EMERGENCY VEHICLE OPERATOR CLASS "A"

Session 1-4 Physical Forces and Emergency Vehicle Control



OVERVIEW

Physical Influences

- Velocity
- olnertia
- •Centrifugal Force
- oGravity
- •Energy of Motion
- Rollover Prevention

PHYSICAL INFLUENCES



VELOCITY: Forward Motion & Speed

Acceleration, deceleration, braking **DIRECTIONAL CONTROL: Steering,**Maneuvering, "Tracking" Curves In The Road



PHYSICAL INFLUENCES- VELOCITY

• ACCELERATING:

- Downward force at rear increases
- More weight & traction at rear wheels if not spinning
- BRAKING OR DECELERATING:
- Downward force at front is increased
- More weight on front end; improved steering

PHYSICAL INFLUENCES- INERTIA

 The law of inertia states that an object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force. The law of inertia is sometimes referred to as Newton's first law of motion.



PHYSICAL INFLUENCES- INERTIA





PHYSICAL INFLUENCES- CENTRIFUGAL FORCE

- The apparent force that is felt by an object moving in a curved path that acts outwardly away from the center of rotation.
 - Affected by speed, tire inflation pressure, sharpness of bank of curve, type of road surface, radius of the curve
 - Acts adversely with velocity, center of gravity, momentum, and inertia to create rollover and uncontrolled skidding



PHYSICAL INFLUENCES- CENTRIFUGAL FORCE





PHYSICAL INFLUENCES- CENTRIFUGAL FORCE





Session 1-4

PHYSICAL INFLUENCES- GRAVITY



 The force that attracts a body toward the center of the earth, or toward any other physical body having mass. For most purposes Newton's laws of gravity apply, with minor modifications to take the general theory of relativity into account



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PHYSICAL INFLUENCES- GRAVITY

HIRE & RESCUE

- Acts on Emergency Vehicle when going up/ down hills
- Must increase power to overcome this force; may involve gear changes



PHYSICAL INFLUENCES- ENERGY OF MOTION

 Energy of motion is the energy an object possesses due to its motion, which is also called kinetic energy. This means that the object, which has energy of motion, can do work on any object it hits



PHYSICAL INFLUENCES- ENERGY OF MOTION

- Energy of motion increases as the square of its change in speed
- Double the speed, stopping distance increases by 4x
- 3x the speed, stopping distance is 9x
- Reduce speed by 1/2, energy of motion reduced by 1/4

Three Key Factors:

- Excessive relative speed causes most rollovers
- Many fatalities can be avoided if occupants wear seatbelts
- Fire and EMS vehicles are involved in rollovers



- The Driver:
 - Training
 - Experience
 - Physical Condition
 - State of Mind



- The Vehicle:
 - Height, Weight, Width
 - Suspension



Common Rollover Circumstances

- Excessive Relative Speed
- Soft Shoulder Drop-off
- Uneven Surface Drop-off and Improper Recovery

Components of a Rollover Collision

- Physical Dynamics of Vehicle Operations
 - Inertia
 - Momentum
 - Center of Gravity
 - Friction
 - Centrifugal Force

Components of a Rollover Collision

- Mechanics of Vehicle Operations
 - Relative Speed
 - Specific Road Conditions
 - Effect of Body Roll, Center of Gravity, Tire Sidewall Flexibility

Road Conditions

Conditions That Effect Rollover

- High Center Crown
- Reverse or negative camber
- "S" Curves
- Restrictions of Lane Widths

Body Roll, Center of Gravity

- The body of a vehicle pivots around the center of side to side
- Keep body roll to a minimum
- Radial tires are designed to flex
- Consider moving loads
- Speed contributes to weight shift and control of vehicle

Weight Transfer, Understeering, Braking & Uneven Surfaces

- Know how your vehicle handles
- Braking and deceleration have an effect on weight transfer
- Overcompensation & oversteering can cause a vehicle to go out of control



Steering Axle and Tire Friction

- Eight patches of rubber are the only thing holding you on the road
- Do not over steer if your vehicle drops off the road surface



Things To Do:

Take your foot off the accelerator and allow the vehicle to slow down gradually

✓ Do not apply full braking

- ✓ Soft application of brakes
- Natural deceleration and down shifting



Things to Do:

✓ Soft Shoulder

Feather the accelerator to maintain control while slowing down

Rev. 12/14/10	Rev.	12/	/14/	/16
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- Things Not To Do:
- ☑ Do not attempt to steer back onto the road surface at speed or under acceleration.
- **I** Do not make any sudden or drastic steering movements.
- **IX** Do not apply full braking.
- **I** Do not attempt to accelerate over the surface drop off.



- Reduce speed upon leaving the roadway
- ✓ Stabilize vehicle
- ✓ 9-3 placement on Wheel/Shuffle Steering
- Control Vehicle, Do not brake
- Re-enter roadway 1 wheel at a time



Can this be avoided?





REVIEW

HIRE & RESCUE

- Physical Influences
 - Velocity
 Inertia
 Centrifugal Force
 Gravity
 Energy of Motion
- Rollover Prevention

