

Agricultural and Biosystems Engineering

Trailer Brakes

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The ability to stop a motor vehicle under control and in a reasonable distance is one of the most critical aspects of safe towing. The service brakes of your towing vehicle are not designed to handle the extra weight of a trailer. They will overheat and wear out prematurely if you do not have proper trailer brakes. Lack of trailer brakes can also lead to loss of control on wet or slippery roads and in emergency stopping situations. Not having trailer brakes may also be illegal.

All states have laws requiring brakes on trailers with gross vehicle weight ratings (GVWR) greater than 3,000 lbs. *Remember -- the GVWR is the manufacturer's rated maximum weight of the trailer plus the load, not the weight of the trailer itself.* However, virtually all car and light truck manufacturers require brakes when towing trailers with a GVWR greater than 1,000 lbs.

This means that either your tow vehicle manufacturer or state law requires brakes on almost all boat trailers, campers and utility trailers.

TENNESSEE REQUIREMENTS:

Let's start with the basics. Tennessee law defines a motor vehicle as "any motorized device upon or by which any person or property may be transported or drawn upon a highway." Exceptions are motorized bicycles and electric trolleys. Farm tractors are specifically defined as motor vehicles.

A trailer is defined as a motor vehicle whenever it is attached to a car, truck, farm tractor or other motor vehicle. So, motor vehicle registration and safety requirements apply to trailers, and there are some specific additional requirements and exceptions that we will cover in this fact sheet.

Every motor vehicle is required to have certain safety equipment, such as lights and brakes, when operated upon a highway. In addition, there are performance requirements that the safety equipment must meet. Braking performance requirements are discussed later in this fact sheet.



TRAILER BRAKES:

All states require that **every trailer** or semitrailer with a **gross vehicle weight rating (GVWR) of 3,000 lbs** or greater is required to have brakes “adequate to control the movement of and to stop and to hold” the vehicle. The trailer brakes may be air, electric or hydraulic, but must be applied by the driver of the towing vehicle from its cab.

State and Federal regulations require brakes on all wheels if the vehicle is required to have brakes. Therefore, tandem and triple axle trailers are required to have brakes on all wheels, not just on one axle. Also, all brakes are required to function properly at all times.

Exceptions in Tennessee to the requirement for brakes that generally apply to individuals and farmers are:

“trailers which are not required to be registered and licensed and which are used by or on behalf of farmers:

- (1) Transporting farm products or livestock from farm to market;
- (2) Transporting products, equipment, materials or supplies used in agricultural pursuits from market to farm or in their transfer from farm to farm or from one (1) part of a farm to another part of the same farm; or
- (3) Delivering such trailer to any farm.”

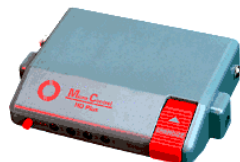
Electric brakes are used on most trailers towed by cars and light trucks. Brakes are applied by a controller mounted somewhere



on or under the dash. The current sent by the controller operates a magnet in each brake to force the shoes against the drum.

Typical electric brake controllers use a pendulum attached to a potentiometer to detect the degree of braking. The controller then sends the correct current to the trailer brakes.

Installing an electric brake controller is relatively simple, especially if your vehicle is pre-wired for trailer brakes as part of a



towing package. Electrical connections required to install a trailer brake controller include:

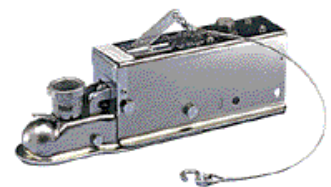
1. a wire (with fuse) from the positive (+) battery terminal to the brake controller,
2. a connection to the brake light circuit that tells the controller when the brakes are being applied,
3. a wire to the trailer wiring connector to provide power to the trailer brakes, and
4. a ground wire from the brake controller.

Be sure to use the proper wiring and fuse to protect your truck from fire. Also, make sure the brake controller is connected to the brake light circuit, not the turn signals! Refer to the instructions for your controller for specific advice and helpful hints.

Adjustments on the controller allow you to set the aggressiveness or quickness of the trailer brake application and the maximum braking force to apply. A simple and effective method of adjusting the brakes is to increase the braking effort until the trailer tires skid at 20 mph, and then reduce the braking effort slightly. Remember to adjust the brakes again each time the load is changed.

Electric brakes add about \$100 per axle to the cost of a new trailer. Brake controllers are available for \$40 and up. Retrofitting electric brakes to an existing trailer costs about \$160 per axle for brakes and drums (for a 3,500 lb axle). Wiring to complete the installation adds little expense to the trailer.

Hydraulic surge brakes are permitted on trailers **operated solely within Tennessee** if the trailer GVWR is 7,500 lbs or less *and* the surge brake actuator is equipped with a hydraulic breakaway mechanism that is separate from the hitch itself. Surge brakes function automatically without any additional equipment on the towing vehicle. The force of the trailer pushing against the hitch pushes a hydraulic master cylinder, and the brake fluid pressure then activates the wheel cylinders of the trailer brakes. Therefore, hydraulic brakes automatically apply the correct level of braking.



Hydraulic surge brakes have several disadvantages, however. One is the higher initial cost compared to electric brakes. The couple/actuator alone costs about \$130 for a 6,000 lb. trailer, plus about \$160 per axle for brakes and drums. Additional expenses include brake lines and fittings.

The biggest drawback for hydraulic surge brakes, however, is that hydraulic surge brakes may not be permitted outside Tennessee, so check the regulations of other states before traveling outside Tennessee.

Federal Motor Carrier Safety Administration regulations clearly do not allow hydraulic surge brakes. Regulations require that all brakes must be capable of operating at all times. According to the department, surge brakes do not meet this requirement because they can operate only when the vehicle is traveling forward.

Air brakes and air over hydraulic brakes are suitable for heavy-duty trailers, and not generally used on utility trailers and farm vehicles. For this reason, brakes of these types are not discussed in this handout.

BREAKAWAY CONTROLLER REQUIRED:

A breakaway brake controller must be used so that all trailer brakes will be automatically applied in case of an accidental breakaway of the towed vehicle. This is required by all 50 states.

A typical electric breakaway controller has a sealed 12-volt gel cell battery and switch that are mounted on the trailer and wired into the brake circuit. The switch is connected to the towing vehicle by a small wire rope (*the cable must be secured to the towing vehicle, not to*



the safety chain nor any part of the hitch ball or ball mount). If the hitch separates or fails, the cable pulls the “key” from the switch, allowing the contacts to close and 12 volts will be applied to the

brakes.

Adjust the length of the cable or lanyard from the key to the tow vehicle frame so that the brakes are applied before the safety chains break. Regulations do not state whether the

brakes must apply before the safety chains break. However, if the brakes are applied and the safety chains hold, the emergency braking keeps the trailer directly behind the towing vehicle so you can stop under control. This also keeps the trailer from slamming into the rear of the tow vehicle, minimizing damage.

Should the safety chains fail before the brakes are applied (meaning your safety chains were not the right size or were improperly attached), the trailer ought to at least stop somewhere nearby, but it may collide with other vehicles before it stops.

Keep in mind that the safety chain must be of sufficient strength and properly attached to “maintain the attachment.” Refer to the fact sheet “Safety Chains for Agricultural Vehicles” for more information.

Electric breakaway controllers and batteries cost about \$40.

BRAKING PERFORMANCE:

Federal and state regulations require that the service brakes of motor vehicles or combination of vehicles must be able to stop the vehicles from a speed of 20 mph within 30 feet on level, dry asphalt or concrete pavement. This performance requirement applies whether the vehicles are empty or are loaded to the maximum capacity permitted.

Emergency or parking brake must be able to stop under the same conditions within 55 feet and must be able to hold such vehicle or vehicles stationary on any grade upon which operated.

MAINTENANCE:

Brakes must be maintained in good working order and adjusted as to operate as equally as possible on both sides of the vehicle. If your electric brakes do not apply evenly, check their adjustment. If this does not correct the problem, check all electrical connections, especially the grounding connections for each brake. Also, check the wires leading to each brake. If necessary, rewire the brakes so that the total length of wire to the brakes is the same for each wheel.

Remove the wheels at least annually and inspect the brakes for wear or corrosion that could cause poor braking performance. Clean

and adjust as recommended by the manufacturer, which is generally to bring the brake shoes almost into contact with the drums.

Check all the condition of all wiring and electrical connections. Replace damaged wires and repair or replace loose or corroded connections.

Make sure the breakaway brake controller battery is fully charged before each trip. Test the operation of the switch to make sure the brakes will be applied in a breakaway.

Replace brake fluid annually and flush and bleed the system. Brake fluid absorbs large amounts of water, and this will lead to corrosion of brake system components and stuck wheel cylinders. Moisture in the brake fluid can also turn into steam if the brakes get hot, causing loss of braking similar to having air in the system.

Inspect hydraulic brake lines and fittings, and replace soft or cracked lines.

FOR MORE INFORMATION:

If you need additional information about safety chains and highway safety in general, contact the your county Extension office, Tennessee Department of Safety, your local law enforcement agency or a knowledgeable towing and hitch specialist.

REFERENCES:

Tennessee Code Annotated:

Definitions: (55-1-103, subpart (3))

Requirements for brakes: (55-9-204, subpart (a)).

Farm use exemption: (55-9-204 subpart (e))

Breakaway controller (55-9-204 subpart (c)(1))

Surge brakes: (55-9-204, subpart (c)(2))

Braking performance: (55-9-205, subparts (a), (d))

Parking brake: (55-9-205, subpart (b))

Brake maintenance: (55-9-205, subpart (e))

(<http://www.legislature.state.tn.us/info/lexis.htm>)

Federal Motor Carrier Safety Administration Regulations, 49 CFR 393, Subpart C

393.41 -- Parking brake system.

393.42 -- Brakes required on all wheels.

393.43 -- Breakaway and emergency braking.

393.48 -- Brakes to be operative.

393.49 -- Single valve to operate all brakes.

393.52 -- Brake performance.

(<http://mchs.fhwa.dot.gov>)

Tennessee Department of Safety Commercial Vehicle Enforcement Division

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