Basic Emergency Vehicle Operators Course

Physical Forces
Non-Emergency & Emergency Mode

Physical Forces

Goal:

EV Operators will understand how non-emergency and emergency response speeds effect vehicle dynamics, handling and control.

Physical Forces

Objectives:

By the end of this module, students will be able to:

- **Will be able to define, Centrifugal Force, Centripetal Force, Inertia, Momentum, Velocity, Gravity and Friction.**
- **Identify factors that affect handling, steering and braking to include ABS Systems.**
- **Identify factors that influence the stopping distance of a vehicle**
- **Identify driving movements that frequently contribute to EV collisions**

Physical Forces

Objectives:

By the end of this module, students will be able to:

- **Identify acceptable vehicle control methods.**
- **Identify methods for skid avoidance.**
- **Identify factors involved in skid control**

Physical Forces

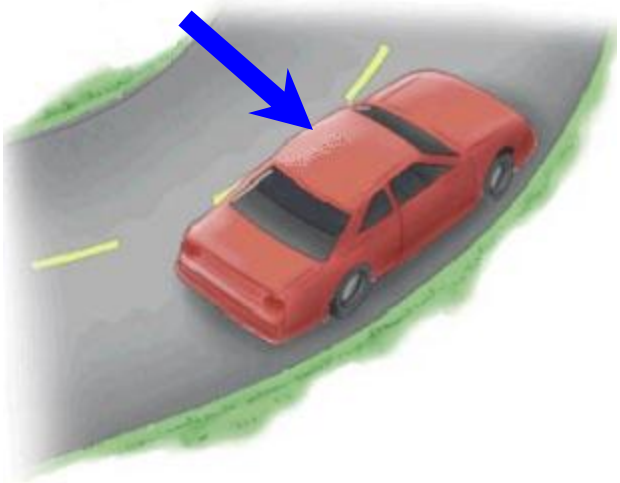
Factors that affect handling, steering, and braking including ABS systems

- Centrifugal Force
- Centripetal Force
- Inertia
- Momentum
- Velocity
- Gravity
- Friction

Physical Forces

Factors that affect handling, steering, and braking including ABS systems

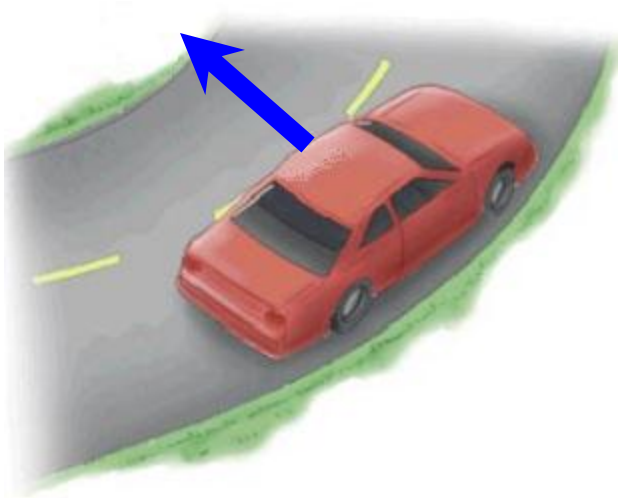
- Centrifugal Force



Physical Forces

Factors that affect handling, steering, and braking including ABS systems

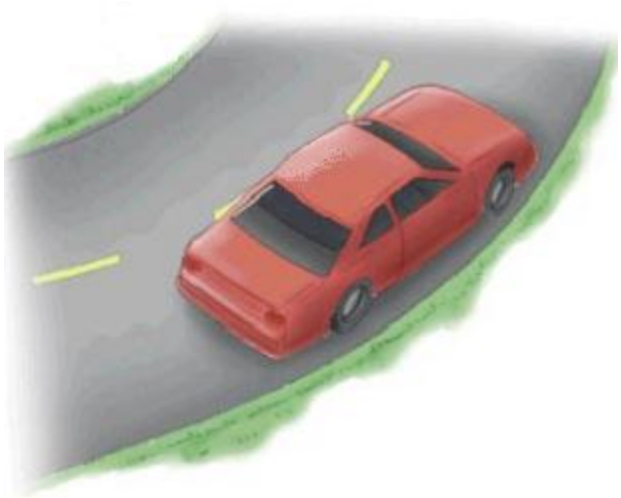
Centripetal Force



Physical Forces

Factors that affect handling, steering, and braking including ABS systems

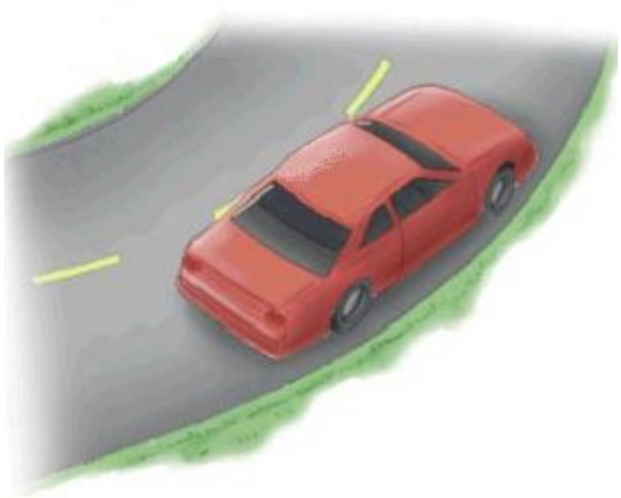
Inertia



Physical Forces

Factors that affect handling, steering, and braking including ABS systems

Momentum



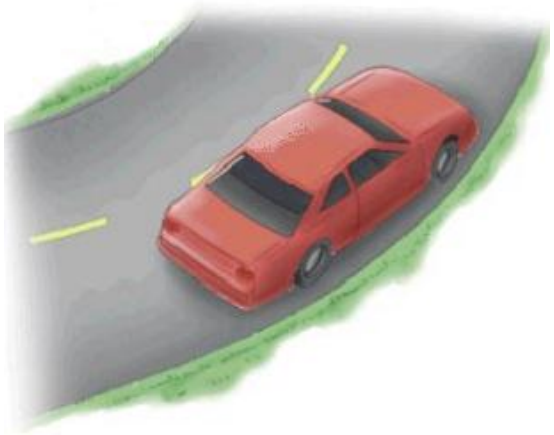
Physical Forces

Factors that affect handling, steering, and braking including ABS systems

Velocity – The rate of motion or speed

Formula converting Speed into Feet Per Second (fps)

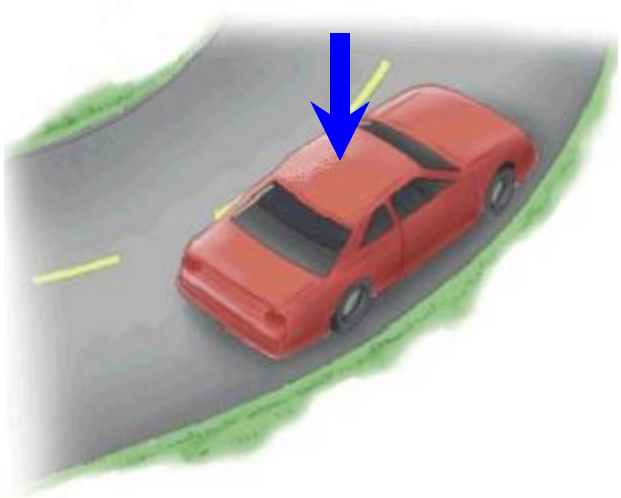
- V x 1.5 = FPS
- Example: 30 MPH is equal to 45 fps



Physical Forces

Factors that affect handling, steering, and braking including ABS systems

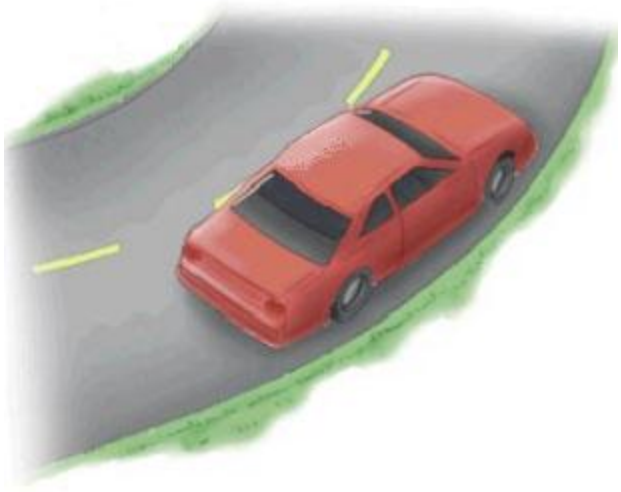
Gravity



Physical Forces

Factors that affect handling, steering, and braking including ABS systems

Kinetic Energy – Is energy in motion

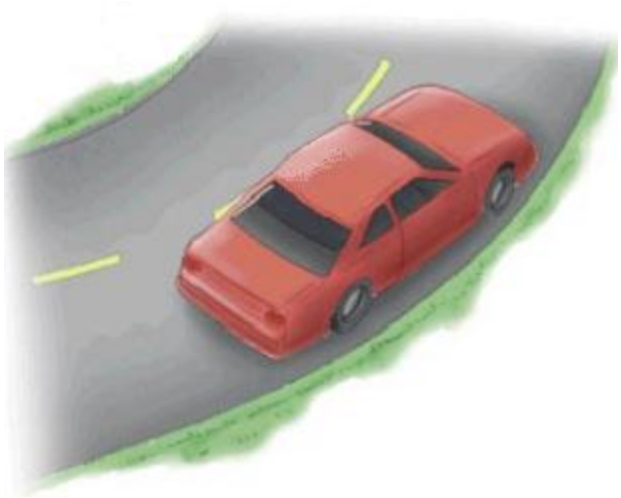


$$KE = \frac{1}{2}mv^2$$

Physical Forces

Factors that affect handling, steering, and braking including ABS systems

Friction



Physical Forces

The two most important areas of friction related to vehicle control are the:

Tires

The tread pattern of rubber tires plays a major role in determining their friction, or skid resistance.

Brakes

The application of the brake slows or stops a vehicle by converting kinetic energy into heat energy, via friction. The heat energy is then dissipated into the atmosphere.

Physical Forces

Factors that affect handling, steering, and braking including ABS systems

- Dynamics of Steering
  - Counter steering
  - Under steer
  - Over steering
  - Steering Loss

Physical Forces

Factors that affect handling, steering, and braking including ABS systems

Dynamics of Steering

Counter steering

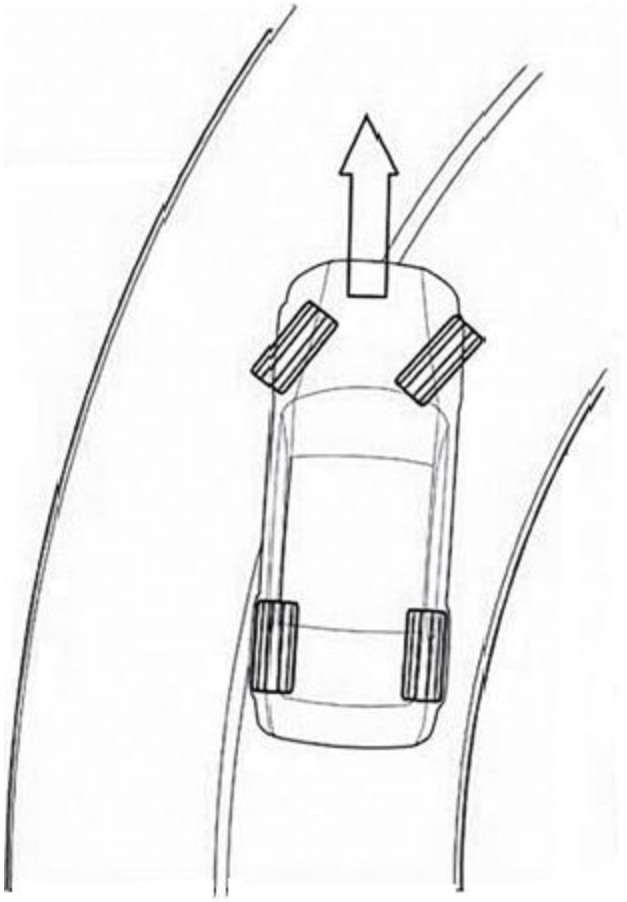
Physical Forces

Factors that affect handling, steering, and braking including ABS systems

Dynamics of Steering

Understeer

– Understeer happens when the front wheels lose their traction and won't turn any sharper, even when the steering is being corrected to turn the car more. This will cause the car to go wide instead of following the line.



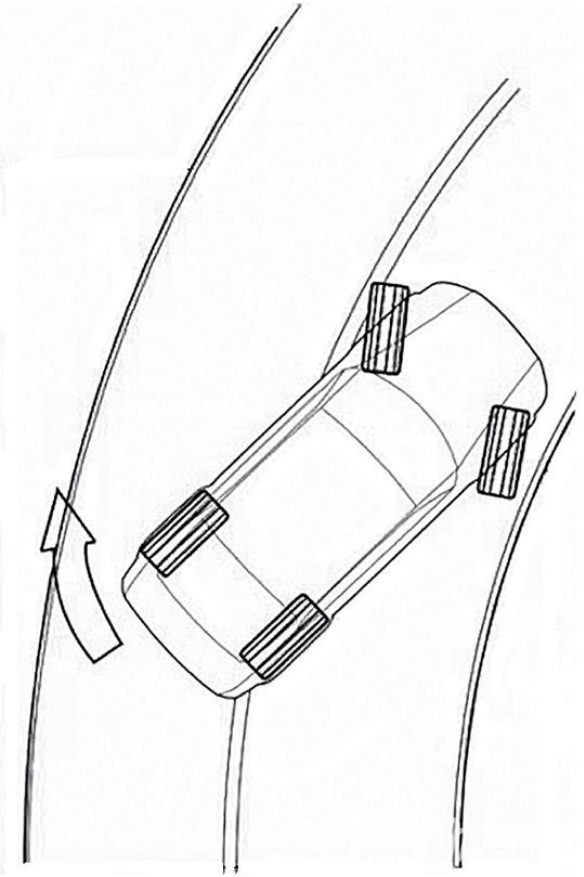
Physical Forces

Factors that affect handling, steering, and braking including ABS systems

Dynamics of Steering

Over steer

– Is when the rear tires lose grip and causing the rear end of the vehicle slides out of a corner. This phenomenon happens particularly to FR (Front engine, Rear wheel drive) or RR (Rear engine, Rear wheel drive) cars.



Physical Forces

Factors that affect handling, steering, and braking including ABS systems.

Dynamics of Steering

Steering Loss

- Steering Wheel Bind
- Lockup
- Kickback

Physical Forces

Factors that affect handling, steering, and braking including ABS systems

- Dynamics of Braking
  - Front wheel lock-up
  - All wheels locked
  - Rear wheel lock-up
  - Brake Fade
  - Weight Transfer

Physical Forces

Factors that affect handling, steering, and braking including ABS systems

- Dynamics of Braking
  - Environmental Factors
  - Vehicle Condition
  - Braking Systems

Physical Forces

Factors that affect handling steering, and braking including ABS systems

Front Wheel Lock Up

Physical Forces

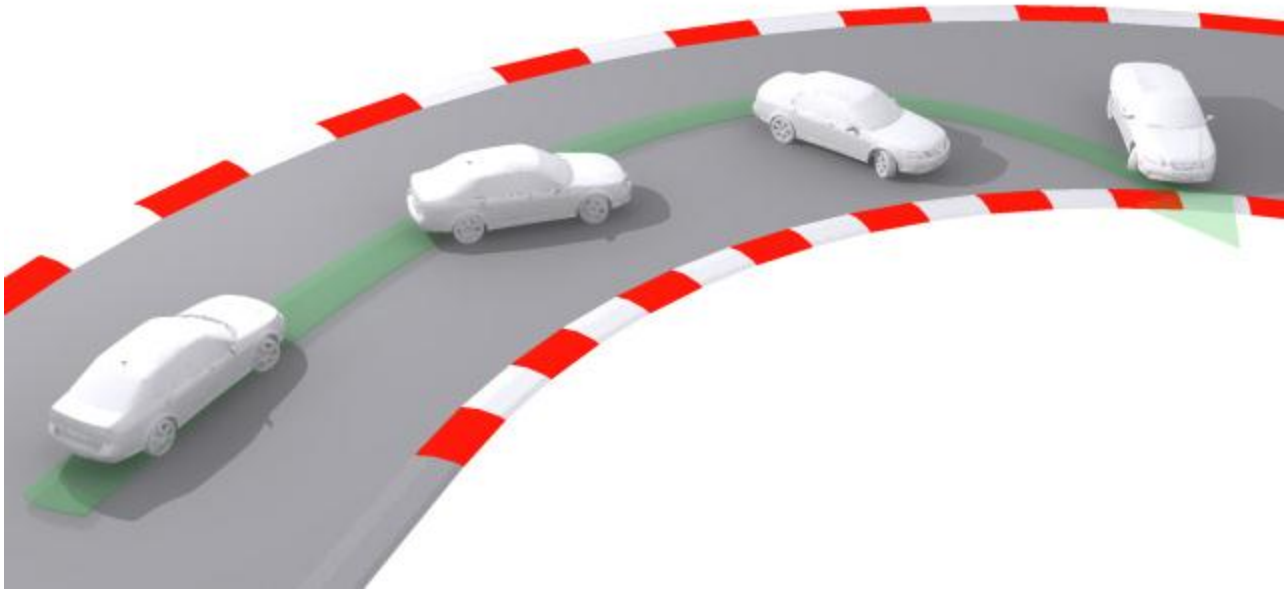
Factors that affect handling steering, and braking including ABS systems

All Wheels Locked

Physical Forces

Factors that affect handling steering, and braking including ABS systems

Rear Wheel Lock Up



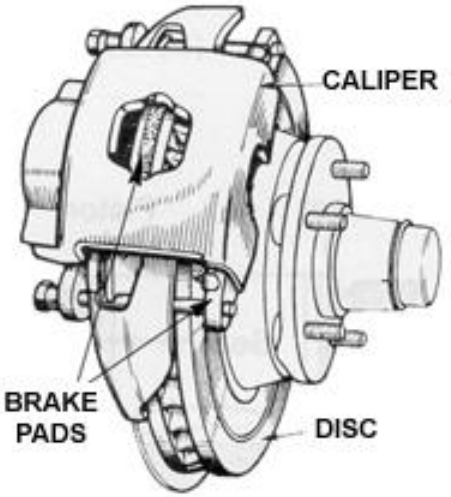
Physical Forces

Factors that affect handling steering, and braking including ABS systems

Brake Fade

Overheated brake pads

- excessive braking
- riding the brake pedal
- improperly adjusted brakes



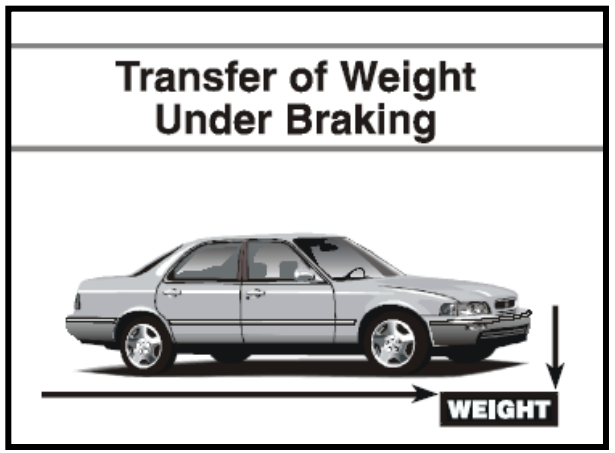
DISK BRAKE

Physical Forces

Factors that affect handling steering, and braking including ABS systems

Weight Transfer

Effective use of weight transfer is critical for safe handling of an EV.



Physical Forces

Factors that affect handling steering, and braking including ABS systems

Environmental Factors

Road Surface

Road Design or Grade

Visibility

Wind / Water

Physical Forces

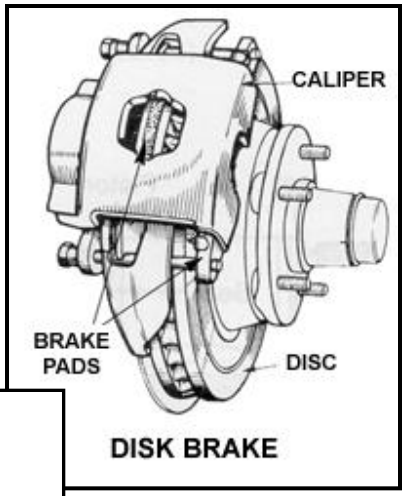
Factors that affect handling steering, and braking including ABS systems

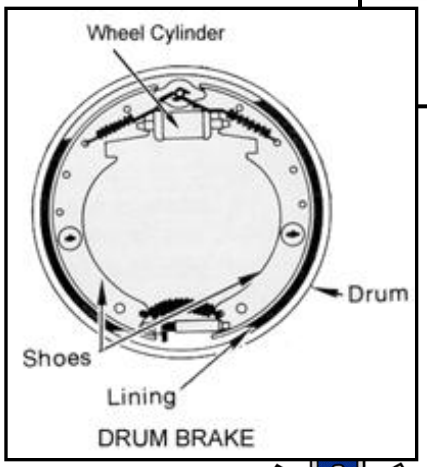
- Vehicle Condition
  - Braking Systems
  - Suspension System
  - Tires
  - Vehicle Weight / Size

Physical Forces

Factors that affect handling steering, and braking including ABS systems

- Braking Systems
  - Conventional – Drum / Disk
  - Four Wheel Disk
  - ABS – Anti Lock Brake Systems
  - Air Brakes





Antilock Braking Systems

What Is ABS?

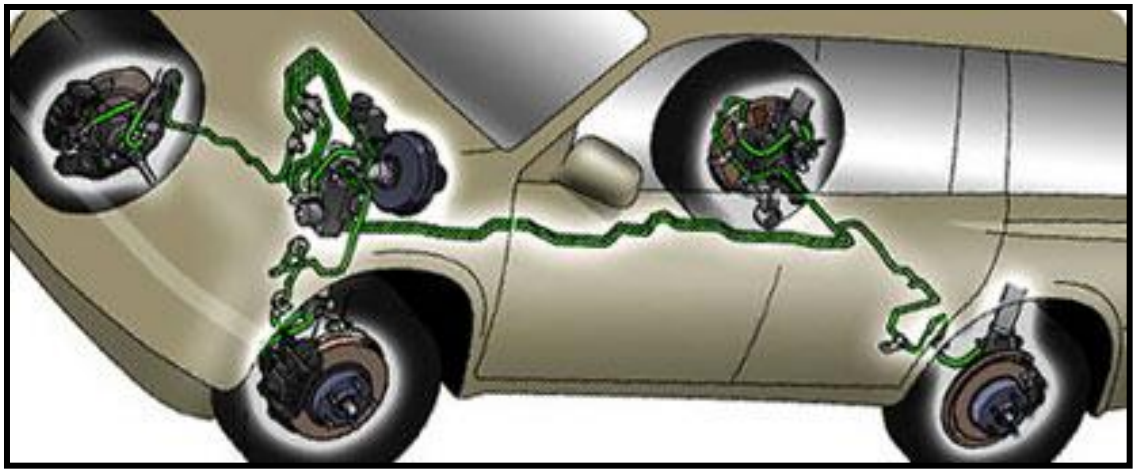
Why Are Antilock Braking Systems Beneficial?

How Does ABS Work?

What Are The Major Components Of ABS?

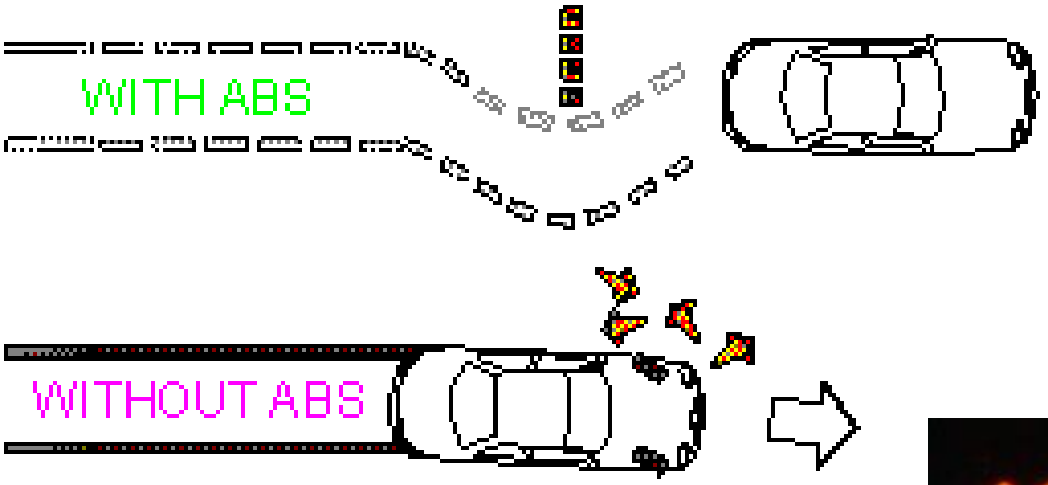
Antilock Braking Systems

What Is ABS?



Antilock Braking Systems

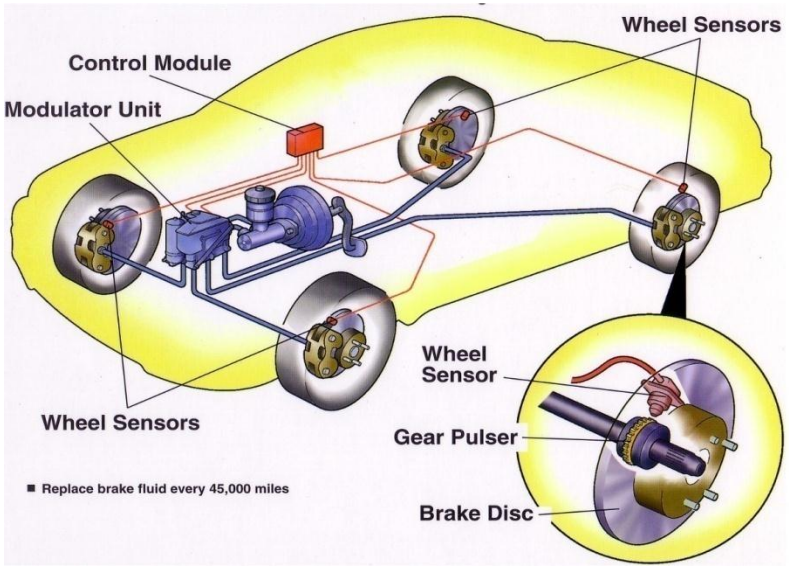
Why Are Antilock Braking Systems Beneficial?

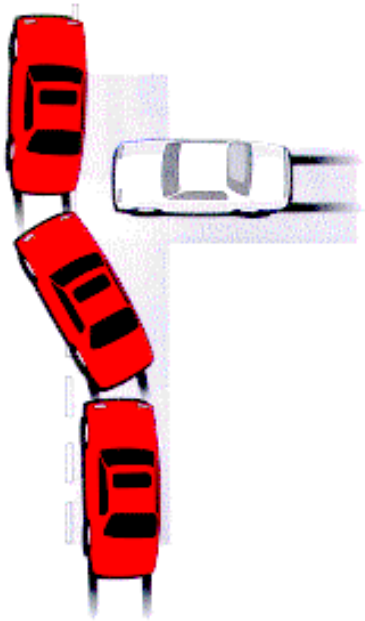


The wheels never lock up allowing the driver to maintain steering control.

Antilock Braking Systems

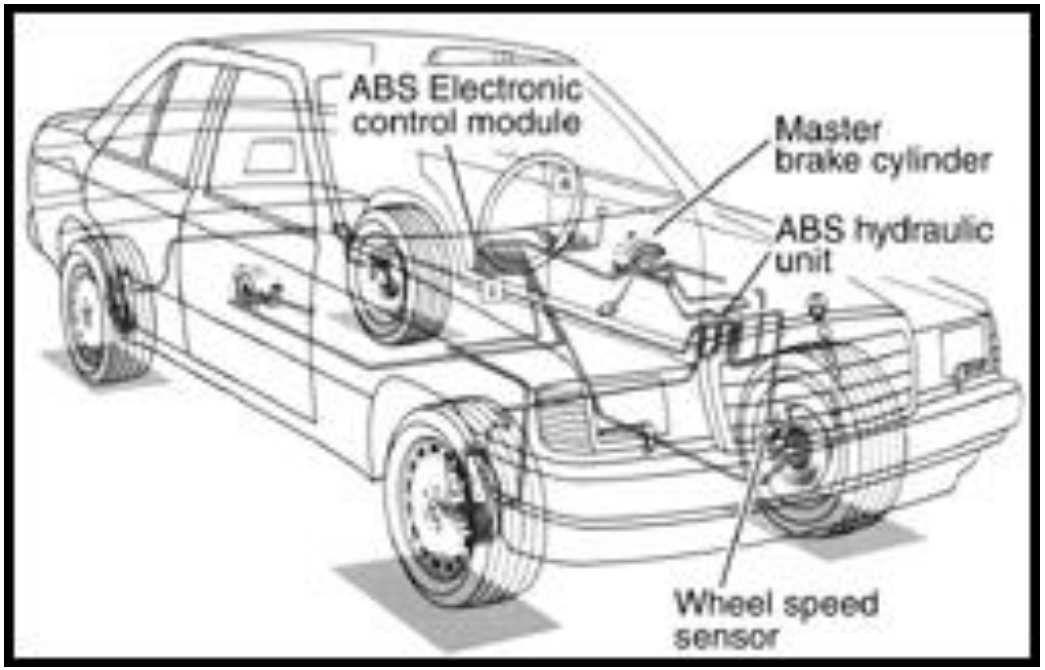
How Does ABS Work?





Antilock Braking Systems

What Are The Major Components Of ABS?



Antilock Braking Systems

What Vehicles Have ABS?

How do you tell

Full Or Partial ABS?

What axel

ABS Failure?

Do I have brakes

Antilock Braking Systems

Emergency Vehicle Training and ABS

1) ABS Video tapes from the manufacture

2) Driver's manual accompanying ABS equipped vehicles

3) ABS warning lamp symbol and functioning

4) Hands-On braking and handling familiarizations through range exercises

Summary

- **The EV operator should realize that non-emergency steering, braking, and handling methods will also work under emergency response driving conditions. By practicing the acceptable control methods the operator will be able to maintain vehicle control for all driving needs.**

REVIEW QUESTIONS

1) Velocity is defined as?

2) Inertia is defined as?

3) What is the primary cause of Brake Fade?

4) What causes weight transfer?

5) Define Counter Steering?