Driving a vehicle with the Lightning Hybrids Energy Recovery System

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Welcome to Lightning Hybrids Driver Training

Lightning Hybrids hydraulic hybrid system saves fuel and reduces emissions.

It’s easy to drive and actually enhances vehicle performance.
Welcome to Lightning Hybrids Driver Training

You will learn...

- What is Lightning Hybrids’ Energy Recovery System?
- How does it work?
- What benefits does it provide?
- How to drive a hybridized vehicle
- How to get the best fuel mileage
More resources

You can find additional resources, including a cool training video, at

www.lightninghybrids.com/drivers
Lightning Hybrids Energy Recovery System

Installed here in a Ford E-350 bus
Lightning Hybrids Energy Recovery System

- Hydraulic hybrid
- Works in-line with the drive shaft
- Resists drive-shaft rotation to slow the vehicle (braking)
- Saves the energy in a hydraulic accumulator
- Applies torque to assist acceleration, using the energy that was saved when braking
- This takes the load off the engine, which reduces fuel intake and pollution in the exhaust
Energy Recovery System - components

- Control module
- Reservoir
- Valve manifold
- Power transfer module
- Drive shaft
- Hydraulic pump/motor
- Low pressure accumulator
- High pressure accumulator
The benefits...

- Reduces fuel consumption
  - Depends on how much stop/start you do
  - Can be up to 35%!
- Reduces pollution
  - CO$_2$ is reduced by the same amount as fuel
  - NO$_x$ (a component of smog) is reduced by 50%
  - Particulate Matter (soot) is also reduced
- Reduced brake wear
  - Brake components can last 4 to 8 times as long
- Faster braking and acceleration
How to drive a hybridized vehicle

Pre-drive check

• The hybrid system is reliable and self-contained.
• However, it does contain high-pressure hydraulic fluid.
• Before driving, check under the vehicle to make sure that it’s not leaking hydraulic fluid (a few drops is OK).
• If it’s leaking, STAY AWAY from the leak as it can penetrate skin and clothing, causing serious injury or death.
How to drive a hybridized vehicle

The main thing:
Knowing how the brake pedal works
1st inch of travel: Hydraulic braking

2 STAGES OF OPERATION

hydraulic only
Remaining travel: Standard brakes + hydraulic braking
How to drive a hybridized vehicle

Brake pedal basics

• Pressing lightly activates hydraulic braking.
• Pressing further activates the standard brakes.
• Use hydraulic braking as much as possible, because this is what saves fuel and reduces emissions.
• But always be ready to press the pedal further to use the standard brakes.
  • Why? Examples are in later slides.
Hydraulic braking

- Hydraulic braking engages below a certain speed (typically 40 mph).
- Hydraulic braking is enough to slow the vehicle to a stop.
- On some vehicles, the rate of braking can be adjusted by how far you press the pedal in the first inch or so.
- Hydraulic braking uses the hydraulic motor as a pump to push fluid into the accumulator.
- You’ll hear and feel it.
How to drive a hybridized vehicle

**Standard brakes**

- For most slow-downs and stops, you won’t need the standard brakes.
- However...
  - You must use the standard brakes to hold the vehicle stationary, especially on a slope.
  - The hydraulic brakes are not active when reversing, so use the standard brakes.
  - The standard brakes should be used for rapid or emergency stops. Just mash the pedal to the floor as you would normally.
    - The vehicle’s ABS and traction control will work as normal.
How to drive a hybridized vehicle

Procedure: Typical slow-down and stop

• As much as possible, use hydraulic braking to slow down.
  • Press the pedal no more than one inch.
• Adjust your foot, including removing it from the pedal, to bring the vehicle to a stop in the desired location.
• If you need to stop in a shorter distance, press further to add the standard brakes for additional stopping power.
• When stationary, press the pedal further (another inch or so) to engage the standard brakes to hold the vehicle stationary.

  • If you don’t do this, there’s a chance the vehicle will roll because the hydraulic brakes will not hold the vehicle stationary.
How to drive a hybridized vehicle

Procedure: Slowing down from high speed

• Remember: The hydraulic brakes won’t engage if your speed is too high, to protect the hydraulic components.

• Therefore, if traveling at faster than 40mph (typically), pressing the pedal in the first inch of travel will have NO EFFECT.

• Press the pedal further to use the standard brakes to slow the vehicle.

• At about 40mph, you will hear and feel the hydraulic braking engage. Now you can lift your foot into the first inch, to slow down using hydraulic braking for best fuel savings.
How to drive a hybridized vehicle

Procedure: Emergency stop

• In an emergency stop, just press the pedal firmly to the floor as you would normally.

• The vehicle’s standard brakes and ABS system will slow the vehicle safely.

• The hydraulic brakes will operate too, making the stopping distance a little shorter.
Remember...

2 STAGES OF OPERATION

This will become second nature very quickly.
How to drive a hybridized vehicle

Accelerating the vehicle

- **Use the accelerator pedal as you would normally.**
  - It’s that simple!
- During the first few seconds of acceleration...
  - You may hear the hydraulic motor running.
  - On most vehicles, you will feel extra acceleration – which is great for merging into heavy traffic!
- Once the accumulator is discharged, the hydraulic motor will disengage and the vehicle will behave completely normally until the next time you apply the brakes.
How to drive a hybridized vehicle

Sounds

• It’s worth being familiar with the sounds of the hybrid:
  • You can tell if something doesn’t sound right.
  • You can tell your passengers that the sounds are normal, and that they show that the vehicle is saving fuel and reducing emissions.

• Hydraulic motor: A whirring sound
  • Strongest on braking.
  • Also present on acceleration.

• “Bypass mode”: A quiet hissing sound
  • Sometimes, during a long braking event (especially down a grade), you’ll hear a quiet hiss. This is normal. It tells you that the accumulator is fully charged. Hydraulic braking will continue uninterrupted.
  • A fully-charged accumulator will give the biggest boost when you accelerate.
How to drive a hybridized vehicle

Idling

• Idling is a significant contributor to fuel inefficiency.
• Idling is a significant contributor to pollution and smog.
• **Whenever possible, turn off the engine when you’re at a delivery stop.**
• The combination of hybrid technology and reduced idling time will deliver great fuel efficiency.

• Your vehicle may be equipped with Lightning Hybrids’ idle shutoff technology.
  • This will automatically turn off the engine at some interval after you engage “Park”.
  • Restart the engine by pressing the brake pedal.
  • In some situations, the engine will remain on, such as if the battery voltage is low, or the cabin temperature is too high or too low.
How to drive a hybridized vehicle

Hydraulic retarder?

- Can the hydraulic hybrid system work as a hydraulic retarder?
  - Yes.
  - However, once the accumulator is fully charged, and the system goes into bypass mode, there’s a risk of overheating the system if it’s used for prolonged retarding.
  - **If it overheats, it will disengage and hybrid braking will go away.**
  - **Therefore, you must be ready to press the pedal further to use the standard brakes.**
  - It’s preferable to use the transmission to control the vehicle during a long down-grade.
How to drive a hybridized vehicle

Green status light

- Most vehicles have a green status light on the dash:
  - It should light up within a minute of turning on the vehicle.
  - If it does not light up, check that it’s pressed in (if it’s a button).
  - If it still doesn’t light up, or if it goes out when on the road, the hybrid system has detected a fault.
    - Stop the vehicle to see if hydraulic fluid is leaking.
    - The vehicle is usually still drivable, as a normal, non-hybridized vehicle.
    - Tell your maintenance coordinator to schedule repairs.
How to drive a hybridized vehicle

Green status light

• In most cases, you should not turn off the hybrid system. Doing so will stop it from saving fuel and reducing emissions.

• Sometimes, Lightning Hybrids will direct you to switch off the system, such as for measuring your MPG with the system switched off.
How to drive a hybridized vehicle

Driver Information Display

• Some vehicles are equipped with a Driver Information Display on the dashboard. It’s designed to provide helpful information about the status and operation of the ERS.

• In normal driving situations, the three messages you will see are:

  - **HYBRID STANDBY** means that the ERS is not engaged, for example if you have finished accelerating, or are driving on the highway. This is the most common state for the ERS.

  - **HYBRID BRAKE** means that the ERS is slowing the vehicle down.

  - **HYBRID DRIVE** means that the ERS is assisting the acceleration of the vehicle.
How to drive a hybridized vehicle

Driver Information Display

• The bar along the bottom shows the level of “charge” in the accumulator. In other words, how much energy is stored.

- The accumulator is completely discharged, such as after an acceleration event.

- The accumulator is partially charged.

- The accumulator is fully charged and is storing the maximum amount of energy.

• Using the hybrid brakes (and not the standard brakes) will store more energy, and that’s what saves fuel. This indicator helps you to see if you’re doing a good job.
How to drive a hybridized vehicle

Driver Information Display

• The Driver Information Display also shows warning and error messages. These are covered in the Driver’s Guide.
• Examples are:
  • **PUMPS TOO HOT**
  • **TOO COLD** - the system is below 0F / -18C
  • **TRACTION CONTROL** - wheel slip detected, ERS disengages
  • **ENGINE STOPPED / BRAKE TO RESTART** (not shown on all vehicles)
  • **HARSH BRAKING** (not shown on all vehicles)
  • **HARSH DRIVING** (not shown on all vehicles)
Summary

- The hybridized vehicle is easy to drive, with very little acclimation.
- The brake pedal is your primary control for the hybrid system.
- Keeping what you learned today in mind will help you to drive safely while maximizing your fuel savings.