necessary to operate appliances like the furnace, demand pump and, in most cases, the refrigerator. Armed with a multimeter, you can diagnose

battery-power problems — and if you have clamp-on induction feature on the multimeter, you can check loads at any time. You can also purchase stand-alone amp meters that can be mounted in a cabinet or in a compartment for monitoring current draw. These meters can be quite handy if you do a lot of boondocking. While you're checking the amperage draw from various appliances and components, keep a log to become familiar with battery performance. Make sure the terminals on open-cell batteries are clean and use a protectant to control corrosion. (This, of course, is becoming an extinct service proce-

sure as more owners embrace lithium battery banks.) If you need to replace fuses or 12-volt DC breakers, make sure to use high-quality parts to avoid problems down the road.

### A Clean Trailer Connection

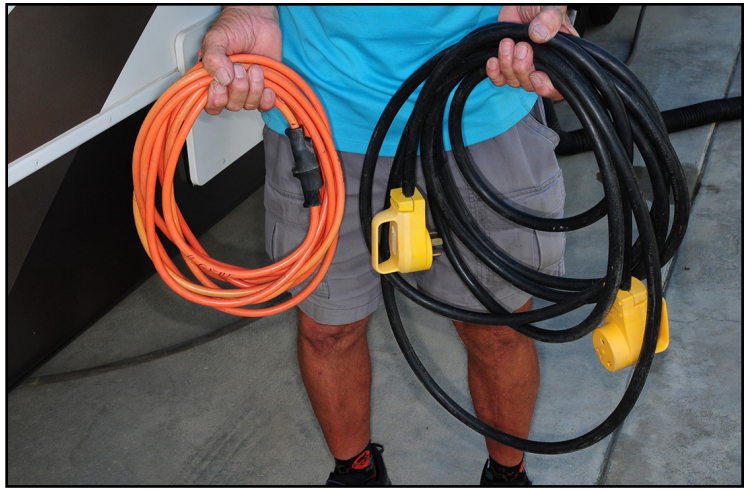
Last, but not least, let's zero in on the 7-way power cord between the tow vehicle and trailer or motorhome and dinghy vehicle. Wires for the clearance lights, taillights, a good ground, electric brake controller and a positive charge line all run through a self-contained cable attached to the trailer/dinghy with blade connectors that easily plug into respective receptacles. Almost all towables and many motorhomes are equipped with a Bargman (or similar style) 7-way connector. Fortunately, they all use the same wiring schematic, which can help immensely when trying to troubleshoot a problem on either end of the cable. These connectors can build up a layer of corrosion, which will impact continuity. Clean these terminals on both ends with a small brass brush, followed by a coating of a continuity improver product like DeoxIT D100L (\$25.99 on Amazon).

Most electrical problems can be easily diagnosed with the use of a good multimeter. Chasing down line breaks and terminal failure takes some time, but is not insurmountable to most owners with basic mechanical skills. Staying abreast of input and output voltages throughout your RV can result in early detection and timely repairs. As always, however, don't be shy about consulting with professional help if issues are beyond your competence level.



Looking for a better connection? The Smart Plug power cord system ([www.technorv.com](http://www.technorv.com)) is one of the best in the business. It uses a completely different plug and receptacle and improves continuity without arcing. Kits to replace the ends of your existing power cord are available in 50- and 30-amp versions.

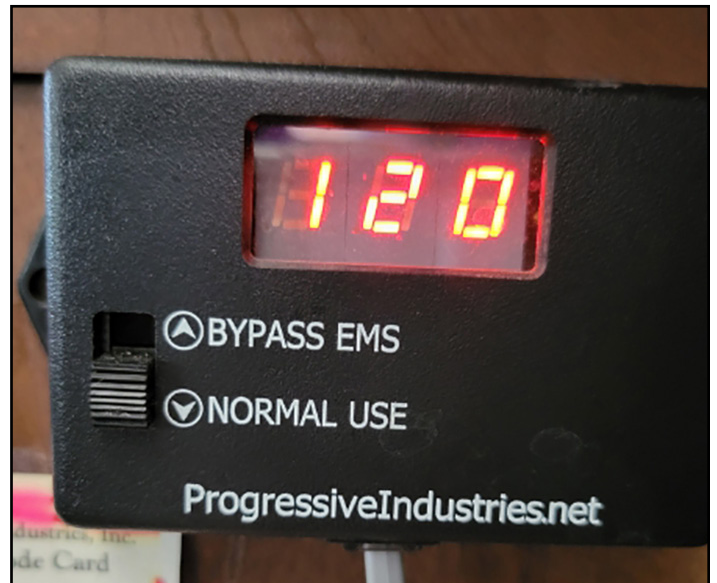




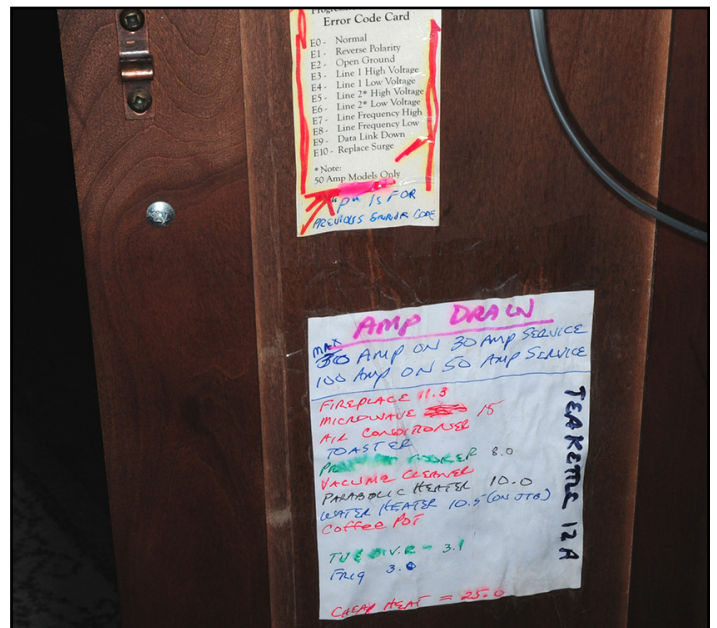
If you're going to use an extension cord for connecting to the RV park pedestal, make sure it's matched with the rig's service. Using an under-rated extension cord can create excess heat and reduce input voltage. Never use lightweight, hardware-store-grade extension cords.



While it's not necessary to buy a professional-grade Fluke multimeter (shown on left), you don't want to go to the other extreme with a cheap counterpart. It's possible to find good multimeters in the \$40-50 price range.



Multimeters cannot check polarity, but this inexpensive plug-in device (Amazon has many, starting at just \$8.99) will show polarity and whether there's an open circuit. Keep this meter plugged in at a convenient location to provide information at a glance.



An energy management system (EMS) allows you to track voltage and amperage. That way you can monitor whether you are near the limit or exceeding the input power. A remote monitor makes it easy to check conditions frequently. Unless you have a great memory, write down the amp draw for your appliances and keep the log near the EMS monitor.





Many portable surge protectors provide information on power conditions at the hookup pedestal. This device from Surge Guard monitors power condition while protecting against voltage variations from lightning and brownouts.

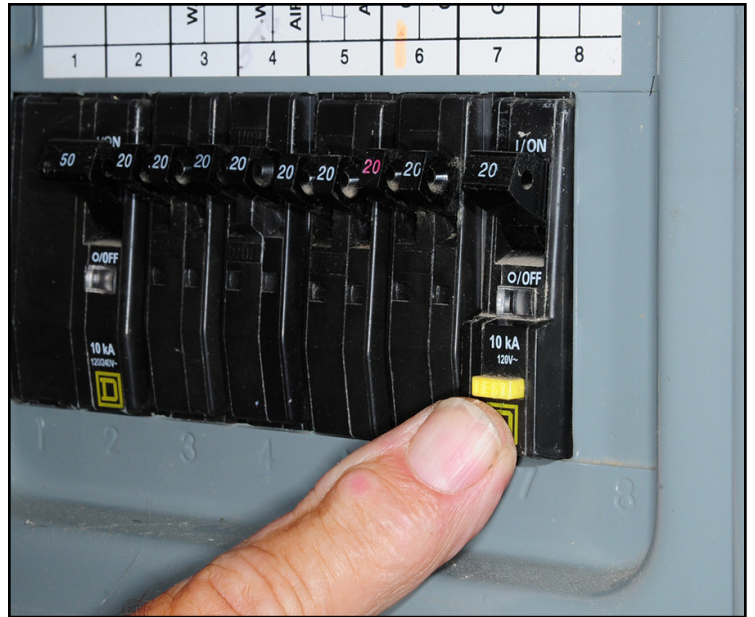


The Hughes Autoformer boosts low voltage conditions at the pedestal. In some cases, it can make the difference on whether or not you can run the air-conditioner in parks with unstable power. This model has been installed in a storage compartment, but the company also offers portable versions, along with high-quality surge protectors.

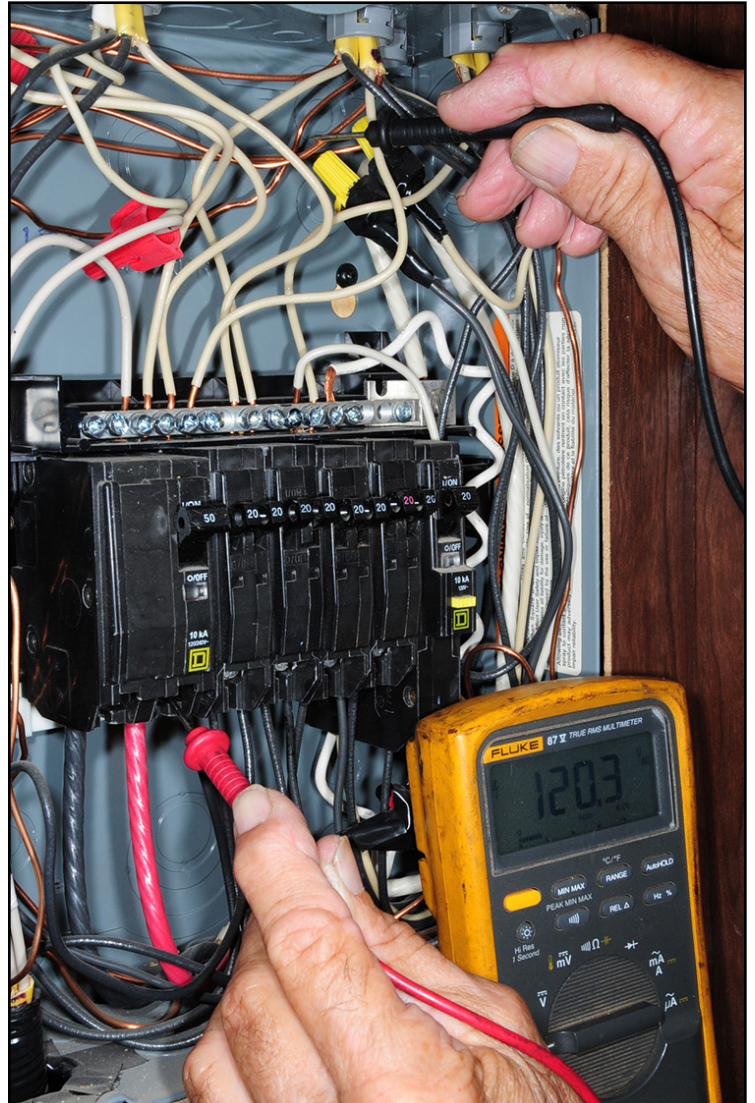


Modern electrical pedestals at RV parks are often equipped with 50-, 30- and 20-amp outlets. A multimeter can be used to check voltage before plugging in the power cord. To test voltage in a 50-amp outlet (shown) put the probes in the common (bottom slot) and one of the two power slots (left or right); the top slot is ground.





Testing the viability of the GFCI outlet should be done periodically. Push the Test button, which will produce an audible click (some have indicator lights); then push the Reset button. If the Reset button does not function, the GFCI outlet needs to be replaced. The GFCI is designed to trip if moisture is present and must be used in kitchens, bathrooms, for exterior outlets and the refrigerator. Some manufacturers install a GFCI in the power distribution panel.



If you need to check the 120-volt AC circuit breakers, remove the front cover from the distribution panel. Using a multimeter, touch the white wire with one probe and the black wire leading to the circuit breaker with the other. If the breaker is defective, it will not read full voltage (or the voltage coming into the RV from the hookup pedestal).





*RVs equipped with larger inverters (usually 2,000 watts and higher) will have subpanel with additional breakers mounted near the main distribution panel. Sometimes owners forget about this panel and are dumfounded when diagnosing an electrical outage.*



*Direct current (12-volt DC) powers most of the lights, the furnace, demand pump and refrigerator control module, to name a few items. The light fixture here was erratic so the power was checked with a multimeter. There was plenty of power to the fixture, so the light failed.*



*A multimeter is one of the most versatile tools for diagnosing electrical problems. Any 12-volt DC outlet can be checked using the probes correctly. Make sure the probe touching the center contact does not accidentally touch the ground side of the socket or the fuse will blow.*



*If you suspect a problem with the batteries, the multimeter can be used to probe the terminals for proper voltage. This is where the testing normally begins when low voltage impacts appliance/accessory performance.*



*The 7-way Bargman plug from the trailer or dinghy vehicle should be checked for corrosion build-up on the terminals. Start here if the lights and brakes fail to operate properly. Terminals can be cleaned with a brass brush and should be treated with dielectric grease or product that improves continuity, like DeoxIT D100L. **RVE***



# HOT SKIN



*A certain amount of stray voltage on the exterior of your RV is normal, but anything in excess of 30 or 40 volts is potentially life-threatening to anyone that comes in contact with it.*

By Mike Sokol

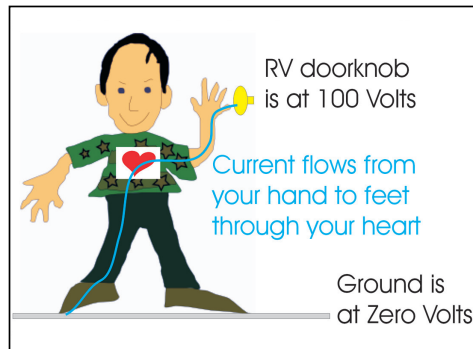
Those of you who are seasoned veterans of camping have likely encountered “hot skin” situations a few times over the years. New RV owners, however, may be surprised and alarmed the first time they touch the side of their RV while standing on the ground and feel a shock. Is this normal? Can it possibly be dangerous?

No, it's definitely *not* normal. And yes, it *can* be dangerous under certain conditions and circumstances. But first, let's get a few definitions out of the way.

### What is “Hot Skin”?

There's really no formal definition of a hot-skin voltage in the National Electrical Code (NEC). In fact, the phrase “hot skin” is unique to the RV industry. In nearly all other industries and trades it is called a “contact voltage” or “stray voltage.” However, I'll stick with the term “hot skin” since that's what the RV

industry has been calling it as far back as the 1960s.



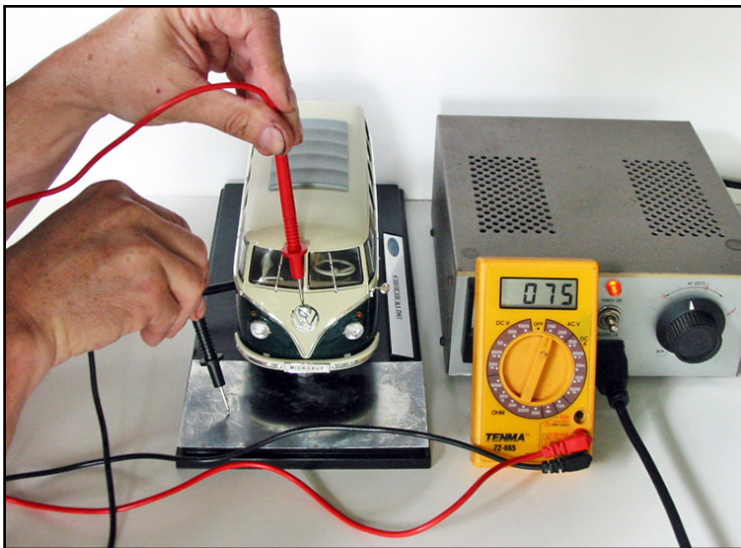
*Hot-skin voltage can be dangerous if you touch the metal exterior of an RV while standing on the wet ground. A ground-fault current can pass through your heart and put it into ventricular fibrillation, stopping the heart's pumping action. If you don't receive immediate medical care (using a defibrillator, now called an “AED”) you could die in minutes.*

RV hot-skin voltage is defined as, “a significant voltage potential between the chassis/skin of the RV and earth ground.” Understand that there can be normal electrical potential of up to 5 volts between the RV chassis and earth, which is caused by the power company, but that's not what I'm describing here. I consider a hot-skin condition to be any voltage potential over 10 volts AC between the RV chassis and earth ground, with any voltages around 30 to 40 volts being potentially dangerous depending on the condition of your heart and how long you're in contact with it. And it's certainly possible to have up to 120 volts AC on an RV skin/chassis, which can definitely be deadly under certain conditions.

### What causes a Hot-Skin Voltage?

Glad you asked. There needs to be two conditions for a hot-skin voltage to





To find the actual hot-skin voltage, you can use a digital multimeter to measure between a metal part of the RV (such as the hitch or wheel lugs) and earth ground. That's most easily accomplished by using a screwdriver stuck into the wet dirt.

occur: First is a poor or missing ground connection between your RV and the service panel's ground-bonding point. That means that your RV and all of its shore power cords, adapters, extensions and whatever it's plugged into (such as the campground pedestal) need to be properly grounded (specifically called "bonded" by the NEC). If your RV is properly grounded to the campground or home service panel's



Many campground owners perform little or no maintenance on their pedestals, resulting in poor electrical connections that can melt the shore power cord or create a hot-skin condition. Note that this one has eliminated the circuit breakers, a clear violation of the National Electrical Code (NEC).

### Dangerous?

If you feel a tingle while touching any part of your RV, there's likely at least 20 or 30 volts AC of hot-skin voltage on everything metal — not only is the skin of the RV electrically energized on aluminum-sided models, but the RV chassis is energized as well, along with the wheels, trailer hitch, propane tank/cylinders and even your tow vehicle. That's because virtually everything metal in and on the RV is tied (or bonded) together. If you have 40 volts on the RV skin, you'll have the exact same 40 volts everywhere else.

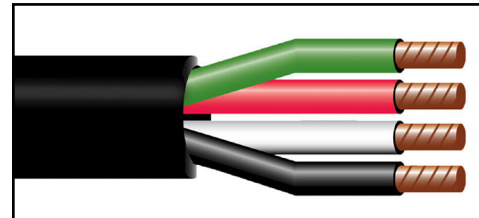
The danger comes when a human body gets between earth ground (standing on the damp dirt, lawn or concrete) and touching anything metal on the RV (such as the steps, door handle, metal skin or bumper). Even the lug nuts on the wheels and the wheels themselves can be dangerous if you touch them while they're energized and you're standing on the ground.

If you touch any of these energized parts with your hands or other body part while standing on the ground, there's a fault current that will pass through your body on the way to ground — and right in the middle of your body is your heart. Depending on your age and fortitude, as little as 10 mA (milli-amperes or 0.010 amperes) of current passing through you can

bonding point, it should be impossible for your RV to develop more than 5 volts between it and earth ground.

Second, you have a source of a ground-fault current, which can turn into a hot-skin voltage since it's not drained away by the ground wire. Please be aware that a ground rod really doesn't "ground" an RV (more on that later).

### Why is This



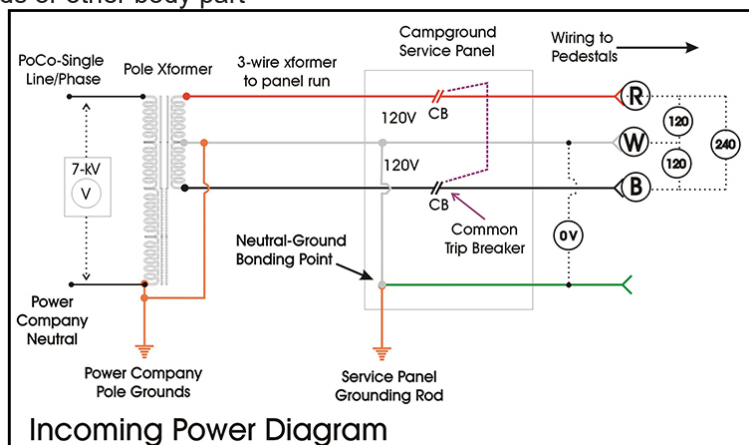
In your RV or shore power cord wiring, green-insulated or bare-copper conductors are always designated as the Equipment Grounding Conductor (EGC), commonly called the "safety ground" or even just the "ground". Note that this may not be connected to actual earth ground at all when running on an AC generator or inverter power.

put your heart into fibrillation. If this happens and you don't receive medical attention in a few minutes, you'll likely die from this hot-skin shock.

### Normal or Dangerous Hot-skin Voltage

If you measure a small voltage potential between earth ground and the chassis ground of the RV (in the range of 3 to 5 volts), that can be caused by the power company's unbalanced 3-phase power lines feeding the service panel. This can be annoying but it's not really dangerous to human life.

However, if you're measuring 30 to 40 volts — with up to 120 volts AC possible between the RV skin/chassis and earth — then there's definitely a broken or loose connection somewhere in the RV's electrical grounding system between the RV chassis and the service panel's ground-bonding point. In many cases, this can be as simple as a missing ground lug on an extension cord or a worn-out pedestal outlet in a campground that's too corroded to make a good connection. The campground pedestal in the accompanying example was so worn the park operator had to use a bungee cord to keep the surge protector from falling out of the outlet. Note, too, the lack of circuit breakers —



Incoming Power Diagram  
Campground power distribution





RV converters can have up to 3mA (3 milliamps or 0.003 amperes) of leakage current to chassis ground and still pass UL listing requirements. This leakage is typically due to the noise filter capacitors on the 120-volt AC line input used to prevent electrical RF noise from feeding back in the electrical grid. That's an FCC requirement to avoid radio interference.

another big code violation.

The green or bare-copper ground wire in a shore power connection is so important because it's the safety ground (technically called the Equipment Grounding Conductor or EGC). Its primary job is to drain away any ground-fault currents to keep them from turning into hot-skin voltages that can shock you. Obviously, any situation

as at least one (and possibly two) eight-foot-deep grounding rods.

Ground rods are probably not what you think they are. The job of the grounding rod is not to "ground" the RV. In fact, the earth itself is a pretty poor ground, believe it or not. Ground rods are there to direct any lightning strikes deep into the earth before they can take secondary paths through your home or RV wiring.

with a missing or corroded safety ground connection is always dangerous.

### Making the Connection

The EGC conductor extends from the bonding point inside the RV's power panel, though the shore power cord, dog-bone adapter, camp-site pedestal outlet and all the way back to the campground's service panel. There, it's "bonded" to the neutral conductor of the transformer from the power company as well

So, a ground rod by itself will not "ground" the RV; that's the job of the safety ground wire (EGC).

Fault currents come from nearly everything you plug into power. Anything that's plugged into an electrical outlet will leak at least a little fault current to the chassis. But UL (and other code-making bodies) limit the allowable amount of leakage current to below the threshold of what a person can normally feel, which is typically around 1 mA (milliamps or 0.001 amperes) of current. When the

available leakage current gets above 5 mA, that's what trips a GFCI. But that's another entire article.

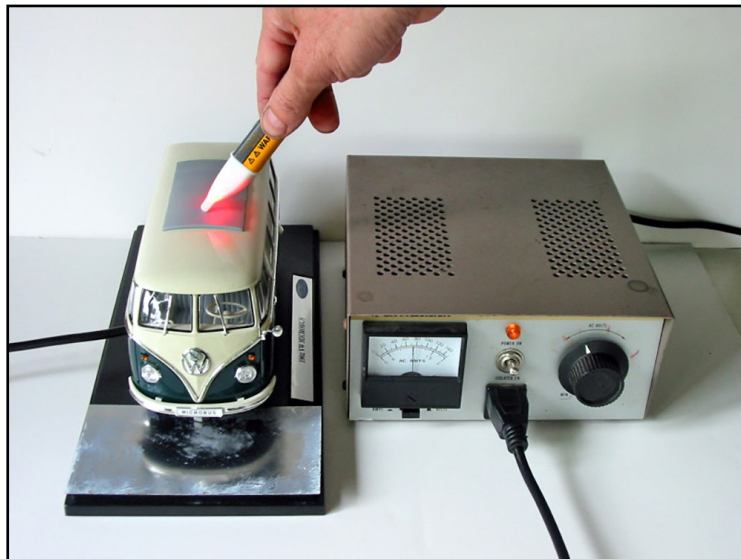
Larger ground-fault currents can also occur in an RV. For the most part, the prime suspects are often the 120-volt AC noise filter capacitors in the RV converter/charger (up to 3 mA), a corroded-through electric water element (up to 2 amperes) or even a dead short circuit between a conductor and the chassis of the RV (up to 20 amperes) which can be caused by something like a screw or nail piercing a wire inside of a wall.

### How Do You Measure for Hot-skin Voltage?

The "gold standard" method to test for hot-skin voltage is to drive a short ground rod into the damp dirt — a 12-inch-long screwdriver will do — and measure between the metal screwdriver shaft and a bare metal spot on the RV chassis. If you measure up to 5



These are the four different non-contact voltage testers that I use in my demonstrations, manufactured by Amprobe, Southwire, Klein and Fluke. All of these will beep, blink or buzz reliably when touching an RV with at least 40 volts of hot-skin potential.



You should grasp a non-contact voltage tester (NCVT) firmly in your hand because it needs to capacitively couple to you as its ground-plane reference. Always test a NCVT first on a live circuit such as the pedestal outlet to make sure its batteries are still good and it is operating correctly. These are safe to make contact with electrified objects up to 1,000 volts, so there's no possibility of getting shocked. Even on my scale model of a VW micro-bus, a NCVT will beep from several inches away from a 120-volt AC hot-skin condition. On a full-size RV this distance is typically more than one foot, with up to two feet being possible.

volts AC with a digital meter, there may not be anything wrong at all — but if you find in excess of 10 volts AC with this measurement, then there's definitely some kind of failure in the RV's safety ground connection (the EGC in code language).

That said, there's an easier way to test for hot-skin voltage, which I developed and pioneered with the late Gary Bunzer more than 10 years ago — and I've found it to still be the quickest and safest way to test for a hot-skin voltage of 30 to 40 volts (where it begins to become really dangerous). A product called a Non-Contact Voltage Tester (NCVT) or Tik-Tester (electrician slang), available from any big-box store, will beep if you get close to an RV skin (or



## Did You Know?

*Did you know that many, if not most, hot-skin incidents happen when an RV is plugged into an improperly wired or maintained home outlet? If you are plugging your RV in at home, invest in an RV connection box (30AMP / 50AMP / 50/30/20AMP) and have it installed by a licensed electrician.*

chassis) that's energized with at least 30 volts. Remember to always check any NCVT on a known-energized electric source like a pedestal outlet first to confirm that it's actually working and hasn't failed from a dead battery.

In fact, if your RV has a hot-skin potential of 60 to 80 volts it will typically beep from several inches away — and if your RV has a hot-skin potential of 120 volts AC, it will usually beep from one to two feet away. That should get your attention.

Here's a basic testing sequence to help determine what is causing hot-skin voltage:

- If you feel the slightest tingle or shock from your RV while standing on the dirt and touching it in any way, immediately power off the pedestal and unplug from shore power.

- Get out your NCVT and test it on a known hot-power source. Turning the pedestal breakers back on and placing the tip of the NCVT in the hot contact will suffice for this.

- Turn off the pedestal circuit breakers, plug in your shore power cord and then test the RV for a hot-skin voltage using the NCVT on normal sensitivity (90 to 1,000 volts). If the NCVT beeps only when making contact with the



*Never cut off the ground pin of an extension cord, and never use a cord with a missing ground pin.*

RV steps, hitch or skin, then you likely have around 40 volts of hot skin. If it beeps from 6 inches away, then you likely have around 80 volts of hot-skin potential. And if it beeps from 2 feet away, then your RV likely has around 120 volts of hot skin.

- Power down the pedestal circuit breaker and retest for hot-skin voltage. If the NCVT doesn't beep, then the source of the current and voltage is your own RV. If the NCVT continues to beep, then the source of the hot-skin voltage is the campground grounding system, something I call a reflected hot-skin voltage.

- If you have a dual-range NCVT, repeat the test at the 12-volt AC setting. If it beeps when in 12-volt AC mode but not in the standard 90- to 1,000-volt mode, then you have a hot-skin voltage between 10 and 30 volts. This is still potentially dangerous since anything more than about 5 volts above earth ground potential indicates loss of your RV's safety ground wire (EGC, or Equipment Grounding Conductor) back to the campground service panel ground/bonding point.

- The next test is sticking a long screwdriver (12 inches or so) into the dirt beside your RV and wetting the dirt with a gallon of water if it's very dry. Now use the AC scale on a digital multimeter to measure the voltage between bare metal of the RV (a lug nut works great) and the screwdriver metal shaft



*A modern Class-A GFCI outlet is designed to trip with a fault current over 5 mA. It's a good test of normal leakage currents in your RV's electrical system.*

in the dirt. With a properly grounded RV, this should measure below 5 volts. However, it could measure between 10 and 120 volts AC, which indicates a lost ground connection as well as a source of ground fault current. This suggests you can easily develop a dangerous amount of hot-skin voltage.

- Most hot-skin voltages occur due to a break in the RV's shore power connection, which can be traced to a lost ground contact in an extension cord, dog-bone adapter or shore-power cord itself. Physically inspect all cords and

adapter for intact ground pins. You can also measure them for continuity (when disconnected from your RV) using the ohms/continuity setting on any digital multimeter. A surprising number of RV hot-skin conditions are caused by using an extension cord with a broken off ground-pin. Never use this on your RV as it can create a very dangerous hot-skin voltage condition.

- If you find any damage to the shore power connection, replace the broken hardware and test again. If it now shows the voltage has returned to less than 5 volts, your ground connection is secure. But, you could still have a mid-current ground fault source.

- Test for a ground-fault current over 5 mA by using a dogbone adapter to plug the RV into a GFCI receptacle. If it doesn't trip the GFCI, then you likely have normal ground fault leakages of under 5 mA. If it does trip the GFCI outlet, then you have a medium-current ground fault source, most likely a corroded or melted water heater element that should be replaced immediately. If plugging in trips the 20-amp circuit breaker, then you have a high-current ground-fault in your RV, likely caused by a pinched wire or a nail, screw or staple that has pierced the wire insulation.

### What to Do if You Find a Hot-Skin Voltage

Well, don't leave your RV plugged into power and hope for it to go away. You need to unplug from shore power immediately until you or the campground operator locates the source of the voltage and repairs it.

You may feel a stronger tingle if the dirt is wet — and it may even seem to go away when the dirt dries out — but that usually doesn't mean that the hot-skin voltage has magically disappeared. What probably has occurred it is that you're now in dry shoes standing on dry ground, so there's so little current passing through your hand that you can't even feel it as a shock. But the hot-skin voltage — and the potential fault current causing it — in all likelihood has not gone away. It's probably just disguised by the dry dirt. The next time it rains, the real danger lurks if anyone touches any metal part of the RV while standing in a puddle outside.

Above all, if you suspect that you are experiencing a hot skin condition, unplug the RV from shore power and either diagnose the issue yourself or arrange for a professional to help you as soon as possible.

The good news? Even if you find a hot-skin condition, it can be rectified!



# Where Does This Voltage Come from?

All electrical appliances plugged into a wall outlet have some current leakage between the incoming line power and their own chassis. All “double-insulated” appliances (including cell phone chargers, slow cookers and double-insulated power tools) will have an ungrounded, two-prong plug and be almost completely isolated from the line voltage (more or less). According to NEC and UL standards, an appliance with a non-grounded plug must have less than 0.75 mA (milliamps) of line-to-chassis leakage current. Let’s call this a Very-Low Current Leakage.



This is a typical NEMA 5-15P plug with the ground pin intact. The purpose of the ground pin is to drain away any fault currents, which prevents them from becoming a hot-skin voltage.

Other appliances with a grounded, three-prong plug may have line-to-chassis leakage currents of up to 3.5 mA (milliamps) and still be within NEC and UL guidelines. Let’s call this a Low Current Leakage. The round prong or pin on the 120-volt AC plug is the “safety ground contact” which must have a low-resistance (impedance) path back to the service panels G-N-E (Ground-Neutral-Earth) bonding point to be effective.

An appliance with a partial-shorting failure (such as a hot-water tank with a break in its hermetically sealed electric element) will leak 1 to 2 amperes of fault current from the AC line to the water supply (and your RV chassis). Let’s call this a Mid-Leakage Current.

An appliance or wiring box with a dead short between the line and the chassis (such as a pinched wire or a screw driven into the wall, which penetrates the wiring insulation), can provide full circuit breaker current between the line and the chassis, up to



It’s pretty easy to drive a nail or screw through a wire inside of a wall, and this can cause a high-current ground fault.

20 amperes. Let’s call this High-Leakage Current.

If that appliance chassis is bonded (connected) to the RV’s safety ground with a proper low-resistance (also called impedance) connection, and the RV’s safety ground (and chassis) is properly bonded to the G-N-E connection back at the entrance service panel, then all of the above fault currents will be returned back to the service panel (and the transformer on the pole) and be rendered harmless. Note that these fault currents do not return to the earth beneath your feet through the ground rod. A service panel ground rod’s job is to protect the system from lightning strikes and help maintain the local ground plane’s voltage close to earth potential.

What does this all mean in the real world?

The Very Low (0.75 mA) and Low (3.5 mA) Leakage currents will be easily drained away without you even knowing about it, probably without

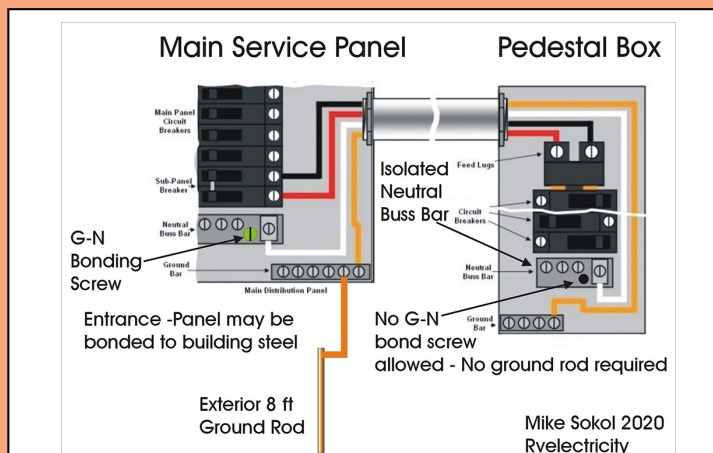
even tripping a GFCI you should be plugged into. These ground fault currents are all within UL and NEC allowed leakage values and are quite normal.

The Mid Leakage Currents (think water heater failure) would certainly be more than enough to trip a 5 mA GFCI breaker, but not enough to trip any 15- or 20-amp circuit breaker or fuse. However, you will still not have any hot-skin voltage as long as the low-resistance safety ground path back to the service panel is intact.

A High-Current Ground Fault (20+ amps) should trip any circuit breaker instantly by returning the fault currents back to the service panel’s G-N-E bonding point. A properly grounded RV will not develop a hot-skin under this failure condition since these High-Current faults should still be drained to the service panel’s G-N-E bonding point, thus tripping the circuit breaker.

So, while the potential for hot skin exists, there are numerous safety systems in place to circumvent it. You’ll notice there are two common points in all of the above scenarios: First, a proper (low-resistance) safety ground path between the chassis of the RV and the Service Panel’s G-N-E bonding point will not allow any dangerous hot-skin voltages to develop on your RV. So if you do have a hot-skin voltage situation, the low-resistance safety ground path has failed.

Secondly, the ground rod really has nothing to do with getting rid of these ground-fault currents. A ground rod connected to your RV or the campground’s power pedestal will not provide a low-resistance ground fault path and will allow hot-skin voltages to exist on your RV. And simply lowering the leveling jacks on the dirt definitely will not ground an RV. RVE



This graph shows that there should be only one neutral-ground bonding point in an electrical service, which would be in the campground service panel. The ground wire of your RV’s shore power connector should have less than 1 ohm resistance to this point. Note that a grounding rod really doesn’t “ground” the RV. The service panel “bond” is what creates the path to get rid of ground fault currents safely and not allow a hot-skin voltage to develop on the RV skin and chassis.



# WAY Celebrates Grand Opening of 800,000-Square-Foot Headquarters



Growing a successful business is never easy. In the case of WAY, a product distributor to both the RV manufacturing industry and the aftermarket, it meant opening up a number of separate facilities in and around Elkhart, Indiana — a situation that spoke well of the company's prowess, but made things tough logistically.

That's now changed. WAY recently held a ribbon-cutting ceremony to celebrate the grand opening of the company's newest facility — a whopping 800,000-square-foot location that will house the company's corporate headquarters, warehouse operations, a 6,000-square-foot showroom and a product testing and development center.

It's difficult to put into context just how big WAY's new headquarters is, but consider this: Almost 14 football fields would fit under its roof. It takes a full five minutes to ride a scooter around the perimeter. A drone needs to climb 1,000 feet just to be able to take a photo of the entire facility.

Chris Greer, WAY's vice president of operations and product development, said the company is in the process of consolidating its 6,000-plus SKUs from its five warehouse locations in northern Indiana and southwest Michigan, totaling a combined 400,000 square feet, into the new 800,000-square-foot building — and it will take 1,500 semi-tractor loads to do so.

though, is not without its drawbacks; owners are essentially left in the dark about how their valued possession is being treated until its return.

Now Zubie — a leading connected vehicle and telematics provider — has collaborated with Outdoorsy, one of the largest players in the online peer-to-peer RV and campervan rental marketplace, to enable RV owners the ability to track the location, driving speed and maintenance status of their assets while being rented by the burgeoning population of outdoor travelers.

RV owners who list their RV on Outdoorsy will have access to Zubie's intuitive tracking devices, including Asset Track, a multi-unit tracking system for vehicle owners wanting a more unified alternative to a straightforward GPS tracking solution. The system, said Zubie's Chief Revenue Officer, Mark Novak, provides "improved visibility into the safe and smooth operation of these drivable and towable vehicles," giving owners peace of mind that their investment is being rented and used as it should.

For more details on the Zubie integration, or to see how much you could be earning on Outdoorsy, visit [outdoorsy.com/gps](http://outdoorsy.com/gps). **RVE**

## Outdoorsy, Zubie Partner on Vehicle Tracking System



Owning an RV is a significant expense, one that many owners mitigate by renting their rigs out. Renting,

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Hopkins Mfg.	<a href="http://hopkinsmfg.com">hopkinsmfg.com</a>	35
Hughes Autoformers	<a href="http://hughesautoformers.com">hughesautoformers.com</a>	5
Lippert	<a href="http://lci1.com">lci1.com</a>	39
Norcold, Inc.	<a href="http://norcold.com">norcold.com</a>	7
REV RV Group – Parts	<a href="http://revrvparts.com">revrvparts.com</a>	37
REV RV Group – Service	<a href="http://revrvserviceandrepair.com">revrvserviceandrepair.com</a>	11
Roadmaster, Inc.	<a href="http://roadmasterinc.com">roadmasterinc.com</a>	19
Transfer Flow, Inc.	<a href="http://transferflow.com">transferflow.com</a>	9
Truma	<a href="http://truma.net">truma.net</a>	64
Yamaha Motor Corp. USA	<a href="http://yamahamotorsports.com">yamahamotorsports.com</a>	23



**Valterra SurgeMinder Surge Protectors**

Valterra, a division of Dometic, has introduced two surge protectors designed to prevent faulty power at RV campsites from ruining your RV's onboard electronics. The company's SurgeMinder is available in both 50-amp (for four-prong plug outlets) and 30-amp (for three-prong plug outlets) capacities. Both are engineered to analyze circuits to verify pedestal power and come with an anti-theft lock and two keys. The 50-amp unit will identify 8 outlet faults, while the 30-amp version will identify 5 outlet faults. Each also features illuminated indicators to show power status and has a finger grip for ease of use. For more information, visit [valterra.com](http://valterra.com).



**Renogy REGO Plug-and-Play Off-Grid Solar System**

Ready to say goodbye to the grid? Renogy has introduced REGO, the first ever fully integrated smart solar power system for off-grid living. Specifically designed for first-timers, DIYers and experienced solar users, the REGO Series is a true plug-and-play power system, where all of the components are made to work together seamlessly, saving users time and stress while making it easier than ever for everyone to add a solar power system to their RV. Fully compatible with the company's Renogy ONE all-in-one energy monitoring and smart-living center, the REGO Series is comprised of multiple individual components, including a solar charge controller, battery charger, 400 amp-hour Lithium battery, inverter-chargers, fuses and adapter cables. For more information, visit [renogy.com/regol/](http://renogy.com/regol/).



**Countryman Coatings Silicone Roof Coatings**

Your RV's roof endures more harsh treatment than any other part of your RV — and causes more problems when not maintained. Countryman Coatings has introduced a line of 100% silicone roof coatings designed to completely seal and restore your aged roof (or even your barn, garage, deck and more). Made in the USA, these coatings are said to reduce energy usage by up to 20% while reducing strain on your air-conditioning system. Available in Silicone Top Coat, silicone skylight sealer and Heavy-Duty Silicone in quart, one-gallon and (except for Heavy-Duty Silicone (five-gallon sizes), in various colors where applicable. For more information, visit [countrymancoatings.com](http://countrymancoatings.com).

**Iosso Odor Buster**

Even the cleanest RV can begin to smell a bit over time as unseen mold and mildew take hold and create an unpleasant mustiness. Odor Buster from Iosso Products is said to be uniquely formulated to neutralize and eliminate the source of annoying odors instead of masking them with fragrance like many household products. Made in the USA, Odor Buster is biodegradable so it's safe to use around children, pets and eating areas. It's equally effective inside and outside the boat or RV for applications such as awnings, cushions, carpeting, clothing and even shoes. Using Odor Buster is easy: the well-shaken formula is sprayed directly onto fabric and non-porous surfaces and, after several minutes, it's blotted to remove excess moisture. To freshen the cabin, it's misted upwards into the air while backing out from the space. For more information, visit [iosso.com](http://iosso.com).

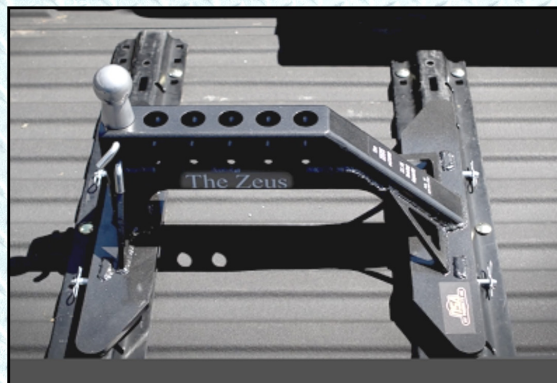






### Air Lift LoadLifter 7500 XL Ultimate

Aftermarket air suspension manufacturer Air Lift Company has updated a kit in its LoadLifter series — the LoadLifter 7500 XL Ultimate — featuring an internal jounce bumper. The LoadLifter 7500 XL Ultimate offers support for the heaviest tows with an internal jounce bumper, absorbing shock for the smoothest ride. Utilizing 7-inch diameter bags — the largest bags of any Air Lift kit — the 7500 XL Ultimate kit is capable of supporting 7,500 pounds, while the closed-cell urethane foam jounce bumper inside the air spring provides a cushion of air that absorbs shock, eliminates harsh jarring on rough roads, and protects vehicles carrying heavy loads. The kit also features upper and lower roll plates for added protection, end caps made with an ultra-high-strength nylon composite formula, are maintenance-free and are fully adjustable from 5-100 PSI for precise control. For more information, visit [airliftcompany.com](http://airliftcompany.com).



### NSA RV Products 'Zeus' Fifth Wheel Hitch

NSA RV Products, a manufacturer of towing equipment known for its tow bars with integrated braking systems, has announced its entry in to the fifth-wheel hitch market with the release of its Zeus product. According to company representatives, the company's goal was to create a hitch light enough to take in and out of the truck bed with minimal effort but strong enough to handle practically any fifth wheel on the market. The Zeus' unique design provides for 24 inches of adjustability, has a 22,500-pound capacity and 6,000-pound pin weight limit, and weighs just 54 pounds. Made in America (including all components), the Zeus carries a lifetime warranty. The aforementioned 24 inches of adjustability is said to be the most of any fifth wheel hitch. For more information, visit [readybrake.com](http://readybrake.com).



### Makita Cordless 'Outdoor Adventure' Products

You're no doubt familiar with the Makita line of battery-powered home-improvement tools, you may soon be using Makita products on your camping trips, as well. The company is pushing "cordless" into new spaces with the announcement of its "Outdoor Adventure" range of cordless products for camping, hiking, fishing, tailgating and more. Featuring a distinctive camo-green color inspired by outdoor environments, the Outdoor Adventure products — which include work lights, flashlights, audio equipment, fans, inflators, chain saws, vacuums, blowers, and even a battery-powered coffee maker — are powered by Makita 18V LXT batteries and feature the same advanced technology that power Makita tools on commercial job sites, so users get the same maximum performance and efficiency for the outdoors. For more information, visit [makitatools.com/products/outdoor-adventure](http://makitatools.com/products/outdoor-adventure).



### SumoSprings Rebel Spacer Kits

SumoSprings, a division of Super Springs International (SSI), are a popular, maintenance-free addition to most tow vehicle suspension systems designed to help maintain vehicle control and comfort. However, owners of lifted trucks haven't been able to utilize the product. Now, the company has released a line of Rebel Spacers that allow SumoSprings to be fitted to these modified vehicles. SSI has engineered a brand-new Rebel SumoSprings Spacer Kit in 2-, 4-, and 6-inch options depending on the type and size of lift already fitted to the truck. Once installed, the Rebel is attached top and bottom using separate male and female pieces. For more information and to consult with the SSI team to identify the correct part, visit [super-springsinternational.com](http://super-springsinternational.com).



# Curing the Wander Woes



*Roadmaster's new Exact Center Steering Stabilizer for full-size trucks, Jeeps and motorhomes civilizes handling while reducing driver fatigue and improving control*

By Bob Livingston / Photos by the author

When it comes to suspension products that improve handling, most aftermarket suppliers love to compare the results to that of driving a sleek little two-seater automobile. You've heard or read such claims countless times: "After installing our 'gizmo,' your truck will handle like an expensive sports car." An exaggeration, to be sure. Granted, in most cases upgrading certain suspension components will make a difference — especially to road-wear drivers who find it necessary to continually "fight the wheel" — but you still can't escape the realities of physics. Tow vehicles will not handle like sports cars because steering is not precise and heavy-duty suspensions are not finely tuned like that of a Lamborghini.

Steering dampers, for example, are supposed to "tighten" steering components somewhat — but in reality, while such stock, shock-absorber-like steering stabilizers may be better than



*The bolt that holds the factory damper to the axle bracket was removed with impact and open-end wrenches. Access is somewhat limited, but better if the front axle is lifted off the ground. Always use jack stands and chocks for safety.*





2

Once the factory damper is free from the axle bracket, the other end was removed from the bracket on the tie rod.

nothing, they can only do so much.

Roadmaster ([roadmasterinc.com](http://roadmasterinc.com)), a major provider of tow bars and suspension upgrades, responded to the frustrations of Jeep SUV owners who struggled with unwanted harmonic steering oscillations — the well-known



3

There are huge differences in the approach to steering control between the factory shock absorber-style damper and the Exact Center stabilizer. The factory unit responds after steering is initiated, while the Exact Center uses two nitrogen-charged cylinders to apply constant pressure.

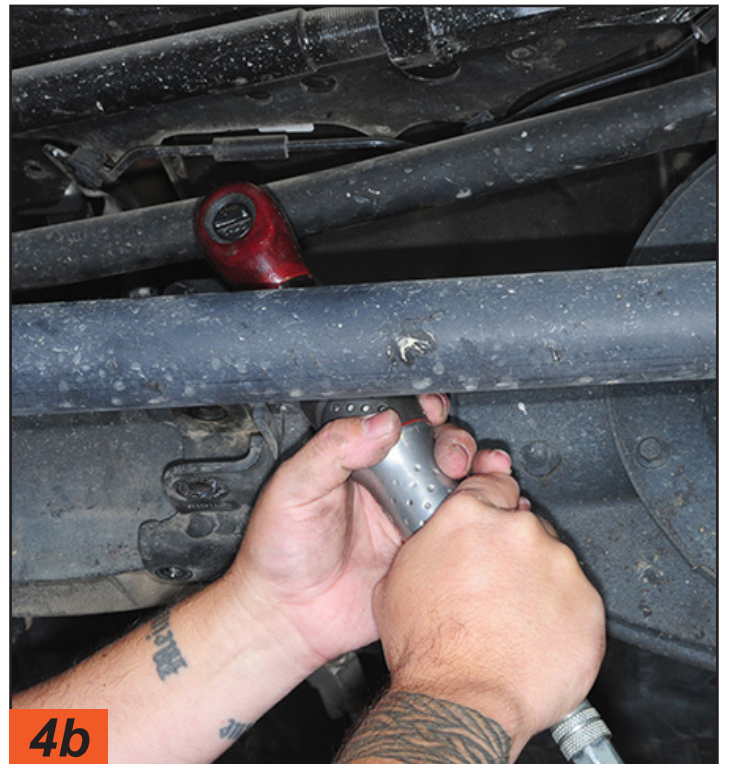
“death wobble” — by introducing its Exact Center Steering Stabilizer to not only fix that problem but also improve overall steering response. While the Jeep suspension malady was behind the product’s development, its popularity has led Roadmaster to expand the line to include stabilizers for most Class A motorhomes, Jeeps and 2016-2022 Ram 2500/3500 trucks (kits for Class C motorhomes and other trucks will be released during the next few months).

The Exact Center stabilizer has a \$580 price tag for full-size trucks and Class A motorhomes; \$450 for Jeeps. Brackets sell for \$89-149, depending on the vehicle. You can check out applications by going to [fitmaster.roadmasterinc.com](http://fitmaster.roadmasterinc.com) and perusing the company’s Fitmaster guide.

We tested the Exact Center on a 2016 Ram 3500 4 x 4 dually that is used almost exclusively for towing a big full-profile fifth wheel trailer. Steering



4a



4b

Removing the factory axle bracket is simple, but there’s not a ton of space to work in. Fortunately, the threads are built into the axle, which makes bolt removal easier. Be careful when using powerful impact wrenches — you don’t want to strip the threads in the axle.





5

Custom brackets are designed to fit precisely into the existing threads in the axle. The new Exact Center bracket (left) is much larger to accommodate the longer stabilizer and stronger forces.

precision on this truck was not horrible, but the Ram had a tendency to wander and require more steering input than optimal, a situation that was amplified when towing the fifth wheel. While there was no death wobble to report in the test truck, friends with similar trucks have experienced this phenomenon. Most times, the wobble was initiated while crossing railroad tracks or pot-holes — and the subsequent loss of control was very disconcerting.

### Proactive Rather than Reactive

The aftermarket has seen its share of shock-style products designed to damp steering input and improve handling, but the Exact Center is different. While other products push the linkage back while negotiating turns in an attempt to provide some steering control, this action is typically after the fact; the vehicle has already started to wander at this point and steering play has already been initiated. The Exact Center is

proactive, meaning that rather than ramping up slowly the forces necessary to control steering remain pressurized in both directions, which promotes a positive feel and maintains steering precision while driving down the road in a straight line or in turns.

Comparing the OEM shock-style damper to the Exact Center shows a completely opposite approach to steering stabilization. While the factory damper looks like a cheap shock absorber — something vehicle manufacturers are famous for — the Exact Center uses a high-pressure nitrogen gas-charged piston in each of two stainless-steel cylinders connected by a stainless-steel rod and covered with a rubber boot. It not only delivers steering control, but its design meets the criteria of car buffs who like attractive accessories.

Installing the Exact Center stabilizer is not difficult but does require that the front wheels are as straight as possible

before starting. It's best to lift the front axle off the ground for better working space, but the job can be done by sliding your body under the truck — just make sure to use jack stands if the front is lifted, and always use chocks.

The first step is to remove the old damper. This procedure requires removing the bolt and nut holding the old damper in place in the axle bracket, followed by the same process at the tie-rod bracket; the bolt and nut from the tie rod side are retained for use during installation of the new stabilizer. Next, the bracket is removed from the axle; for the Ram truck, four bolts are pulled out. These bolts have no nuts to contend with, but tool access can be tight, especially when using an impact wrench (which the company discourages unless you have experience using power tools). Once the old bracket is removed, the new one is installed using the original bolts; the bracket matched up perfectly to the factory threads in the axle. Thread sealer is required, and the bolts were torqued to 36 ft.-lb.

The Exact Center can be mounted in either direction. Simply place one end in the axle bracket, pop in the new bolt, add the washer and tighten the locking nut. You'll do the same for the tie rod bracket but will need to fill the gap with the provided 1/2-inch washer/spacer. These bolt threads should also be coated with Loctite or a similar product and tightened to 57 ft.-lb. Lastly, tighten the jam nuts on both sides against the ring nuts and straighten the boot. Figure on about an hour for the install if laying on your back.

Chances are you'll have to make final adjustments after test driving. This is done by loosening the jam nut and rotating the cylinder in slight increments. After the initial test drive the truck was pulling slightly to the left, so the driver's



6

It's important to coat the axle-bracket bolts (which were retained from the factory bracket) with thread sealer before tightening to 36 ft.-lb. Red Loctite was used, which will make it virtually impossible for the bolts to back out.



7

The new axle bracket is nicely machined and has a power-coated finish. When mounted, it looks better than the original equipment bracket.



side jam nut was loosened and the cylinder was rotated upward slightly. You'll do the opposite if the truck pulls to the right.

### On the Road Again

Admittedly, any improvement in steering response and handling will be subjective — but in this case, I had a smile on my face right from the get-go. Steering feel was more precise and reaction time shortened. Rather than working the steering wheel back to center manually, it returned toward

center almost by itself. After making the aforementioned adjustment, it got even better.

Solo, lane wander virtually disappeared and attacking undulating pavement restored confidence in control. Towing the fifth wheel was even more fun. Steering movement on straightaways was reduced and it was possible to take curving roads at higher speeds with better control. Overall, driver fatigue while towing was virtually eliminated.

Roadmaster claims that's it's even

possible to back up an Exact Center-outfitted dinghy vehicle while connected to a motorhome. I didn't get the opportunity to test that claim, but it makes sense that if the front wheels are restricted from turning, backing longer distances (within reason) is entirely possible.

Roadmaster also makes the "sports-car" analogy, which may be somewhat of a stretch — but once you drive with the Exact Center installed on a Ram 3500 dually, you'll probably forget that you're driving a beast.



**8a** It took a little coaxing with a block of wood to get the end of the Exact Center into the axle bracket. There's no question the fit is precise. The stabilizer was mounted into the axle bracket first. A new bolt (provided with the kit) was used here and torqued to 57 ft.-lb. after coating with thread sealer.



**9a** Since the factory tie-rod bracket is a little wider than the Roadmaster replacement, a washer/spacer is provided with the kit to take up the slack. The original bolt, washers and nut are reinstalled in the tie-rod bracket to hold the end of the Exact Center stabilizer in place. This nut and bolt are also torqued to 57 ft.-lb.



**10** The Exact Center stabilizer can be installed in either direction and is designed to resist steering wander by keeping the system pressurized.



**11** Once the jam nuts were tightened against the ring nuts, the truck was test driven to make sure the unit was centered properly. The truck pulled slightly to the left, so the driver's side jam nut was loosened, and the cylinder rotated upward slightly before retightening the jam nut. **RVE**



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