

OBJECTIVE 3.4 Identify the changes in vehicle dynamics that occur during an emergency response.

INTRODUCTION

As the officer responds to an emergency, the vehicle will usually travel at speeds greater than normal. With increased speed, and the distraction from driving caused by the emergency condition, the officer should understand how the vehicle dynamics will change.

CONTENT

The following concepts are consistent with increased speeds:

1. STEERING

- a. Countersteering: due to speed and weight transfer, the vehicle may experience a side skid while negotiating a correct turn. The skid will necessitate countersteering, which is steering into the skid, i.e., the direction in which the vehicle was to go originally.
- b. Over-Correct Steering - In a secondary skid there is a tendency to over-correct steering input and allow the vehicle to get into a lesser skid in the opposite direction. This skid requires a conscious effort on the part of the driver to carefully control the steering of the vehicle.
- c. Steering in a Skid - When the vehicle brakes lock up, there is a loss of control in the steering of the vehicle. Regardless of the steering, the vehicle will proceed in a straight line. This skid requires the operator to release the brakes and use a threshold braking method.
- d. Understeer - The handling characteristic of a vehicle that tends to increase the desired cornering radius as the vehicle progresses through a turn. To correct this condition, the driver should slowly straighten the steering until directional control is regained.
- e. Oversteer - The handling characteristics of a vehicle that tends to reduce the desired cornering radius as the vehicle progresses through a turn. To correct this condition, the driver should slowly straighten the steering and use weight to control the rear of the car.

2. BRAKING**a. Front Wheel Lock-up**

- (1) Caused by improper brake adjustment or slick spot on the road
- (2) Causes reduced braking ability and loss of steering
- (3) Rear wheels act as a rudder and maintain straight ahead slide.

b. All Wheels Locked

- (1) Caused by a panic situation in which brakes are applied abruptly and hard enough to lock all four wheels
- (2) The vehicle will probably skid in a straight line as long as variables such as road surface, tire tread, and air pressure are fairly even.

c. Rear Wheel Lock-up

Caused by improperly adjusted brakes which cause rear wheels to lock while front wheels continue to rotate

d. Brake Fade

Most common during a drive when frequent use of the brakes does not allow for proper cooling: the brakes are unable to grab and stop wheel movement.

3. CORNERING**a. Centrifugal force -** As a vehicle travels around a corner at high speed, there is an increase in the centrifugal force which impels an object outward from a center of rotation.

- (1) A turn or curve can not be entered at a speed greater than the driver and vehicle can handle.
- (2) Any braking done in a curve will take away from the steering capability.

- (3) No increase in acceleration should occur until the vehicle begins to exit the turn or curve.
- b. Centripetal Force - Opposite of centrifugal force, which must act on a vehicle in order to cause it to move in a curved path.
 - (1) Centripetal force and centrifugal force must be in balance when driving around a curve or turning a corner.

4. WEIGHT TRANSFER

- a. It occurs when the vehicle changes velocity or direction.
- b. As a vehicle accelerates, the front lifts, causing weight in rear to increase. This weight shift to the rear can cause loss of traction for front-drive vehicles, but an increase in traction for rear-wheel drive vehicles.
- c. When braking the vehicle, weight is transferred to front wheels which have high braking efficiency.
- d. Change in direction transfers weight from one side of the vehicle to the other, which is more noticeable in vehicles with high center of gravity.

SUMMARY

When the student understands how vehicle dynamics change during the increased speeds of an emergency response, the chance for vehicle control increases significantly.

SUGGESTED INSTRUCTIONAL METHODOLOGY

LECTURE WITH VIDEO TAPES

Make a videotape of your range activities. Obtain one which demonstrates the following concepts:

- 1. Steering
 - a. Countersteering
 - b. Over-correct steering

- c. Steering in a skid
 - d. Understeer
 - e. Oversteer
2. Braking
 - a. Front wheel lock-up
 - b. All wheels locked up
 - c. Rear wheels lock-up
 3. Cornering Effects
 4. Weight transfer

In conjunction with the videotape demonstration, explain how these concepts work against a law enforcement officer during an emergency response and explain how they can be avoided.

LECTURE WITH DEMONSTRATION

Use a model car that has steerable front wheels.

Demonstrate a rear wheel skid by placing a model car with the rear wheels blocked, on an inclined board. The wheels can be locked by placing a small piece of cardboard between the rear wheel and the frame. The student will be able to observe a rear wheel skid. The same thing can be accomplished with the front wheels.

Allowing the car to roll down the incline with all wheels rotating and the steering turned fully to either side, the student will be able to observe the effects of speed upon the vehicle during cornering. To show an increase in speed, elevate the incline.

RANGE

Create range activities to have the students identify steering, braking, cornering, and weight transfer effects while the vehicle is traveling at various speeds. Refer to Appendix C for example exercises.

RESOURCES AND AIDS

1. Physics textbooks
2. Driver training textbooks covering concepts of vehicle dynamics
3. Collision investigation textbooks
4. "Police Driving Techniques," by Anthony Scotti
5. Model car for classroom demonstrations
6. Practice driving area
7. Driver training vehicles

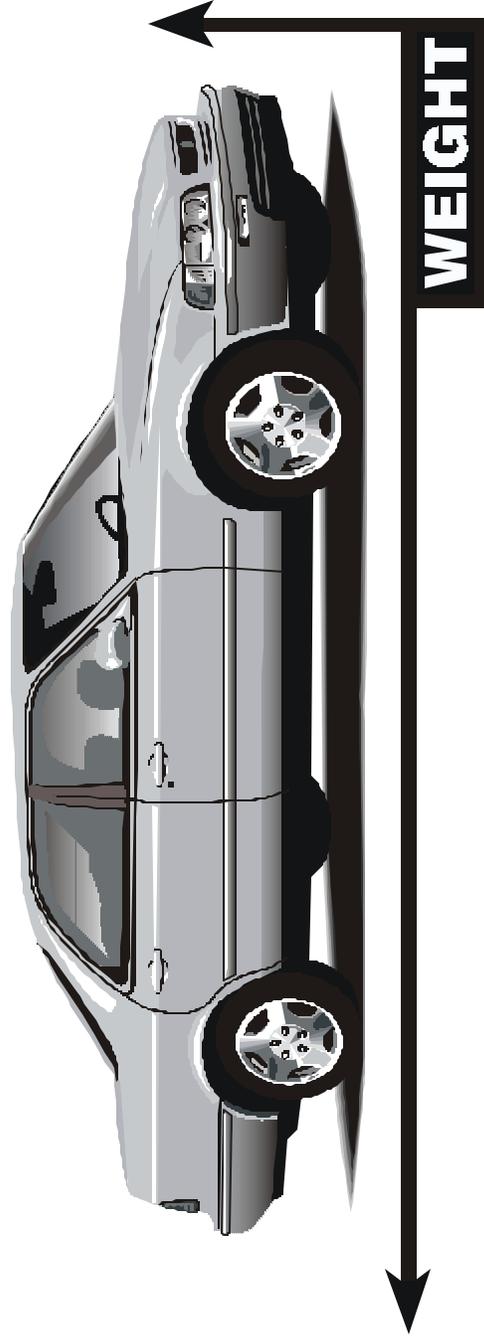
SUGGESTED EVALUATION METHODOLOGY**STUDENTS**

1. Written or verbal responses to questions on vehicle dynamics and conditions existing in an emergency response
2. Written or verbal identification of various vehicle dynamics concepts during practice driving area demonstrations or video demonstrations

COURSE

Observe officer's on-the-job performance.

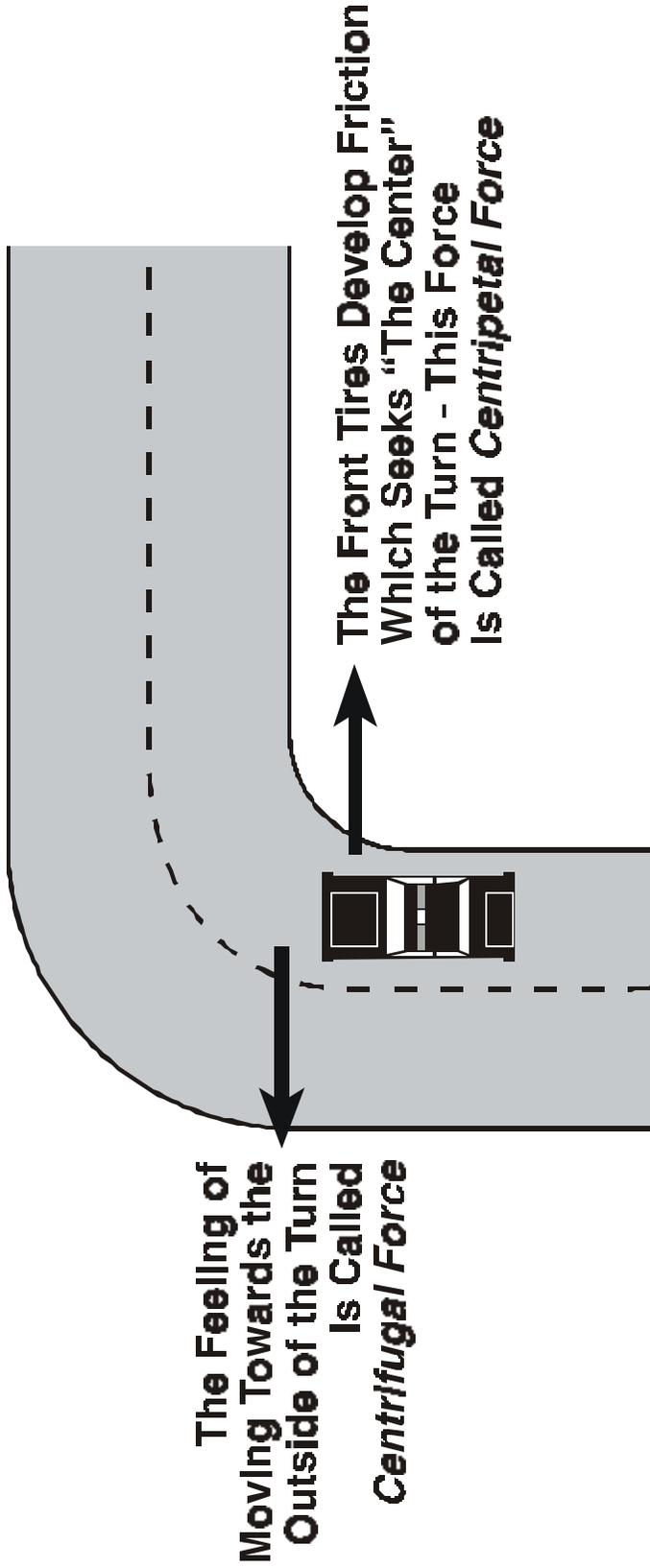
Transfer of Weight Under Acceleration



Transfer of Weight Under Braking



Cornering



Forces Must Balance for Successful Completion of a Turn