CHAPTER 4

VEHICLE DYNAMICS

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CHAPTER 4

VEHICLE DYNAMICS

1. VEHICLE PLACEMENT. A large percentage of departmental accidents occur while the vehicle is being operated at low speeds, such as in parking lots or while backing. Many of these accidents involve fixed or stationary objects. Consideration of some basic concepts in steering a vehicle will minimize the potential for low speed or vehicle placement accidents.

a. Rear Wheel Cheat. Rear wheel cheat is present any time a vehicle is turned from a straight path. While driving forward and turning to the left, the rear tires will follow a path to the left of the path travelled by the front tires. When turning right, the rear tires will track to the right of the front tires. In a standard-size vehicle, the path of the rear tires may be as much as 36 inches closer to the inside of the turning radius than the front tires. The severity of the rear wheel cheat is in direct proportion to the degree of turn attempted and the vehicle wheelbase.

(1) There are two methods of compensating for rear wheel cheat when turning a vehicle.

(a) The simplest method is to swing wide enough to allow space for the rear of the vehicle to clear the hazard, in the same manner as a bus turning a corner in the city. This may not always be possible in confined areas.

(b) In the second situation, a driver must remember the rear axle is the pivot point of the vehicle's turning movement. The driver should proceed in a straight line until the rear axle is aligned with the hazard. The turn can then be accomplished without any danger of the rear of the vehicle contacting the hazard.

(2) When operating in confined areas, a driver can best accomplish accurate vehicle placement by guiding primarily on the left side of the vehicle and leaving the maximum amount of available space on the right side of the vehicle.

b. Front-End Swing. Backing a vehicle brings different dynamics into play. The most obvious factors are the limited vision to the rear and the fact that the vehicle steering is now reversed, and controls are awkward to reach. A driver must again remember that the rear axle is the pivot point of the turning movement.

(1) When backing to the right, a driver must consider that the front of the vehicle will swing out to the left as much as four feet. This front-end swing can be responsible for a crash if the driver fails to allow sufficient space. When

backing and turning in confined areas, it is important to position the vehicle as closely as possible in the direction the vehicle is to be turned. A driver should turn the vehicle no more than necessary to accomplish the maneuver. This will minimize the front-end swing and the potential for a crash.

(2) Backing should be done with the upper body turned toward the right, the right arm on the seat back and the left hand positioned toward the top of the steering wheel. This will allow the driver maximum vision through the rear window.

(3) In confined areas, a driver can periodically check the left mirror to ensure accurate vehicle placement and maximum vision to the left. Opening the door, looking out the left window, or relying solely on the left mirror should not be attempted as a driver will not be able to see hazards toward the right rear of the vehicle.

(4) As speed is increased in reverse, steering smoothness becomes more important and, as many have experienced, small movements of the steering wheel may result in violent weight transfer and erratic steering control.

(5) In vehicles with limited or obstructed visibility to the rear, drivers should utilize side rearview mirrors as well as a back-up camera if equipped. Drivers need to confirm the blind spot directly behind the vehicle is clear prior to beginning any backing maneuvers.

2. BRAKING. The sudden realization that the brakes are not working properly can be a terrifying experience. This is particularly true when this condition is discovered at the precise moment the brakes are desperately needed the most.

a. Brake Failure. Brake failure is due to a mechanical malfunction in the braking system. The particular situation will have to dictate what the following action will be.

(1) Downshifting to the lowest gear available may reduce speed enough to steer around a hazard, or it may be best to concentrate on steering and the power of the engine to get out of the situation.

(2) If no open escape route is available, the last and most undesirable alternative may be to lessen the force of a crash by attempting a sideswipe crash with parked vehicles or an embankment.

(3) A driver experiencing total brake failure must remember, above all, that they still retain steering and throttle control of the vehicle. Panic and indecision

can result in the driver losing complete control of the vehicle when resolute action is most needed.

b. Brake Fade. Brakes, when overused and consequently overheated, will begin to lose their braking efficiency. This is termed “brake fade.” This usually occurs on steep downgrades or in a pursuit which involves frequent, hard brake applications.

(1) A discussion of the principle of conservation of energy would clarify the phenomenon of brake fade. Energy can be neither created nor destroyed, but may be converted to another form. Kinetic energy, which is present by virtue of the movement or speed of a vehicle, must be converted to heat in order to slow or stop a vehicle. This heat must be dissipated by the braking system as a vehicle stops.

(2) An example of the severity with which brake fade can affect braking performance was demonstrated during the following test:

(a) The test vehicle could be stopped initially from 60 miles per hour (mph) in a distance of 185 feet, and brake temperature averaged 200 degrees Fahrenheit. After deliberately overworking the brakes to a temperature of 450 degrees Fahrenheit, stopping distance lengthened to 486 feet, an increase of over 2 1/2 times.

(b) The important point for a driver to understand is that the kinetic energy created by the vehicle increases as a square factor of the velocity or speed (V^2). In simpler terms, as a driver doubles the speed of the vehicle (20 mph to 40 mph), the kinetic energy increases by four times. This means dissipating four times as much heat which, at maximum braking effort, will take four times as long. If the speed increases by three times (20 mph to 60 mph), the stopping distance increases nine times. By using the formula $\mathbf{KE = \frac{1}{2}WV^2 / 32}$ it can be shown that the current Class E vehicle used by the Department develops over 2,000,000-foot/pound (lb.) of energy at 120 mph. This energy, if it could be so channeled, would lift a 2,000,000 lb. building one foot off the ground. As a further example of the extreme, destructive heat generated at high speeds, the brakes must generate and dissipate as much heat slowing the vehicle from 90 mph to 70 mph as would be required in slowing from 70 mph to a complete stop. A driver encountering brake fade should attempt to slow the vehicle by other means, as an effort to allow the brakes to cool.

(c) As suggested, during brake failure the first consideration should be to shift to a lower gear for deceleration. If there is time, smoothly increase engine speed to more closely match wheel speed before downshifting. The parking brake **may** provide enough stopping power through the rear brakes to slow the vehicle.

(d) Drivers should not get so engrossed in finding a way to brake the vehicle that they forget they are still able, and may be required, to steer away from hazards. When speed is reduced to a level safe enough to do so, get off the road and allow the brakes to cool before attempting to move the vehicle again.

c. <u>Anti-Lock Brake System</u>. The purpose of the anti-lock brake system (ABS) is to prevent wheel lock-up under heavy braking conditions on virtually any type of road surface. An ABS is desirable because a vehicle which is stopped without locking the wheels will allow the driver to maintain directional stability and some steering capability (rolling friction). However, there are conditions where ABS does not provide any benefit. In particular, hydroplaning is still possible when the tires ride on a film of water, resulting in the tire leaving the road surface, rendering the vehicle virtually uncontrollable. In addition, extreme steering maneuvers at high speed or high speed cornering beyond the limits of tire cohesion may cause the vehicle to skid independent of vehicle braking. For this reason, the ABS is termed “anti-lock” instead of “anti-skid.” An ABS is not intended to stop a vehicle in a shorter distance. The basic laws of physics cannot be changed. This means if the coefficient of friction between the tire and the road does not change, the stopping distance will not improve. An ABS allows panic braking and steering at the same time for better accident avoidance.

(1) Sensors located within the system continuously monitor each wheel’s rotation and relay this data to a microprocessor which controls brake pressure during braking. When a sensor detects a wheel is about to lock up, the microprocessor rapidly modulates hydraulic pressure to that brake, either left front, right front, or both rear brakes, providing maximum braking efficiency without wheel lock-up. This, in effect, modulates the brakes up to ten times per second, much faster than any driver could. A computer continuously monitors the ABS, via wheel speed sensors. If an abnormal condition is detected within the ABS, the computer deactivates the ABS function and turns on an amber warning light in the instrument panel to alert the driver. The normal hydraulic power-assist brake system function is not affected. If the ABS warning light is on, the driver shall immediately drive the vehicle back to the Area office and place the vehicle out of service.

(2) Braking should always be done gently and gradually, whether on routine patrol or in a performance driving application. In the event a driver encounters a panic situation and brakes too hard or abruptly, the ABS will detect this condition, and the microprocessor will rapidly modulate hydraulic pressure to

prevent any wheel lock-up. The driver will experience a pulsating sensation through the brake pedal during ABS operation, this is normal. Do not release brake pressure when this occurs, but maintain firm, steady braking pressure until the maneuver is complete. **Never pump or modulate the brake pedal during ABS operation.** The ABS is designed to maintain rolling friction so the driver can steer the vehicle around any potential hazards.

(3) It is important to remember that ABS-equipped vehicles have parking brakes that are designed for static parking only and should not be used when the vehicle is in motion. Attempting to use the parking brake with the vehicle moving, such as attempting to execute a U-turn maneuver, will result in extensive damage to the brake system. (Refer to Annex A.)

d. Electronic Stability Control. Electronic stability control (ESC) is computerized technology that improves the safety of a vehicle's stability by detecting and reducing the loss of traction. During normal driving, the ESC works in the background and continuously monitors steering and vehicle direction.

(1) During normal driving, all of the sensors report vehicle data to the computers. By comparing the steering wheel angle to the vehicle readings, the computers are able to determine if the driver has the vehicle under control, or has entered an unstable situation (e.g., a skid or uncontrolled slide).

(2) The ESC system compares the driver's intended direction of travel to the vehicle's actual direction. The ESC intervenes only when it detects a probable loss of steering control, when the vehicle is not going where the driver is steering. The ESC does not improve a vehicle's cornering performance; instead, it helps to minimize the loss of control. Essentially, the ESC attempts to prevent loss of control due to oversteer and understeer conditions. This may happen, for example, with the loss of traction resulting from poorly judged turns and on slippery roads or hydroplaning. The ESC may also activate during high-performance cornering. The ESC can work on any surface, from dry or wet pavement to black ice and frozen surfaces. It reacts to and corrects loss of traction much faster than the driver. Performance of the ESC is limited by available traction, which snow, ice, water, and other conditions can affect. For example, in a severe hydroplaning scenario, the wheels the ESC would use to correct a skid may not initially be in contact with the road, thus reducing the ESC system's effectiveness. Activation of the ESC system is an indication that at least some of the tires have exceeded their ability to grip the roadway.

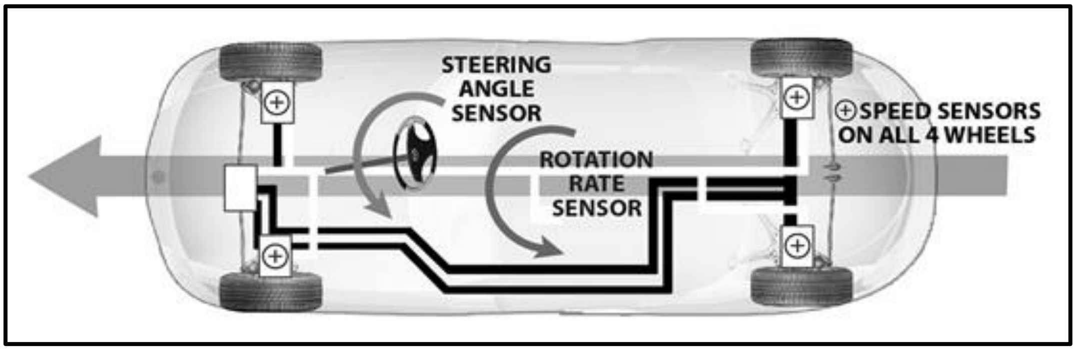
(3) The ESC regulates hydraulic and mechanical components on the vehicle using sensors shared with the ABS and the traction control system (TCS). With a typical stability control system, the ABS and TCS sensors monitor the

speed of each wheel. The ESC information is fed into combined computers via three types of sensors.

(a) Speed sensors. One speed sensor at each wheel measures the speed of the wheel.

(b) Steering angle sensor. This sensor, which is in the steering column, measures the amount of steering input the driver initiates.

(c) Rotation rate sensor. This is also known as the center axis rotation or “yaw” sensor. The rotation rate sensor is located in the center of the vehicle and measures the rate of rotation around the center vertical axis of the vehicle (yaw).



(4) The ESC system lessens the likelihood and/or severity of skids and lateral slides. It automatically applies the brakes to individual wheels, such as the outer front wheel to counter oversteer or the inner rear wheel to counter understeer. When needed, some ESC systems also reduce engine power until control is regained. This slows the vehicle, allowing the driver to “steer” where they intend to go. If the ESC warning light flashes and the ESC system is engaged, the driver should utilize less throttle and steer in the intended direction of travel, and maintain steering input for the intended path through the turn while easing off the throttle. Attempting to countersteer can act to defeat the effectiveness of ESC.

(5) The ESC works within the vehicle’s handling limits and provides traction between the roadway and the tires. It is imperative the driver maintain proper speed and driver input for prevailing road conditions. Driving recklessly with excessive entry speeds will likely exceed the handling limits of the vehicle and cause loss of control. Remember that even advanced technology can never overcome careless driving actions.

(6) Officers driving patrol vehicles equipped with ESC should still utilize good performance driving techniques (e.g., straight line braking, high entry, entering turns at less than maximum speed, and achieving an apex). Proper use of these techniques will avoid the activation of ESC.

e. Left-Foot Braking. Many drivers have acquired the habit of “left-foot braking” when driving a vehicle equipped with an automatic transmission. Some driving school instructors recommend this practice. It is true that the use of the left foot could, if positioned on the brake pedal at all times, slightly decrease the normal reaction time; however, unless the left foot is poised over or upon the brake pedal, it takes no longer to brake with the right foot. The following are some reasons that left-foot braking should not be practiced:

(1) A driver is best braced when the left foot is placed against the left floorboard of the vehicle and the right foot is positioned over the accelerator pedal. The three-point position will stabilize the driver’s position behind the steering wheel and helps retain control during sudden vehicle movements that occur during an evasive action, mechanical failure, or actual impact with another object.

(2) In an emergency stop, the “left-foot braker” can end up with both the accelerator and brake pedal depressed. Not only is the engine trying to keep the vehicle moving but vacuum boost is reduced, and more pedal pressure is required to operate the brakes.

(3) Maximum deceleration is acquired through threshold braking. Rolling friction, which will be discussed later in this chapter, allows the driver to maintain directional control of the vehicle. For most drivers, braking just short of a locked wheel skid is best achieved with the right foot.

(4) Left-foot brakers have a tendency to allow their left foot to rest on the brake pedal, actually pushing it down. It is unlikely that their foot will remain poised over the pedal without touching it for any length of time. Even a slight pressure can cause brakes to rub and become heated. The constant friction of brake shoes and pads will result in rapid destruction of disc brake rotors, pads, and shoes. Operators may find themselves with inadequate brakes when they need them most.

f. Wet Brakes. Wet brakes, like brake fade, are a temporary condition. The brakes may be dried out by lightly pressing the brake pedal.

3. SKIDS. Probably the biggest factor which makes skids a significant accident cause is misinformation regarding their cause, effect, and correction. An untrained or

inexperienced driver who knows little or nothing about the forces involved with skids can suffer momentary panic and often does nothing or the wrong thing.

a. A vehicle is supported on a cushion of air within the tires. Control of the vehicle is transmitted through the four-tire "footprints," each about the size of a person's hand. Changes of direction or speed are made by twisting these rubber patches. The cohesive quality between the rubber and the roadway is called the coefficient of friction, which is a variable factor. It depends upon the rubber compound in the tire, variations of tread, the roadway surface (be it concrete or asphalt), or foreign substances such as sand, oil, water, or ice upon the roadway. When one or more of the tires exceed the coefficient of friction, skidding occurs.

b. Acceleration Skids. Acceleration skids usually involve only the rear drive wheels. To maintain control of the vehicle, wheel slippage may be stopped by easing up on the throttle which will reduce torque to the rear drive wheels. In a turn, acceleration skids will usually progress to oversteer with rear-wheel drive vehicles, or understeer with front- or all-wheel drive vehicles. Accelerating to the point of wheel spin puts tremendous strain on the drive train components, wears out tires, and results in a slower start than controlled acceleration.

c. Locked-Wheel Skids. There are two types of braking skids: locked-wheel and impending. Locked-wheel skids are the most undesirable of the two because the driver relinquishes all directional control of the vehicle. The front wheels steer only by rolling friction. With the brakes locked, all efforts to turn the vehicle from its course will be futile. If all four wheels lock, the vehicle will have a tendency to rotate. The rotation of the vehicle can be affected by the roadway surface, weather conditions, a crown in the roadway, or a sloping roadway.

d. Impending Skids. As opposed to a locked-wheel skid, an impending skid allows the driver to retain directional control of the vehicle because the wheels are still rolling. An impending skid on clean pavement will leave traces of rubber, but not solid black skids. An impending skid will also stop the vehicle in the shortest distance because the vehicle is not sliding on a layer of melted rubber.

e. Understeer "Slip Angle." Most front-engine automobiles are designed in a manner that produces an understeer characteristic. This means simply that the vehicle wants to go in a straight line. If something disturbs its path, it has a tendency to straighten itself out and return to the original direction of travel. While this may be of benefit to the average motorist who wants to exert minimum effort in controlling the vehicle, it does introduce problems in vehicle handling in that a greater effort is required to move the vehicle from a straight line. Some natural forces aggravate the understeer problem. Centrifugal force, the force that tends to pull the vehicle toward the outside of a turn, may overcome the driver's input of centripetal force necessary to allow the vehicle to negotiate a turn. The initial result is usually understeer, causing the turned front wheels to skid sideways. Understeer should not be confused with the principle of rolling friction. In an understeer condition, the front tires are skidding sideways even though they are still rolling.

(1) There are three basic and related driver-caused reasons for understeer.

(a) The most common cause of understeer is simply the driver attempting to negotiate a curve at an excessive rate of speed. Cohesion between the front tires and roadway is overcome and the vehicle will not turn to the degree necessary to negotiate the curve.

(b) The second cause of understeer is improper throttle application while cornering. If a driver attempts to accelerate too early in a curve, or accelerates too hard, weight is transferred from the front to the rear of the vehicle. Engine torque is also providing a straight-ahead pushing force through the rear wheels. Coupling the lightened front end with the pushing rear wheels can induce understeer. This characteristic may be further complicated by slippery pavement or foreign materials on the roadway surface in the same manner that roadway conditions affect stopping distance. This is because steering also relies on friction between the vehicle tires and the road surface.

(c) Abrupt steering input while cornering can cause a loss of traction and will likely result in understeer.

(2) Understeer occurs in varying degrees of severity. When a front wheel is steering a vehicle, the rubber tire is deformed. Although the wheel is turned a given amount from straight ahead, the tire tread assumes a lesser degree from straight ahead than does the wheel. The difference in the angle the wheel is turned from the angle assumed by the tread contacting the roadway is called the slip angle. This slip angle, and therefore understeer, is always present when a vehicle is cornering. At low speeds or in moderate curves it goes unnoticed; however, as speed and cornering forces are increased, the slip angle increases up to the point of breakaway. When breakaway has been reached, a driver may experience the extreme example of understeer with the front wheels turned completely to lock the vehicle proceeding straight ahead.

(a) An example of slip angle and understeer is given in the following test using a patrol vehicle. At idle speed, a U-turn with steering locked could be executed in 44 feet 6 inches. The same turn attempted at 10 mph took 53 feet. When the vehicle was accelerated, short of wheel-spin or front tire breakaway, the U-turn took 57 feet 6 inches.

f. Oversteer. Oversteer means simply that the rear of the vehicle slides to the outside of a curve as the front of the vehicle tightens its turning radius. The rear tires exceed the limit of cohesion and the back end of the vehicle skids toward the outside of the turn. Oversteer can be the result of braking into the entry of a turn; sudden rough steering movements; sudden application or withdrawal of the throttle; reduced rate of cohesion due to water, ice, or foreign materials; or a progression from understeer.

(1) When a vehicle is understeering in a turn because of excessive speed or throttle application, tremendous stress is placed on the front tires, wheels, and suspension. This has the effect of braking with the front wheels as the front tires skid sideways. As this stress reduces the vehicle's speed, traction will be regained by the front tires which are now turned sharper than necessary to negotiate the radius of the turn. At this point, the vehicle turns abruptly toward the inside of the curve which causes the rear tires to exceed cohesion, and the vehicle almost instantly attains a condition of oversteer.

(2) If the oversteer is a result of excessive throttle or rough steering while in a curve, control would normally be gained by looking in the desired direction of travel, smoothly letting up on the throttle, and simultaneously countersteering or turning the front wheels toward the outside of the curve.

g. Four-Wheel Drift. Four-wheel drift describes that condition when a cornering vehicle is beyond the limits of cohesion and in a balanced understeer/oversteer attitude. The vehicle is pointed in the direction it is traveling and all wheels are following a line of the curve; however, the vehicle is evenly drifting or skidding toward the outside of the curve. If there is adequate roadway available, the vehicle may negotiate the turn without incident.

(1) The danger involved with a four-wheel drift is there is no margin of safety. Any sudden or abrupt input of steering, throttle, or brakes will upset the delicate balance of the vehicle and result in loss of control. Additionally, a driver encountering foreign material, obstacles in the roadway, or any unexpected traffic hazard would be virtually helpless to avoid a crash.

4. TRANSFER OF WEIGHT. Another factor that plays a part in the dynamics of vehicle control is transferring of weight of the vehicle. Weight transfer can be classified into two categories: longitudinal and lateral.

a. Longitudinal Weight Transfer. Longitudinal weight transfer is accomplished when accelerating or decelerating. When a vehicle is accelerated, weight is transferred to the rear. Applying the brakes or decelerating transfers weight to the front.

(1) If too much forward weight transfer is gained at curve entry, the lightened rear end may cause oversteer.

b. Lateral Weight Transfer. When a vehicle is turned right or left from its course of travel, a lateral weight transfer is incurred. This causes the suspension to be compressed on one side and stretched on the opposite side. If the vehicle is immediately turned in the opposite direction, this stored potential energy in the suspension can induce a violent lateral weight transfer. When negotiating a series of reversing turns, these weight transfers can have a cumulative effect, each lateral transfer becoming more violent than the one preceding it. Smoothness of operation in steering, braking, and throttle is the only effective way to minimize and control lateral weight transfer.

5. PERFORMANCE DRIVING TECHNIQUES. A peace officer must be proficient in the operation of the vehicle and be aware of the dynamic forces at work. Proper steering control, throttle control, closure rate judgment, and braking technique are essential components of performance driving. Proper performance driving techniques begins with proper cornering techniques. The two basic considerations when cornering a vehicle are entry speed and roadway position, speed being the most critical factor.

a. Entry Speed. A turn should always be entered at a speed that is less than maximum. Less than maximum means the driver can position the vehicle wherever desired on the roadway while negotiating the curve. At maximum speed, the vehicle will understeer and push wide as it goes through the turn. A driver will be unable to choose a route to effectively utilize the full pavement surface. If a driver inadvertently enters a turn too fast, use of the brakes to slow the vehicle in a controlled manner is vital.

(1) All braking should be done prior to entering the turn. If the driver enters the turn at the **proper** speed, the vehicle should remain neutral and planted to the roadway surface. This is the quickest way through a turn with a maximum degree of safety.

(2) Excessive skidding in a turn defeats all other good techniques and is dangerous as well as abusive to the vehicle.

b. Roadway Positioning. In selecting the proper position for a turn, a driver should attempt to attain a high entry and drive the vehicle through on the line of least resistance or minimum stress to the vehicle. The curve should be approached from the high side or top, and in application, the driver should hold this position until a high entry is attained. This cornering technique should only be utilized when safe to do so and the driver shall ensure the curve is **entered at less than maximum** speed.

(1) While attempting to establish proper position or line through a curve, the driver must laterally scan the curve while approaching. The path of travel should bring the vehicle to the apex or low side of the turn just prior to that time when the vehicle is pointed out of the turn. The length of time and distance at the apex depends on the radius of the turn negotiated. On a long, sweeping turn it may be hundreds of feet, in tight turns, only a few feet. The vehicle should be held as close as possible to the apex to allow room when exiting the turn. The driver may then release the stress on the vehicle by allowing the vehicle to smoothly drift out to the high side upon leaving the turn. Normally, the driver should attempt to exit in a manner that will allow staying within the correct lane, unless the driver can safely allow the vehicle to exit high into the opposing lane and promptly return to the correct lane position.

(2) It should be noted that if a curve is properly negotiated, the driver could, **if necessary, exit the turn** on either side of the roadway. This may be needed to establish proper entry position into a subsequent curve in the opposite direction. Entry speed and proper entry position are the key points to safe cornering.

c. Vehicle Control. When a vehicle approaches the limits of cohesion, rough steering, throttle, or brake application will induce skidding which sacrifices both speed and control. A smooth driver can, on the other hand, utilize the performance capabilities of the vehicle.

d. Steering. Shuffle steering has great advantages over other steering techniques. It allows for greater steering control and weight transfer control, and it minimizes the potential for air bag injury in the event of a crash. Smooth, minimal steering input will minimize the amount of weight transfer, resulting in better vehicle control. Shuffle steering requires the use of balanced-hand position. Most commonly mentioned are a “10 and 2,” “9 and 3,” or “8 and 4” position, meaning the left hand grips the wheel at the 10, 9, or 8 o’clock position and the right hand is at the 2, 3, or 4 o’clock position.

(1) These hand positions may be used effectively by maintaining a balanced-hand position with the hands opposite each other at the **sides** of the wheel, and they allow a driver to make instant corrections or countersteer while negotiating a curve.

(2) Drivers must anticipate the curve and maintain their hands on the wheel to a position that will result in balanced-hand positioning when the steering wheel is turned. For some drivers this is best accomplished by “shuffling” alternately the right and left hands. In this manner, the hands are always at the sides of the steering wheel. An equally effective method is to slide one

hand to the top of the wheel, the other toward the bottom, just prior to turning the steering wheel. As an example, when approaching a curve to the left, the left hand is moved up to approximately 12 o'clock and the right hand is dropped toward 5 o'clock.

e. Seat belts provide a great degree of safety and added stability for a driver and shall always be fastened. The position of the left leg can also improve stability and assist to "lock" the driver behind the wheel when negotiating sharp curves. Some drivers brace their left leg against the door to achieve this. An even better method is to adjust the seat far enough forward to permit the extended left leg to push firmly against the floorboard.

f. One of the most important aspects of performance driving is vision. Officers must be alert to the fact the excitement of the moment can adversely affect their ability to concentrate and safely operate a vehicle under emergency response or pursuit driving conditions, causing what is referred to as "siren syndrome." The effect of siren syndrome includes increased adrenaline flow, tunnel vision, and loss of speed reference. Under pursuit or response conditions, a driver must make a conscious effort to raise the visual horizon, remain calm, take deep breaths, drive with deliberate caution, and glance at the speedometer periodically to combat the effects of siren syndrome. Scan curves as far ahead as possible and mentally plot the course of the vehicle beforehand. If you cannot see ahead around the curve, reduce the vehicle speed. The approximate distance travelled while **reacting** can be computed by taking the speedometer reading and adding the first digit. For example, a driver traveling at 50 mph will cover approximately 55 feet while reacting. This just allows **reaction** distance and is not enough room to stop the vehicle if the road ahead is blocked. Looking far enough ahead is also the single most important factor in attaining smoothness in the control of the vehicle.

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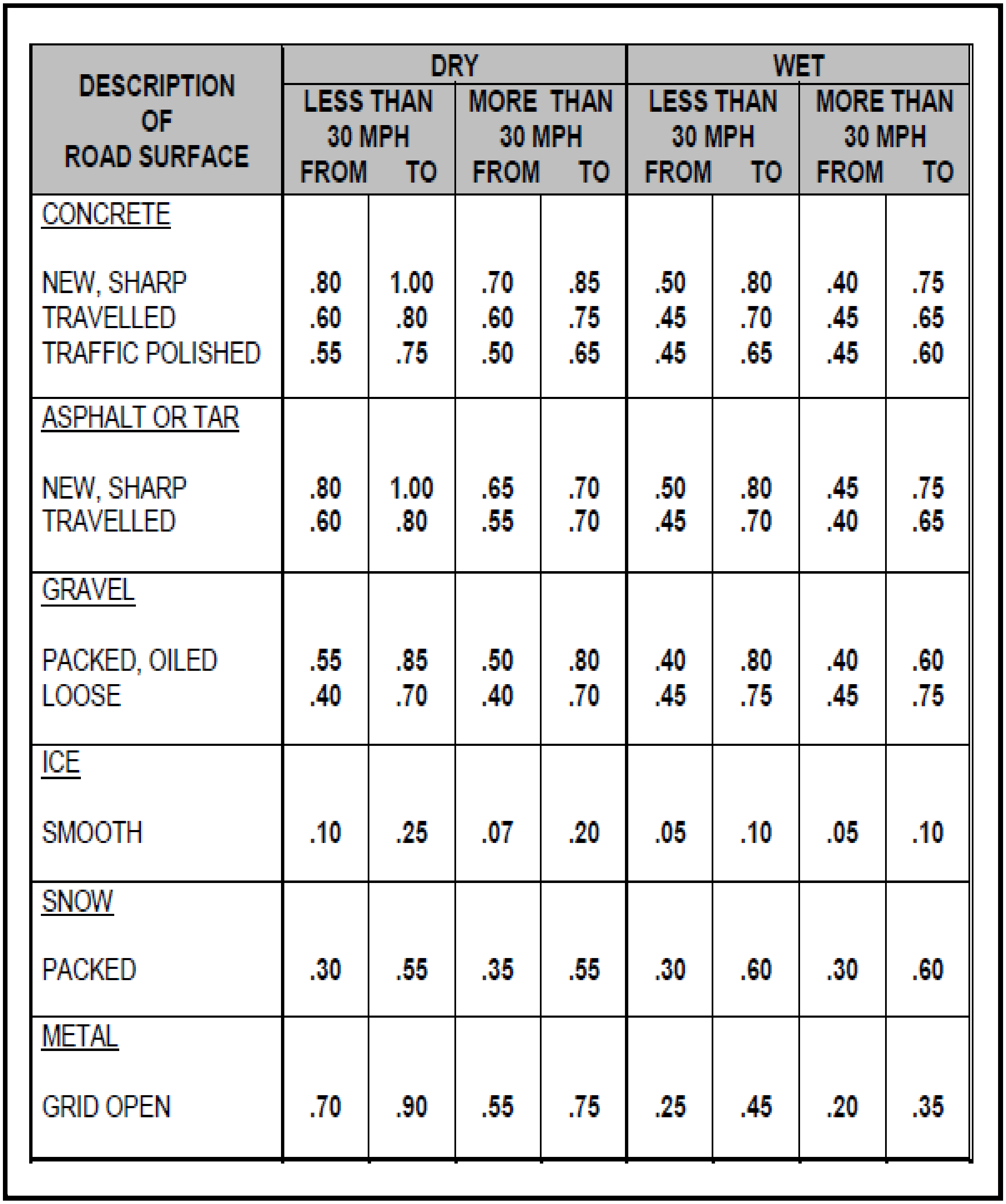
ANNEX A

AVERAGE COEFFICIENTS OF FRICTION FOR VARIOUS ROADWAY SURFACES



DESCRIPTION OF ROAD SURFACE	DRY				WET			
	LESS THAN 30 MPH		MORE THAN 30 MPH		LESS THAN 30 MPH		MORE THAN 30 MPH	
	FROM	TO	FROM	TO	FROM	TO	FROM	TO
<u>CONCRETE</u>								
NEW, SHARP	.80	1.00	.70	.85	.50	.80	.40	.75
TRAVELLED	.60	.80	.60	.75	.45	.70	.45	.65
TRAFFIC POLISHED	.55	.75	.50	.65	.45	.65	.45	.60
<u>ASPHALT OR TAR</u>								
NEW, SHARP	.80	1.00	.65	.70	.50	.80	.45	.75
TRAVELLED	.60	.80	.55	.70	.45	.70	.40	.65
<u>GRAVEL</u>								
PACKED, OILED	.55	.85	.50	.80	.40	.80	.40	.60
LOOSE	.40	.70	.40	.70	.45	.75	.45	.75
<u>ICE</u>								
SMOOTH	.10	.25	.07	.20	.05	.10	.05	.10
<u>SNOW</u>								
PACKED	.30	.55	.35	.55	.30	.60	.30	.60
<u>METAL</u>								
GRID OPEN	.70	.90	.55	.75	.25	.45	.20	.35

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