

## BETTER BRAKING REPORT

### [HENSLEY MFG., INC.](#)

Pilots have a saying: Taking off is the second greatest thrill in flying. Landing is the first.

What holds true for flying holds true for anything that moves at high speeds. Stopping is not optional. While most RV articles talk about the dynamics of motion or the joys of the destination, few address the principles of going from 60 to 0mph without damage to trailer or occupants.

While Hensley Mfg. put itself on the RV map with the introduction of the Hensley Arrow Advanced Towing System, a product designed for a vehicle in motion, we've recently become interested in what happens in those precious few seconds from the moment the driver pounces on the brake pedal to the sigh of relief at the end.

We began our quest with what has become a necessary evil for the trailer enthusiast: the **brake controller**.

Brake controllers have gone from a simple timing device to pendulums to the modern accelerometer driven devices most of us use today. The overriding theory has always been that you want your trailer brakes to engage at precisely, or slightly ahead, of the tow-vehicle's brakes. Of course, no one has invented a brake controller that can read minds (yet), so every manufacturer has had to fall back on the one common event that occurs every time a tow vehicle's brakes are applied: illumination of the brake lights.

Your car or truck's brake light comes on the moment the brake pedal is pushed, slightly before any brake pressure is actually applied. Brake control manufacturers take advantage of this by tapping into that circuit (called the "Brake Light Wire" by most) and sending a small amount of power to the trailer brakes the moment it's detected. That's how your trailer stops "ahead" of the tow vehicle.

After that, the brake controller sends a greater or lesser amount of power to the trailer brakes, depending on the input from the accelerometer, cable to the brake, hydraulic pressure, or pendulum position, depending on which type of brake controller you have.

**Myth #1: Brake controllers that tap into the brake line or cable to the brake pedal are the only type that can stop the trailer ahead of the tow vehicle.**

Hydraulically controlled brake controllers rely on the brake light signal to make this happen. The signal from the brake line pressure doesn't go into effect until the tow-vehicle brakes actuate. Cable type controllers are essentially doing the same thing, except they detect the slight "tug" on the cable instead of detecting the brake light signal. *Any brake controller that connects to the brake light circuit can stop the trailer ahead of the tow vehicle.*

On most brake controllers, the driver adjusts this initial power output with the GAIN control. That way, the power can be reduced in city driving to keep the trailer from “grabbing” the brakes, resulting in the “bobble head” effect on the tow-vehicle occupants. The safety issue here is that the driver can fail to turn the gain back up for high-speed driving, which can **result in an accident in a panic stop situation.**

Once the accelerometer or other input device takes over, the power sent to the brakes depends on two factors: the reading from the input device and the **gain**. In the case of an accelerometer based controller, the deceleration of the tow-vehicle is measured and, depending how rapidly the tow-vehicle is slowing, power is sent to the trailer brakes. Again, this output is limited by the gain setting. This is true of any brake controller, whether it taps into the brake line, cables to the brake pedal, or uses an accelerometer to control power to the trailer brakes. The goal of any of these controllers is to make the trailer brakes work in conjunction with the tow-vehicle brakes.

### **Myth #2: Proportional braking is the key to smooth trailer braking.**

Brake controller manufacturers have been attempting to line up your tow-vehicle brakes to your trailer brakes for decades. The theory is that if both sets of brakes are applied at precisely the same time, smooth braking will be accomplished.

Here’s the problem: the hydraulic disc brakes in your tow-vehicle do not function the same as the electric drum brakes in your trailer. Thus the recent popularity of hydraulic trailer brakes, a very expensive “cure” for the problem. The fact is, electric drum brakes are more efficient at low speeds and hydraulic disc brakes are more efficient at high speeds. Therefore, applying the same amount of braking to both sets of brakes actually exacerbates the problem. It would be like putting a distance runner and a sprinter on the starting line together and expecting them to always finish together, no matter the distance.

To date, the best solution to this problem has been electric/hydraulic disc brakes for the trailer, an option that runs into thousands of dollars. Hydraulic brakes, however, have their own problems, the biggest being the inherent delay, as much as a half second, between pressing the brake pedal and the activation of the hydraulic actuator. Ironically, the best brake controllers for this type of system have always been the low cost timer or pendulum based controllers, which don’t allow for every condition and are still limited by the gain setting.

### **Myth #3: RVers are simply stuck with inadequate trailer braking.**

Hensley Mfg. didn’t conduct all this testing and research just to deliver bad news. We wanted to solve the problem. We started with a blank sheet of paper and wrote down what we wanted, based on our testing and experience with our own travel trailers. Here’s what we wanted out of a brake controller:

- Smooth stopping at any speed.
- No gain adjustment.
- Enough power to always stop the trailer ahead of the tow vehicle.
- Easy installation.
- Easy functionality – no menus!
- Driver feedback – amperage to the trailer brakes.

It was a daunting list, and we wondered if we weren't in over our heads. Even the largest brake controller companies hadn't come up with anything this elaborate. After two years and countless trips back to square one, however, we came up with the **TruControl™**. It's the only brake controller on the market that solves all the problems mentioned above. Through the use of patented software, we were able emulate the hydraulic profile of the tow-vehicle brake line, but we were also able to adjust the power output to make up for the inefficiencies of the trailer brakes at high speeds and the tow-vehicle brakes at low speeds.

The pivotal feature of the TruControl™ is the automatic gain adjustment. The solid-state gyro, an upgrade from the standard accelerometer, feeds into a gain register, which updates the gain 1000 times per second, with no input from the driver. Adjustments are made based on acceleration/deceleration, angle of incline, acceleration around curves, and trailer brake heat based on amps drawn. In other words, **the TruControl™ thinks for the driver**, adjusting to any driving condition. The patented software and automatic gain provide smooth stopping at any speed and the exact amount of power needed.

Power was the next issue. Standard electric trailer brakes draw about 3 Amps each. Therefore, a 2-axle trailer will draw about 12 Amps. All brake controllers to date have put out between 2.5 and 3.25 Amps. In a perfect world, the 3.25 Amp models would be adequate. However, because of inefficiencies in wiring and connections, a good deal of power is lost before it ever reaches the trailer brakes. The results: No brake controller prior to TruControl™ delivered the full amount of power that trailer brakes will draw.

After considering the worst case scenario for power loss, we settled on a target of 4.5 Amps output per brake, with a maximum surge of 48 Amps, more than double all other controllers on the market. At 4.5 Amps per brake, TruControl™ allows for any loss and provides more braking power than anything available.

Ease of use and functionality were next on our list. Ironically, because the gain control is automatic, we actually built in the user-friendliness of the TruControl™. The only setting is a quick configuration at set-up to adjust the initial power out. This is based on trailer and tow-vehicle weight and requires no adjustment after installation. TruControl™ is a true “forget it's there” product. Once installed, the driver never needs to touch it again. Installation is a standard 4-wire connection and dash mount, about 20 minutes for even the most electrically challenged trailer owner.

Last on the list was driver feedback. That part was easy. The display gives you battery voltage and, most importantly, amperage drawn from the trailer brakes. Here you can actually see what the TruControl™ does for you. Remember the 3 Amps per brake standard? On a 2-axle trailer, the display will show anywhere from 11 to 14 Amps, depending on your wiring. If you see 10 Amps or less, you know you have a brake wiring problem.

Which brings us to the last problem: those darn brake wires. Here we had this state-of-the-art brake controller and were still limited by the trailer's wiring. While we could overcome most of the problem by pumping out more power, you simply can't squeeze 18 Amps through 20 feet of 12AWG wire. To make matters worse, most trailer manufacturers wired their brakes in series, essentially daisy-chaining them together. If you think of electricity in terms of water, you can see the problem. The first brake gets the most power, followed the second, and so forth. By the time power gets to the last brake in the chain, it's a trickle. Not only are you not getting maximum braking efficiency, you're getting uneven brake wear.

No, we didn't re-invent electricity. We went with the old-fashioned solution: heavier wire. But wire in parallel. We ran one 10AWG wire (wire numbers go backward, smaller numbers mean heavier wire) from the blue brake wire in our trailer's junction box to a point between the axles. We then branched that off into four equal length 12AWG wires and tied them directly to the trailer brakes. We repeated the process for the ground wire. This was amazingly simple. We didn't even have to worry about polarity, as long as each brake got one positive and one negative (ground) wire. We tested that configuration and then tried again with 8AWG wire. This was done on a 33' Sunnybrook 2-axle trailer towed with a Chevy Avalanche and using the TruControl™ brake controller.

The results: the amperage reading on the TruControl™ started at 14.32Amps with the factory installed wiring. This is actually quite exceptional, few trailers have that kind of efficiency; most will see 12 Amps. With the 10AWG wire, the reading jumped to 15.44 Amps, a full 1.1 Amp increase. While that doesn't seem like a lot, remember that we started out at 14.32 Amps. A trailer at 12 Amps would have seen a 3 Amp jump.

Amperage isn't the only factor. Remember that trailer brakes wired in series experience uneven braking and wear. By keeping all our wires to the brakes the same length, we guaranteed equal power to each brake, and equal timing. When I slammed on the brakes at 60mph, I didn't get the usual lurch to one side that I did before the upgrade. The trailer maintained a perfect track behind the tow-vehicle.

When we tried the 8AWG wire, we found that we only experienced an additional 0.1 Amp increase. We're still limited by the 14AWG wires that come with the brake magnets and the connectors in the circuit. The slight increase in efficiency didn't justify the additional cost of the 8AWG wire (remember, we needed two 20' pieces).

## **Conclusions**

The upgrade to the TruControl™ brake controller resulted in smoother braking along with an amperage increase from 9.8 Amps to 14.3 Amps. The wiring upgrade resulted in an additional 1.1 Amps for a total of 15.44 Amps. The maximum amperage possible with the 4 brake system and the TruControl™ is 18 Amps. This means that I'm using 85% of TruControl's™ maximum output. We could eliminate one connection if we ran the 10AWG wire directly from the plug to the 4 brake wires, but the trouble and cost would not likely give us much benefit. Unless brake magnet manufacturers change their wiring and someone figures out a way to connect a truck to a trailer without a 7-way plug, we've gone about as far as we can go. The good news is that we removed the brake controller as the major contributor to electric brake inefficiency.

## **Recommendation**

Upgrade your trailer brake controller to the TruControl™ before paying a lot of money for a hydraulic system. For another small cost, you can also upgrade your wiring. Our testing shows that these two upgrades provide better braking than even the most expensive hydraulic systems.

**Call Hensley Mfg. at 800-410-6580** to or visit our website at [www.hensleymfg.com](http://www.hensleymfg.com) to order.