DEPARTMENT OF CALIFORNIA HIGHWAY PATROL

ENFORCEMENT DRIVING

GUIDE

FOREWORD

The California Highway Patrol is concerned primarily with protection of life and property of the public highways; and as an organization, we can be no less concerned with the protection of the lives of our employees than we are with those of the general public.

This guide is intended to augment initial cadet driver training and to serve as a reference of enforcement driving techniques for field officers of our Department. In addition, this guide can be used as a basis for the reduction of accidents in which employees are involved. The subject matter is not intended to be all-inclusive; therefore, field input is solicited to expand the content through future revisions.

OFFICE OF THE COMMISSIONER

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INTRODUCTION

The material contained in this guide has been divided into chapters which cover various aspects of enforcement driving. There is an overlap of subject matter which, in some cases, has been done deliberately to reinforce areas of importance.

The Table of Contents further separates the text of each chapter into subtopics, providing a ready reference to the respective subjects.

The last chapter offers general guidelines for field training. It is hoped that this will assist in the implementation of local level training programs to strengthen skills and correct driving deficiencies.

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CHAPTER 1 KEY WORDS - TERMINOLOGY

ANTI-LOCK BRAKE SYSTEM (ABS)	Computer controlled brake system to prevent wheel lock-up under heavy braking.
APEX (or low side)	The lowest portion of the vehicle's path through a curve.
BALANCED-HAND POSITION	Maintaining a wide grip on the steering wheel.
BRAKE FADE	The loss of braking efficiency normally due to heat build-up resulting from excessive use.
CENTRIFUGAL FORCE	Center Fleeing - pulling away from the center.
CENTRIPETAL FORCE	Center seeking.
CODE 3	Operating with red light and siren in compliance with Section 21055 CVC.
COEFFICIENT OF FRICTION	The measurement of cohesion between two surfaces.
COHESION	The sticking power between two surfaces.
COUNTERSTEER	Turning the front wheels in the direction that the rear of the vehicle is sliding.

FRONT-END SWING	When backing to the left, the front end wil swing to the right. When backing to the right, the front end will swing to the left.
HIGH SIDE	The outside of a curve.
HYDROPLANING	The tire rides upon water rather than the roadway surface.
IMPENDING SKID	A preliminary skid caused by maximum pedal Pressure short of locking the brakes.
KINETIC ENERGY	The energy possessed by a body in motion.
MOMENTUM	A body in motion will remain in motion in a straight line and at a constant velocity unless acted upon by an external unbalanced force.
OVERSTEER	The characteristic of a vehicle to tighten its turning radius as the rear end slips or skids toward the outside of the curve.
POTENTIAL ENERGY	Energy a body possesses by virtue of its position (i.e., aft automobile parked on a hill), or by virtue of displacement (i.e., the energy stored in the vehicle's springs as they are stretched or compressed while the vehicle is in a curve).
POWERSLIDE - FOUR-WHEEL DRIFT	The controlled lateral skidding of a vehicle when the limits of cohesion are exceeded by all four tires.

REAR-END CHEAT	While driving forward and turning left, the rear tires will track to the left of the front tires. When turning right, the rear tires will track to the right of the front tires.
ROLLING FRICTION	The fact that the front wheels of the vehicle must be rolling in order to steer the vehicle.
SPACE CUSHION	The open area surrounding the vehicle while driving. An "escape route" to the front, rear and sides.
THRESHOLD BRAKING	Application of braking force to the point just prior to wheel lock-up. More efficient at slowing a vehicle than locked-wheel braking.
THROTTLE	Gas pedal, accelerator.
TIME SPATIAL JUDGMENT, RATE OF CLOSURE	Being able to judge the proper rate or deceleration necessary to negotiate a curve or avoid a hazard.
TIRE FOOTPRINT	The contact area of a tire tread with the roadway.
UNDERSTEER	The tendency of a vehicle to continue in a straight line and resist turning from a direct course of travel.
VISUAL HORIZON	The distance a driver is looking ahead.
WEIGHT TRANSFER, LONGITUDINAL - LATERAL	Acceleration causes weight to go to the rear axle. Braking or deceleration causes weight to transfer to the front axle. Turning right transfers weight to the left and turning left transfers weight to the right.

CHAPTER 2 THE VEHICLE

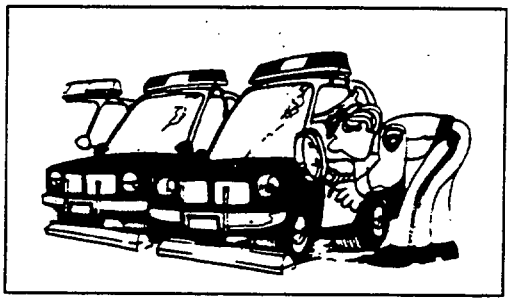
Within budgetary limitations, the CHP provides its officers with the fastest, safest automobile available. The vehicle is fast to do the job quickly, and to minimize accident exposure. It is maneuverable to permit evasive action in order to avoid a collision. The vehicle is stable to permit rapid change of direction without loss of control, and if properly used, the brakes are adequate to provide maximum deceleration.

Departmental regulations provide for maintenance and inspection of the patrol car at regular intervals. Civilian personnel of the Department normally coordinate and are responsible for seeing that lubrication and other maintenance items are carried out at the prescribed intervals. CHP Motor Transport Section, in cooperation with the manufacturers and through field input, issues bulletins outlining new maintenance procedures, modifications and anticipated mechanical problems with current patrol vehicles. All of this is intended to provide the officer with a safe, efficient, reliable enforcement tool.

Unfortunately, concern for vehicle condition frequently stops with the person that should be most involved, the field officer. In the final analysis, the mechanical safety of the vehicle rests with the driver. ' The operator, as well as the public, must be protected from the hazards of an unsafe vehicle.

PREOPERATIONAL CHECK

HPM 31.1, Motor Transport Manual, Chapter 2, states that a driver is responsible for inspecting a unit of automotive equipment upon assuming control. This directive not only requires an action on the part of the officer to make a preoperational inspection, but offers relief from driving a vehicle that could be unsafe. A preoperational inspection need not be a long, timeconsuming project. Most officers develop a system that allows a thorough check of the patrol car in less than three minutes. A preoperational check should include, but not be limited to the following items:



CONDITION OF THE VEHICLE
A visual inspection of the vehicle when it is parked next to other cars can reveal broken springs, torsion bars, shock absorbers, sway bars or even a low tire. If the car appears to be lower on one corner, bouncing that fender might give an audible clue that something is broken.

TIRES
From a safety standpoint, tires are one of the cheapest investments the Department can make. Smooth tires can provide a small amount of additional traction on dry pavement, but on wet pavement, good tread is vital. Deep tread also enhances puncture resistance. Regularly check tire pressures and maintain manufacturer's recommendations.

WHEELS
While checking tires, glance at each wheel. Hairline cracks would normally develop adjacent to the hubcaps as this is the weakest point of the wheel. Breakage in the area of the rim is rare but it still warrants a check.

LIGHTS
Walk around the car or have another officer assist you while checking high and low beams, turn signals, stop lamps, and emergency equipment.

BODY DAMAGE
Look for noticeable dents or scratches and report them.

TRUNK
Inspect to see if the spare is inflated. Is the jack complete? Is there a lug wrench? Flares? First aid kit? Is the fire extinguisher full? Check for any other equipment your Area normally keeps in the car. All items should be safely secured.

ENTERING THE VEHICLE
Check for dirt and trash on the floor that could blow into the driver's face at high speed. Adjust the seat and both mirrors. Start the engine and while it is warming up, check the instrument panel, and ensure the fuel level is full. Check the brake pedal height by stepping on the brake. Does the parking brake work? Examine the windows for cleanliness as a film on the windshield can cause eyestrain. Place your citation book, clipboard, and other personal items where they won't interfere with your driving. Accidents have occurred where loose articles slid across the dash and became lodged in the steering wheel as the officer was rounding a curve. Never place such items on the dashboard. This is the time to make sure the other seat belts in the car are accessible. It is very frustrating and dangerous to wrestle a combative arrestee into the car only to find that the seatbelts you need for restraint have slipped under the seat. Last, but not least, fasten the lap-shoulder belt. Sit up straight when adjusting the lap-shoulder belt. The shoulder belt should go over the shoulder and across the chest. Be sure the seatbelt is not twisted as this will bind the retractor mechanism and could interfere with exiting the vehicle quickly on an enforcement stop.

PLACING THE VEHICLE IN MOTION
Listen for unusual sounds in the car as you leave the office. A worn-out disc brake pad can make a definite metallic scraping sound as the wheel turns. A rhythmic clicking sound can signal loose lug nuts or a cracked wheel. Check steering for excessive play, vehicle wandering, or pulling to one side.

As mentioned earlier, the preoperational check described could be accomplished in a few minutes once the officer has developed a routine. A set pattern is also beneficial to ensure that critical items are not overlooked at the start of each shift. An officer may then start work with a sense of security and confidence, and possibly prevent the frustration of having to . call for tow service a few minutes after leaving the office:

Awareness of the mechanical condition of the vehicle should not end with the preoperational check. The officer should not ignore sounds in the vehicle that were not there a moment earlier. A bumping sound or oscillation in the steering could be a tire or wheel bearing going bad. A shimmy or loud vibration could be a loose wheel or a drive shaft about to self-destruct. The sense of smell might warn the driver of an overheating problem; antifreeze burning on a hot manifold creates its own .peculiar odor. It may be possible to exit the freeway and get to a service station before the engine overheats because of a ruptured hose. If the acrid odor of burning wires from an electrical short is present, pull over and investigate before the lights go out on a dark, narrow roadway. An alertness to many of these signals could ultimately save an officer's life.

CHAPTER 3 THE DRIVER

The smallest number of factors which can be analyzed in the driving scene form a triad: the driver, the vehicle, and the environment or roadway. When analyzing a collision, a deficiency in one or more of these three factors will be found as the cause. The vehicle and the roadway are normally a known quantity and their efficiency is constant. Neither are amenable to change by any immediate human control. The one point of the triad that is a truly flexible component is the driver. The driver alone can adjust to the vehicle's limitations and allow for the variables encountered on the roadway. The driver is responsible for the successful integration of the operator-vehicle-roadway relationship and is the person who will suffer most of the consequences of failure. This chapter will address some aspects of the psychological and physiological make-up of the driver.

PSYCHOLOGICAL FACTORS

A driver can be taught to develop skills and coordination of mind and body. The eyes see, the brain transmits, and the body reacts; but good judgment comes from experience, training, and a good attitude. Driver attitude is the mental or emotional regard for one's self, other drivers, the vehicle, and surroundings. We have all known drivers with a bad attitude; generally, they are the everybody-is-wrong-but-me type. Some of these drivers are very pleasant, good humored, intelligent individuals-until they get behind the wheel. In a supermarket check-out line they would smile and apologize for brushing against an elderly person, but, on the highway, in the impersonal surroundings of their own car, they will cut off other traffic, refuse to yield the right-of-way, and blast the horn at the slightest provocation. Let's take a look at some of the characteristics of a poor 'driver attitude.

OVERCONFIDENCE

Taking too much for granted. Serenely confident that they can control the vehicle under any circumstance, they narrowly avoid accidents and assume it is because of their superior ability. Overconfident drivers fail to allow for mistakes or unpredictable actions on the part of other drivers. Studies have shown that the overwhelming majority of enforcement drivers would rate themselves as superior or above average drivers!

PRIDE
Pride overlaps with confidence. "I've never had an (enforcement) accident." *Fatal accidents have occurred as a result offirst collisions*. Or, "I've never lost a pursuit." *Many pursuits are terminated as a result of the police car becoming involved in an accident. There is a first time for almost everything in life*.

EXPERIENCE
Experienced officers have generally been in police work for several years. There is very little these officers have not learned (or so they think). Their time on the job is supposed to divinely see them through. There might not be an officer on the shift who wants to work with them because they are terrible drivers. Fellow officers are afraid to tell them so, and the supervisor's comments are passed off as being overcritical. Experience develops bad habits as easily as good ones.

IMPATIENCE
This is characterized by taking unnecessary chances, getting into tight situations, taking shortcuts, and last-minute, hard braking at every stop, all to try and save a little time.

DISCOURTEOUS
The other drivers on the roadway do not have as much of a right to be there as discourteous drivers do, and other traffic is a continual irritant just because it is there. Drivers with this attitude never allow another car to merge or change lanes in front of them if they can accelerate and force the other driver to slow down. They will almost always jump their turn at a four-way stop sign and would not yield to a left-turner under any circumstances short of hitting the turning vehicle.

ABUSES THE VEHICLE
Abusive drivers overwork the brakes, downshift at high speeds, overrace the engine when starting or accelerating, burn rubber with any excuse, slide the patrol car around corners, and bounce over curbs or railroad crossings without slowing down. Then, when a breakdown occurs, the officer complains that the patrol car the Department is buying is junk. *In enforcement driving, it is never known when the speed is going to go from 50 mph to over 100 mph, and the patrol car is going to become an extension of an officer's life*.

There are many more characteristics. of poor driver attitude, but those listed above are some that most enforcement drivers can relate to. The fortunate thing is that attitudes are not inborn or inherited, rather they are created, evolve and become reinforced through repetition, which means they can be corrected.

Driver attitude contributes to more accidents than does lack of skill. Statistics of young drivers indicate that young male drivers around the 20-year age group are reasonably skilled in the psychomotor aspects of driving a car; however, they compromise their safety to become the most accidentprone group of drivers. It is, therefore, not how much skill has been developed through training, experience or practice - it is the extent to which that skill is applied to the driving task. Driver attitude is the controlling factor in avvlyina skill.

Attitude is defined as the posture of a person showing his/her mental state or mood; or a person's manner of acting, feeling, or thinking that shows his/her disposition. Taken one step further, the characteristics enumerated as being symptoms of a poor driver attitude comprise that vague quality we call judgment.

As related to driving, judgment could be simply defined as an individual's ability to perceive hazards or dangers. The quality known as good judgment is demonstrated by the person who perceives driving hazards far enough in advance to avoid an accident or loss of control.

The Department contracted a study with the Space Biology Laboratory, Brain Research Institute of the University of California. The purpose of this study was to determine if accident-prone drivers could be identified through testing. Forty-two officers were selected from the field, matched in age and experience. Twenty-two drivers had been involved in preventable accidents during pursuit; the remainder were accident free. Both groups were tested on a battery of psychomotor tasks. They then drove an instrumented car at high speeds on the EVOC track, at which time physiological and vehicle control data was recorded.

Differences in skills, judgment, and heart rate profiles under stress were observed to differentiate the two groups. Nineteen of the twenty accident participants were identified during testing, while seventeen of the eighteen accident-free drivers were positively excluded.

The study was quite involved and a number of observations were made and resultant conclusions drawn. One of the more interesting conclusions was that inadequate driving skill was less often a determining factor in accident occurrence than was poor judgment. The accident-prone group demonstrated an inability to perceive dangers at the moment they arose, and a tendency to relax vigilance at points of less apparent difficulty:

PHYSIOLOGICAL FACTORS

Physiological factors affecting driver performance could provide sufficient material to fill many books as the subject has been the focus of a great deal of research and will no doubt continue to be in the future. This manual is meant to address some of the more basic concepts that should be understood by the field enforcement officer.

STRESS

The very nature of police work frequently subjects an officer to highly stressful situations. Usually these occurrences are without warning and may be preceded by a period of relative inactivity. This has long been acknowledged as a contributing factor in the high incidence of cardiac-related health problems experienced by veteran police officers.

While a small amount of stress can cause individuals to operate more efficiently, excess tension can hamper the ability to function normally. Stress causes an increase in blood pressure, injection of adrenaline into the blood stream and impaired breathing. These things can so alter the function of the nervous system that an individual may be incapable of intelligent action. There are different stress thresholds for each individual which can be described as the point where physiological reactions so impair the functioning of the senses that the driver becomes unaware of the surroundings. Frequently, a driver questioned after a pursuit accident is unable to recall any of the circumstances immediately preceding the collision.

ATTENTION FAILURE

Almost everyone experiences lapses of attention and the results can be fatal. Safely operating an automobile today requires not only attention, but concentration. Tests have long disclosed that accident-prone drivers share certain deficiencies; one of these deficiencies is attention failure.

From a physiological standpoint, people are more apt to suffer lapses of attention when their bodies are in a less-than-normal condition. Alcohol or medication not only increases reaction time, but adversely affects the ability to concentrate on psychomotor tasks. Fatigue or illness have the same effect. The enforcement driver should exercise a great deal of caution when reporting for work tired or sick.

Emotions can have a profound effect on a person's ability to concentrate. Problems at home, worries about financial matters, anger, an unpleasant violator contact, nervousness over an upcoming event such as a court case, or concern over dealings with a supervisor are some examples. These things not only cause stress, but can make it virtually impossible to concentrate on driving. At this point, an otherwise competent driver may become an accident looking for a place to happen. The individual officer is the only person who can control his/her emotions. After a particularly irritating enforcement stop, an officer should take a couple of moments to take good notes, and calm 'down. If problems at home are mounting to the point it becomes impossible to concentrate at work, it might be prudent to consider asking for vacation time. Loss of a vacation day would be much more desirable than being hospitalized for a month as a result of a collision.

VISION

Good vision as well as' good physical condition is a prerequisite to safe driving. Enforcement drivers should regularly have their eyesight checked, particularly as they get older. Many internal factors can adversely affect visual acuity and depth perception, even in a person 'with 20-20 vision. Alcohol or drugs, including cold tablets, have a marked effect on vision. Carbon monoxide produced when smoking affects the retina of the eye. This is termed anoxia and is most pronounced in bad lighting conditions or at night, and is substantially increased at higher altitudes.

In a study conducted by Columbia University, low, medium and high accident-frequency groups were polled and the percentage of smokers was recorded. It was found that in the-low-accident group only 18.6% were smokers. The medium group had 32 % smokers and the high-frequency group was comprised of 54% individuals who smoked. It is felt that many factors in smoking contribute toward a higher accident rate, but it is proven that smoking affects visual acuity.

Everyone has a natural blind spot in each eye. At the point where the optic nerve leaves the retina, there are none of the rods and cones that otherwise line the retina and no vision is possible. Under normal conditions, one eye overlaps the blind spot of the other eye and nature compensates for this deficiency. If one eye is closed or rubbed because of a piece of dust or cigarette ash, there is an area in front to which you are totally blind. At only 50 feet this blind spot can hide a motorcyclist and at 100 feet we can lose a truck. A driver's only real defense to this natural blind spot is to always look twice. This is also a good practice to compensate for the mechanical blind spots in a vehicle created by rearview mirrors and door posts. Remember to take visual "snapshots" by stopping movement of your eyes. A person's eyes are unable to pick up detail when they are moving.

Many officers find it desirable or necessary to wear sunglasses during daylight hours to prevent eye fatigue. Good quality sunglasses in no way damage eyesight, but proper selection of lenses must be made to ensure that protection is adequate and that the officer's vision is not changed in an abnormal way. The recommended lens is a neutral gray with 100% ultraviolet (UV) protection; lenses of other colors such as amber, blue, brown, violet, or rose may interfere with normal vision. Officers should carefully select sunglasses used on duty so that the ability to identify and describe what has been seen will not be adversely affected. Sunglasses should never be worn after darkness.

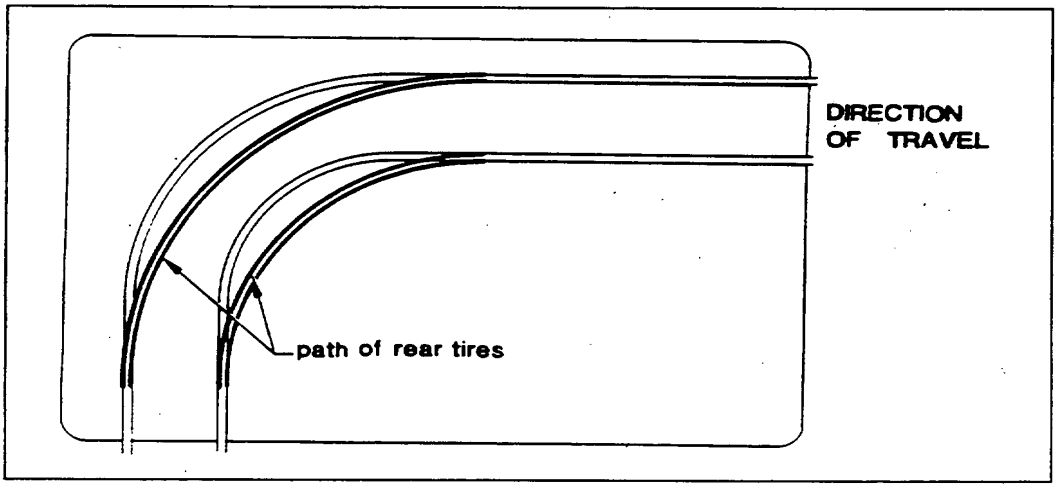
CHAPTER 4 VEHICLE DYNAMICS

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 phenomena in steering a vehicle will minimize the potential of low speed or vehicle placement accidents.

REAR-WHEEL CHEAT

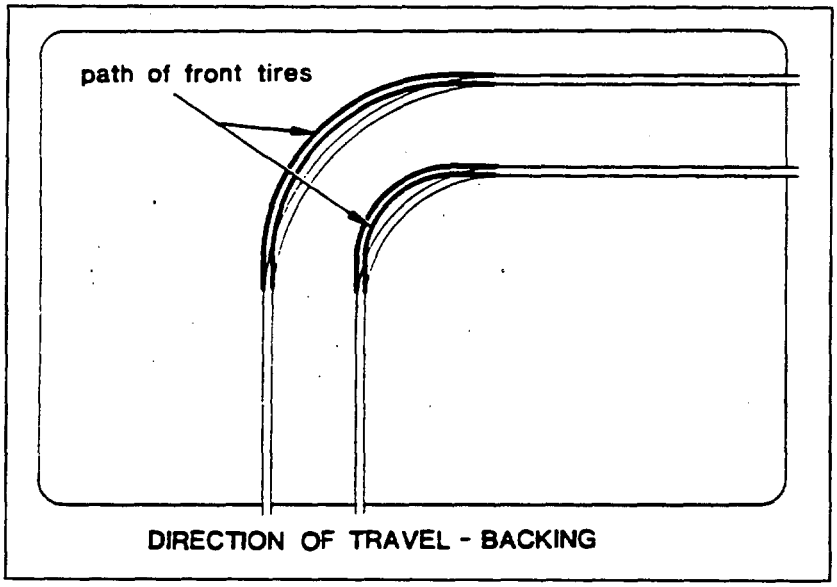
Rear-wheel "cheat" is present any time a'vehicle is turned from a straight path. While driving forward and turning to the left, the rear tires will follow a path to the left of the path traveled by the front tires. When turning right, the rear tires will track to the right of the front tires. In a standard size CHP car, the path of the rear tires may be as much as 36" closer to the inside of the curve 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. Most drivers have observed a long truck or bus swing wide around a corner to avoid jumping the curb, but how many drivers are aware that this same phenomenon affects their own vehicle?



There are two methods of compensating for rear-wheel cheat when turning a vehicle. The simplest method is to swing wide enough to allow space for the rear of the car 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. In the second situation, a driver must remember that the rear axle is the pivot point of the car's turning movement. The driver should proceed in a straight line until the rear axle is aligned with the hazard. The turn can now be accomplished without any danger of the rear of the car contacting the hazard. 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 to available space on the right side of the car.

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. When backing to the right a driver must consider that the front of the car will swing out to the left as much as 4 feet.



This front-end swing can be responsible for a collision 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 collision.

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. 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 car. As speed is increased in reversed, 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.

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.

BRAKE FAILURE

Brake failure is due to a mechanical malfunction in the braking system. When the brake pedal is depressed, nothing happens. The particular situation will have to dictate what the following action will, be. Downshifting to the lowest gear available may reduce enough speed 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. Total brake failure is usually related to a component of the hydraulic system. If this is the case, the mechanical parking brake will still be operative. The parking brake should not be applied to the point of locking the rear wheels except in the most dire of conditions. If the rear wheels are allowed to skid for more than a short distance, the car will spin around and the driver will find that he/she is trying to control the car while traveling backwards. When using the parking brake to stop a vehicle, the driver must remember that brake application is controlled with the left foot on the emergency brake pedal and the left hand simultaneously holding out the ratchet release to prevent rear wheel lockup. This procedure should not be utilized on ABS equipped vehicles.

If no open escape route is available, the last and most undesirable alternative may be to lessen the force of a collision by attempting a sideswipe accident with parked vehicles or a bank. A driver experiencing total brake failure must remember, above all, that he/she still retains steering and throttle control of the vehicle. Panic and indecision can result in the driver losing complete control of the car when resolute action is most needed.

BRAKE FADE

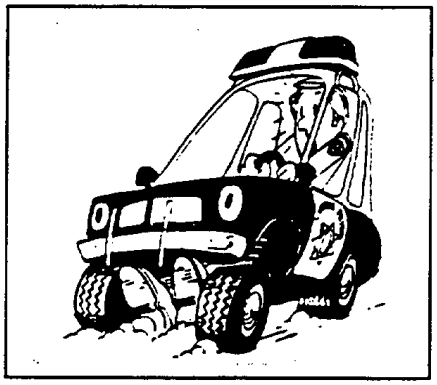
Brakes, when overused and consequently overheated, will begin to lose their braking efficiency. This is termed brake fade. This usually occurs on steep downgrades or in a pursuit which involves frequent, hard brake applications.

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 an automobile, must be converted to heat in order to slow or stop our vehicle. This heat must be dissipated by the braking system as our vehicle stops.

An example of the severity with which fade can affect braking performance was demonstrated during the following test. The test car could be stopped initially from 60 mph in a distance of 185 feet, and brake temperature averaged 200° Fahrenheit. After deliberately overworking the brakes to a temperature of 450° Fahrenheit, stopping distance lengthened to 486 feet, an increase of over two and one-half times.

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 (V2). In simpler terms, as, a driver doubles the speed of the vehicle (20 mph to 40 mph), the kinetic energy increases by four times. M is 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 $KE = \frac{1WV^2}{32}$, it can be shown that the current Class E vehicle used by
the Department develops over 2,000,000 ft.-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. 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. As discussed earlier, the parking brake may provide enough stopping power through the rear brakes to slow the vehicle. Drivers should not get so engrossed in finding a way to brake the car 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 car again.



ANTI-LOCK BRAKE SYSTEM

The purpose of the Anti-Lock Brake System (ABS) is to prevent wheel lockup under heavy braking conditions on virtually any type of road surface. 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 system is termed "Anti-Lock" instead of "Anti-Skid." ABS is not intended to stop a car 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, then the stopping distance would not improve. ABS allows panic braking and steering at the same time for better accident avoidance.

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, pumps the brakes up to ten times per second, much faster than any driver could. A computer continuously monitors the anti-lock system. If an abnormal condition is detected within the anti-lock system, 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.

Braking should always be done gently and gradually whether on routine patrol or in a performance driving application. Unfortunately, we are only human and mistakes will be made. This is where ABS has its greatest value. In the event a driver encounters a panic situation and brakes too hard or abruptly resulting in a wheel lock-up, 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. Remember, ABS is designed to maintain rolling friction so the driver can steer the vehicle around any potential hazards. During brake pressure modulation, as brake pressure is increased, wheel slip is allowed to reach up to 30%. This means that the wheel rolling velocity is 30% less than that of a free rolling wheel at a given speed. This slip may result in some tire "chirping" depending on the road surface. This sound should not be interpreted as total wheel lock-up. Complete wheel lock-up normally leaves black tire marks on dry pavement. However, antilock braking will not leave dark black tire marks since the wheel never reaches a locked condition. Tire marks may, however, be noticeable as. light patched marks.

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. (Annex A, Anti-Lock Brake System Exercise.)

LEFT-FOOT BRAKING

Many drivers have acquired the habit of "left-foot braking" when driving a car 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:

Drivers who spend the majority of their time in a car equipped with an automatic transmission can become quite adept at left-foot braking. However, in an emergency situation, when driving with a standard transmission, they will probably find themselves depressing the clutch pedal when they need immediate severe braking.

A driver is best braced when the left. foot is placed against the left floorboard of the car and the right foot is positioned over the accelerator pedal. The three-point suspension provided 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.

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 car moving but vacuum boost is reduced and more pedal pressure is required to operate the brakes.

Maximum deceleration is acquired through impending skids. 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. .

"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 rubbing of brake shoes and pads will result in rapid destruction of disc-brake rotors, brake drums, pads, and shoes. Operators may find themselves with inadequate brakes when they need them most.

The driver who rides the brakes with the left foot causes constant illumination of the stoplamps which negates their value.

The brake systems on most current automobiles equipped with front-wheel discs are basically the same. Vacuum boost begins operation when 10 to 15 pounds of pressure is applied to the actuating shaft of the booster. Because of the mechanical advantage provided by the brake pedal, vacuum may begin applying the brakes with a very small amount of foot pressure and resultant pedal movement. During tests at the Academy it was noted that from 30 to 60 ounces of foot pressure and less than 1 /8 inch pedal movement would initiate braking action. A well-worn size 10 shoe may weigh as much as 24 ounces, requiring very little additional pressure to activate the brakes.

Left-foot braking can be justified when driving with a cold engine which is running at fast idle in congested areas and at low speeds. Left-foot braking is also a means of drying out water-soaked linings while operating at normal speeds.

WET BRAKES

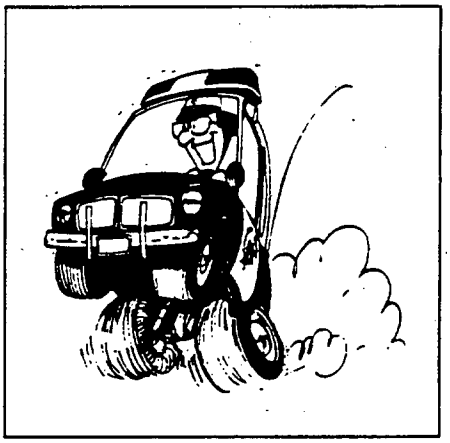
Wet brakes, like fade, are a temporary condition. Normally, a vehicle will have to be driven through water deep enough to partially immerse the brakes because they are designed to accommodate normal splash. Disc brakes are more impervious to water and dry sooner than drum brakes. Wet brakes can result in harder pedal effort, lengthened stopping distances, and brake pull. Brake pull is most apt to occur when only one front brake is wet. If the left front brake is wet the car will pull to the right. As mentioned earlier, the brakes may be dried out by lightly riding the brake pedal.

SKIDS

Probably the biggest factor.which makes skids a significant accident cause is the aura of mystery and misinformation regarding their cause, effect and correction. The untrained or inexperienced driver who knows little or nothing about the forces involved suffers momentary panic and hence does nothing or the wrong thing.

An automobile 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 obviously 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. Basically, when one or more of the tires exceed the coefficient of friction, skidding occurs.



ACCELERATION SKIDS

Acceleration skids usually involve only the rear 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 wheels. In a turn, acceleration skids will usually progress to oversteer, which will be covered in detail later in this chapter. Acceleration skids serve no useful purpose. The driver who burns rubber leaving a stop is showing the world his/her ignorance and improper driving techniques. 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. Lost time at the start cannot be made up.

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 car from its course will be futile. For all practical purposes, a driver in this situation may just as well be in the passenger seat. 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.

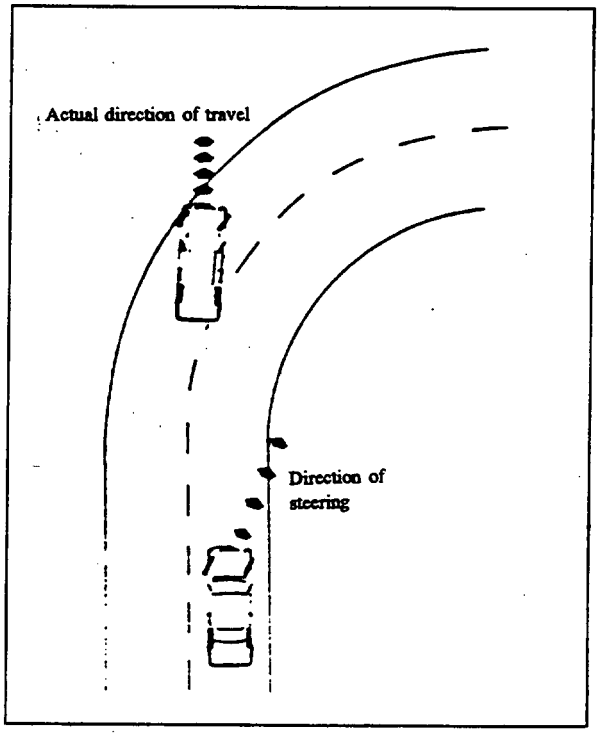
Many enforcement vehicle accidents are caused by the driver's lack of understanding of the principle of rolling friction. Often, a unit rolling down the freeway on an emergency run of some nature at 85-90'mph approaches an off-ramp and begins to reduce speed. As the driver enters the off-ramp, there is a sudden realization that he/she is traveling at 65-70 mph. This is slower than the previous speed, but too fast for the curve at the end of the off-ramp. From past experience, the driver knows that it is impossible to make the curve in excess of 30 mph. In panic, the brakes are applied, locking all four wheels which results in skidding. Upon reaching the curve, the speed is only 25 mph, but the vehicle is still skidding with the front wheels turned in the direction the driver wishes to go. The vehicle doesn't go around the curve, but skids straight ahead over the curbing and into a strategically placed light standard. Ironically, the speed of 25 mph was slow enough to negotiate the 30 mph curve if the driver had released the brakes. It does not matter if the car is going 20, 15 or 5 mph when it reaches the curve, because it will continue to. skid in a straight line until it stops - or until the driver eases off the brakes to permit the front wheels to rotate.

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 would leave traces of rubber, but not solid black skids. An impending skid will also stop the vehicle in the shortest distance because the car is not sliding on a layer of melted rubber.

UNDERSTEER "SLIP ANGLE"

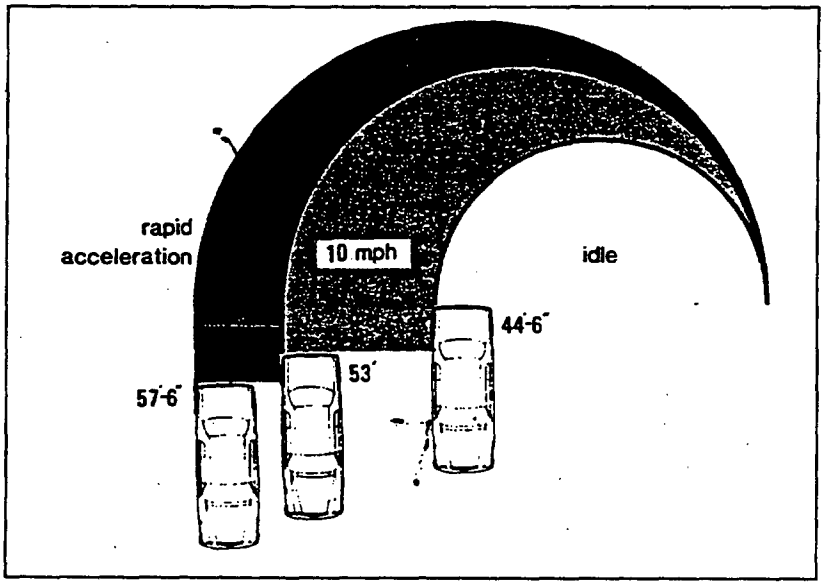
Most front engine automobiles are designed in a manner that produces an understeer characteristic. This means simply that the vehicle wants to go in a straight line. If something disturbs its path, it has a tendency to straighten itself out and return to the original direction of travel. While this may 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 car 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.



There are two basic and related driver-caused reasons for understeer. 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 car refuses to turn to the degree necessary to round the curve. 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 car. 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 road surface.

Obviously, understeer occurs in varying degrees of severity. When a front wheel is steering a car, 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 car proceeding straight ahead.

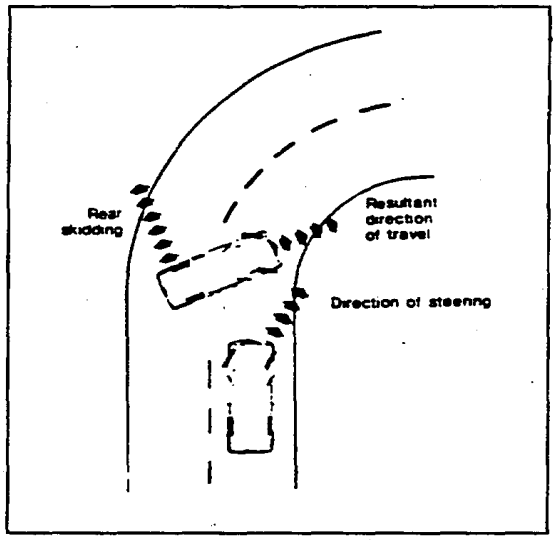
An example of slip angle and understeer is given in the following test using a patrol car. At idle speed, a U-turn with steering locked could be executed in 44'6". The same turn attempted at 10 mph took 53' . When the car was accelerated, short of wheelspin or front tire breakaway, the U-turn took 57'6".



It was also interesting to note that at idle speed the U-turn was completed in 6.5 seconds. At the higher rate of speed the turn-around not only required an additional 13 feet of roadway, but the elapsed time increased to 8.7 seconds.

OVERSTEER

A natural progression from understeer may be oversteer. This condition is often described as "crossed-up" or loose. Oversteer means simply that the vehicle points itself in a direction that will tighten up its turning radius. The rear tires exceed the limit of cohesion and the back end of the car skids toward the outside of the turn. Oversteer can be the result of 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 of understeer.



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 car almost instantly attains a condition of oversteer. The problem here is that the driver's attempt to countersteer will almost always be too late or too slow to regain control. The oversteer will become a spinout with complete loss of directional control.

If the oversteer is a result of excessive throttle or rough steering while in a curve, control would normally be gained by smoothly letting up on the throttle and simultaneously countersteering or turning the front wheels toward the outside of the curve. The oversteer could be maintained by reapplying enough throttle to again spin the rear wheels, then reducing throttle while countersteering. Excessive throttle applied to an oversteering vehicle can result in a spinout regardless of efforts to countersteer.

The severity or degree to which oversteer has progressed will determine whether or not a driver can regain control. If oversteer has progressed beyond the limitations of the vehicle's steering, the car will continue to pivot around the front wheels and spin out. The front wheels of most cars will turn approximately 20 degrees from straight ahead to steering lock. Thus, if the rear of the car is allowed to skid .beyond 20 degrees before the driver effects his/her countersteering, efforts at regaining control will be futile. For this reason it is imperative that a driver react immediately and instinctively when an oversteer is experienced: The higher the speed the faster the driver must react to regain control.

FOUR-WHEEL DRIFT

The term "four-wheel drift" is often misunderstood. For our purposes four-wheel drift describes that condition, when a cornering vehicle is beyond the limits of cohesion and in a balanced understeer/oversteer attitude. The car is pointed in the direction it is traveling and all wheels are following a line of the curve; however, the car 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.

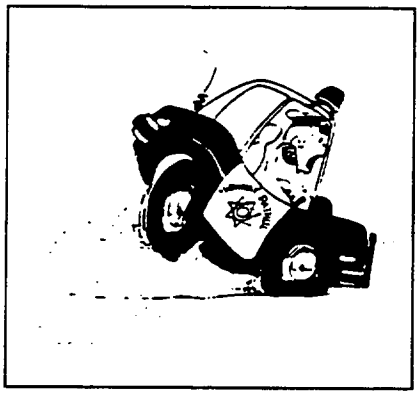
The danger here is that there is no margin of safety left. Any sudden or abrupt input of steering, throttle.or brakes will upset the delicate balance of the vehicle and result in loss of control. It should also be mentioned that a driver encountering foreign material, obstacles in the roadway or any unexpected traffic hazard would be virtually helpless to avoid a collision. A true four-wheel drift can be attained and utilized in the controlled environment of a race track, but should not be deliberately attempted on public roads.

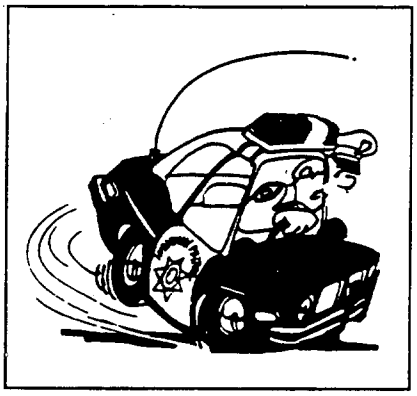
TRANSFER OF WEIGHT

Another factor that plays a part in the dynamics of vehicle control is transferring of weight of the vehicle. For purposes of discussion, weight transfer can be classified into two categories, longitudinal and lateral.

LONGITUDINAL WEIGHT TRANSFER

Longitudinal transfer of weight is accomplished when braking, accelerating, or decelerating. When a vehicle is accelerated, weight is transferred to the rear. This can increase traction and help a driver retain or regain control. An example could be a moderate oversteer in which a smoothly applied throttle might help gain enough traction with the rear wheels to straighten out the vehicle's course. Applying the brakes or decelerating transfers weight to the front end compressing the front suspension. If done just prior to the vehicle's going into a corner, it can increase safe, curve-entry speeds appreciably.





Obviously, if too much forward weight transfer is gained at curve entry, the lightened rear end may be induced to oversteer. Forward longitudinal weight transfer can also have a negative effect prior to traversing dips, chuck-holes, railroad crossings or the like. Hard braking at this point only compresses the front suspension and lowers vehicle height when clearance and suspension movement is most critically needed. A driver unexpectedly encountering these hazards should brake and reduce speed as much as possible, then release the brakes and coast, or possibly accelerate moderately as the vehicle crosses the hazard.

LATERAL WEIGHT TRANSFER

When a car 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. Normally, the curve is completed and the suspension overcomes the effect of centrifugal force and returns the vehicle's chassis to level. However, 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. If unchecked or overcontrolled, the vehicle will spin out of control. A driver must consider what reaction in the vehicle his/her action will cause. Smoothness of operation in steering, braking and throttle is the only effective way to minimize lateral weight transfers.

PERFORMANCE DRIVING TECHNIQUES

A good definition of performance driving might be a driver's ability to fully utilize the performance potential of the vehicle. Limited skill is needed to floor the throttle and drive in a straight line. A discussion of performance driving techniques is a discussion of proper cornering techniques. The two basic considerations when cornering a vehicle are entry speed and roadway position, speed being the most critical factor.

ENTRY SPEED

A turn should always be entered at a speed that is less than maximum. For most drivers this is a subtle point to learn. The fact that a driver manages to keep the car on the pavement through a turn does not mean the speed was 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. Proper position will be impossible to attain at maximum speed except for the most proficient and experienced driver; furthermore, it definitely isn't the quickest or safest way through a turn. In this situation, all the driver can do is hope to keep the car on the roadway. Throttle application will cause additional problems. The rear wheels push only in the direction they are heading and will, in all probability, cause the vehicle to understeer and leave the turn on the outside. The car is at the limits of cohesion, so braking would have the same results. If a driver inadvertently enters a turn too fast a general rule of thumb is --- stay off both throttle. and brakes.

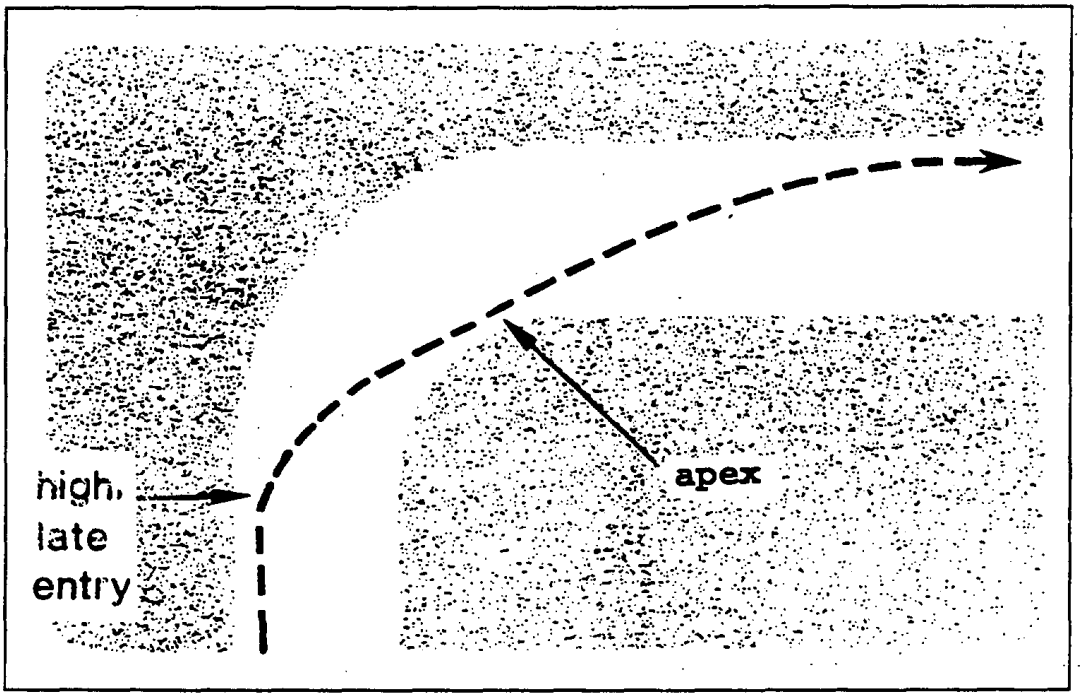
If braking is done prior to entering the turn and the driver enters the turn at the proper speed, the vehicle should tend to oversteer a predictable amount. The rear end is lighter than the front and centrifugal force will pull it to the outside of the turn as in a skid. This skid may or may not be detectable to the driver depending on the degree of movement. When this movement occurs, the throttle may be smoothly applied to maintain or correct vehicle attitude. Countersteering may also be necessary as excessive oversteer can, to a degree, be controlled this way. The transfer of weight to the rear wheels by judicious throttle application causes increased cohesion at that point; however, it decreases cohesion at the front end. Hard throttle application should not be attempted until the vehicle is leaving or being pointed out of the turn. This is the quickest way through a turn with the maximum degree .of safety.

Excessive skidding in a turn defeats all other good techniques and is abusive to the vehicle. As the tires skid sideways on the pavement they are scrubbing off speed in the same manner as locking the brakes would. Remember, drivers should be able to leave turns faster than they go in.

Auto racing fans often marvel at the sudden burst of speed one car in a pack will have as it leaves, a turn. This is due to that driver's ability to pick the entry speed and proper positioning, allowing early acceleration out of the turn.

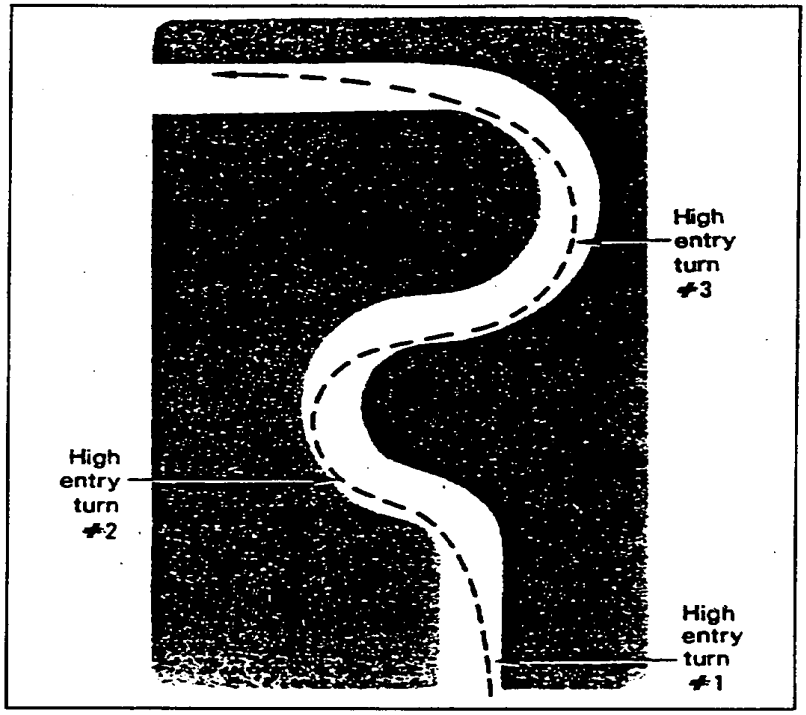
ROADWAY POSITIONING

In selecting proper position for a turn, a driver should attempt to drive the car through on the line of least resistance or minimum stress to the vehicle so that he/she is able to accelerate as early as possible and attain a maximum curve exit speed. Therefore, it follows that the curve of the vehicle's path should be the sharpest where the speed is the slowest. This, as was previously discussed, should be at the entry of the curve. The curve should be approached from the high side or top, and in application, the driver should hold this position late or deep into the turn. This will initially feel strange or uncomfortable to a driver but poses no hazard if the curve is entered at less than maximum speed.



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 car 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 car 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.

It should be noted that if a curve is properly negotiated the driver could, <u>if necessary exit the turn</u> on either side of the roadway. This may be needed to establish proper entry position into a subsequent curve in the opposite direction. Generally speaking, entry speed and proper entry position are the key points to safe, fast cornering.



VEHICLE CONTROL

A discussion of performance driving techniques would not be complete without mentioning some additional factors which affect control of the vehicle. As a driver begins to employ the concepts previously enumerated, confidence and speed through curves will increase appreciably. There may not be a conscious awareness of the increased speed because utilizing proper cornering techniques requires less effort and mental stress. It is at this point that smoothness and precise input to the vehicle become critical. A driver who is rough or tries to "muscle" the car, may be spectacular for a race track crowd to watch, but simply cannot be the fastest driver on the track. When a vehicle approaches the limits of cohesion, rough steering or 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.

There are a number of schools of thought on steering wheel hand positioning. Most commonly mentioned are a "10 and 2" or "9 and 3" position; meaning the left hand grips the wheel at 9 or 10 o'clock and the - right hand is at 2 or 3 o'clock. Either technique may be used effectively by maintaining a balanced-hand position with the hands opposite each other at the sides of the wheel. This position allows a driver to make instant corrections or countersteer while negotiating a curve. Driving a car equipped with fast-ratio steering (such as many foreign "sports" cars) requires a minimum amount of hand movement on the wheel to maintain a balanced-hand position. The steering in'domestic sedans purchased by the Department turns approximately three and one-half times from full left to full right. This introduces problems in maintaining a balanced-hand position as a driver enters turns. Drivers who grip the wheel at "9 and 3" in a straightaway will find their hands at the top and bottom of the wheel or even have their arms crossed when they enter a curve. This is the point when they most need full control of the vehicle; therefore, drivers must. anticipate the curve and slide 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 hand. 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, slide the left hand up to approximately 12 o'clock and drop the right hand toward 5 o'clock.

Most experienced high-speed drivers utilize a combination of these two techniques to maintain a balanced hand position when cornering. Because of the amount of steering wheel travel in severe corners and the annual model changes in enforcement vehicles, the pursuit driver should refrain from using the steering wheel spokes as a reference for hand positioning. The wheel should be gripped from the outside in a firm but relaxed manner..

The seat belts installed in modern automobiles 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. Doing this, the driver's buttocks can be pushed hard against the seat back in severe turns which will prevent sliding across the seat and enhance control of the vehicle.

One last aspect of performance driving is vision. Tests have revealed that most drivers do not look far enough ahead when operating an automobile. Strangely enough, this phenomenon occurs even more as the average enforcement driver increases speed. It should be the opposite, in that the faster the speed, the farther ahead the driver should look. Under pursuit or response conditions a driver must make a conscious effort to raise the visual horizon. Scan curves as far ahead as possible and mentally plot the course of the vehicle beforehand. Curves should never "sneak up" on a competent driver and if you cannot see ahead around the curve, reduce the vehicle speed. The approximate distance traveled while reacting can be computed by taking the speedometer reading and adding the first digit. As an example, a driver traveling, at 50 mph will cover approximately 55 feet while reacting. Remember that 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.

CHAPTER 5 COLLISION AVOIDANCE

THE DEFENSIVE DRIVER

The topic of defensive driving has been the subject of books and manuals too numerous to mention. They might have various titles, but the underlying theme is simply how to avoid traffic accidents. The job as a Highway Patrol officer entails a lot of driving. A vehicle is as inherent to this occupation as it is to a truck driver, but there is now the added burden of overtaking and arresting violators and responding Code 3 at speeds far above the legal limits. It is incumbent upon every enforcement driver to improve and maintain driving skills above those possessed by the average motorist.

Some drivers appear to possess an uncanny ability to avoid collisions such as truck drivers with over a million accident-free miles, while other drivers cannot purchase car insurance because of frequent collisions. What is the difference in these two types of drivers? A driver's physical attributes do have an effect, but not to the same degree as the more intangible qualities such as driver attitude, judgment, awareness, training, and experience. Avoiding collisions requires more than advanced or above-average psychomotor skills in the mechanical operation of an automobile. Enforcement drivers must'not only be skilled at handling the automobile, but must know how to drive defensively.

The phrase "defensive driving" is an overworked cliche that tends to close the mind of many drivers because it has been heard for so long. As an enforcement driver, this phrase should take on more meaning than it did when daily driving consisted of commuting to and from work. What is the definition of a defensive driver?

A DEFENSIVE DRIVER IS ONE WHO DRIVES IN A MANNER TO AVOID ACCIDENTS, REGARDLESS OF WHAT THE LAW SAYS, MISTAKES MADE BY OTHER DRIVERS, OR ADVERSE DRIVING CONDITIONS ENCOUNTERED.

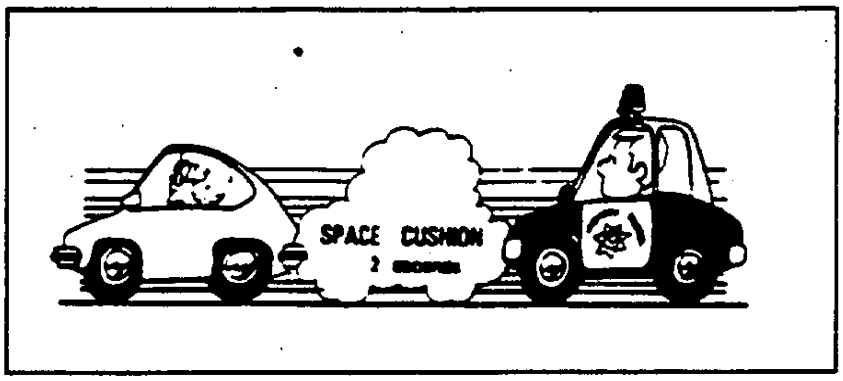
How do drivers compensate for the mistakes of others around them and the . hazards of adverse road and weather conditions? First, analyze the driving scene and recognize hazards. This requires staying alert to the driving task and not becoming distracted by a radio transmission. For instance, when traveling down the highway an officer observes a group of children playing in a yard next to the roadway. This is a hazard and requires defensive caution. Formulate a plan. What defensive action will be taken if a child runs into the roadway?

There is no traffic in the on-coming lane. It's too late to stop. A dog runs onto the highway followed by a child. The defensive driver, because of recognizing the hazard and formulating a defense, can now act in time and swerve into the left lane avoiding an accident.

PREVENTABLE VS NONPREVENTABLE

Traffic accidents can be categorized into two types, preventable and nonpreventable collisions. A preventable collision is one in which the driver failed to do everything reasonably possible to avoid it. As an example of a preventable accident, when driving on a four-lane highway there is a car alongside in the right-hand lane, slightly forward proceeding at the same speed. While beginning to overtake a truck, the driver alongside changes into the left lane colliding with the right front of the patrol car. Although legally right, as the other driver made an unsafe lane change, this was a preventable accident. The hazard should have been recognized ahead of time as the other driver overtook the truck. The officer should have been aware that he/she was in the other driver's blind spot.

There are few absolutes when talking about defensive driving or collision avoidance. Play an odds game and attempt, whenever possible, to stack the percentages against an accident. The remainder of this chapter will be addressed in basic concepts that can help tip the scales a little more toward collision avoidance.



SPACE CUSHION

The term "space cushion" refers to the clear area of maneuvering room to be maintained around the vehicle. To maintain a space cushion is to have an escape route in which to take evasive action. Obviously, when driving in traffic, it is often impossible to have adequate room to the sides and both front and rear. The point is simply that, when a space cushion cannot be maintained in one direction, be aware of it and leave an "out" in another direction. Don't become boxed-in for any length of time.

The space cushion which is most controllable is to the front. The old axiom of leaving one car length for each -10 mph of speed is valid, but awkward for most people to interpret and apply. A better rule which can be applied uniformly by all drivers is the two-second rule. Regardless of the speed traveled, simply count one-thousand-and-one, one-thousand-and-two as the vehicle ahead passes a fixed point such as a tar strip or shadow. The twosecond gap provided will allow time to react if the car ahead suddenly brakes; if less than two seconds, that is too close. The space cushion to the front should not be forgotten when stopping the car in traffic. When stopping behind other vehicles, leave enough room to see where the rear tires of the car ahead contact the road when looking over the hood. This will leave approximately 20 feet of space in which to turn right or left. This can be particularly advantageous to a police officer observing a violation or receiving a radio call as it leaves room to pull out of a line of traffic and respond.

There are two ways to alter the distance between the patrol car and vehicles to the rear: one is to slow down and change lanes, and the other is to increase speed to open up the gap.

Employing the space cushion concept to the right or left involves many more variables. On a narrow, two-lane highway, there is little that can be done about that deep drainage ditch to the right, other than to be aware of it as a not-so-desirable escape route. Taking to the ditch might become a good choice, however, if faced with an imminent head-on collision. On multilane roadways, the choice of lanes can play a great part in collision avoidance. Why drive next to a line of parked cars when there is a clear lane available to the left? On freeways there is usually more traffic and, hence, more conflict from entering and exiting vehicles in the right-hand lanes than there is to the left.

Due to the nature of enforcement driving, it will often be necessary to make quick lane changes. The awareness of the space cushion concept will allow you to know your vehicle's position in relation to other traffic. Giving thought and consideration to the principle of maintaining a space cushion can help a driver to avoid or minimize the severity of a collision.

INTERSECTIONS

Intersections pose the greatest potential for conflict and collision that may be encountered in routine driving. In California during one year, almost 45,000 injury accidents were broadside-type collisions. Of these, 692 were fatal to the driver or other occupants. These figures are similar to nationwide statistics.

Most busy intersections have some type of traffic control, whether it be a signal light or stop signs, but what good is a green light if the cross traffic fails to stop for a red light? Enforcement drivers must establish and maintain a habit of visually clearing intersections for cross traffic before entering. CHP officers have been killed crossing an intersection on a green light. Normally, the officer should scan from left to right then left again. Look to the left first because traffic coming from that direction is the first hazard when entering the intersection. If, while waiting for the green light the view to the left is obscured by a large vehicle, allow the other driver to start moving first. In this manner there is some protection, even if the other vehicle gets hit by a car running the red light.

When approaching a traffic signal that is green, give some thought to the duration of the green phase. A "stale" green light can change forcing an abrupt stop.

When stopping in an intersection to execute a left turn, signal and make sure other traffic is aware of your intentions. Don't turn the wheels to the left, as a rear-end collision will push the vehicle into opposing traffic. The officer should question him/herself and ask if it is really necessaryy to make a left turn at this location, particularly if there is no left-turn pocket or light controlling such a movement. Oftentimes in heavy traffic it would be safer to make a series of right turns to end up one block beyond the intended street desired. When opposing traffic appears to be yielding to a left turning movement, look for eye contact from the drivers or pedestrians involved. Once committed to the. turning movement, get it over with as quickly as possible.

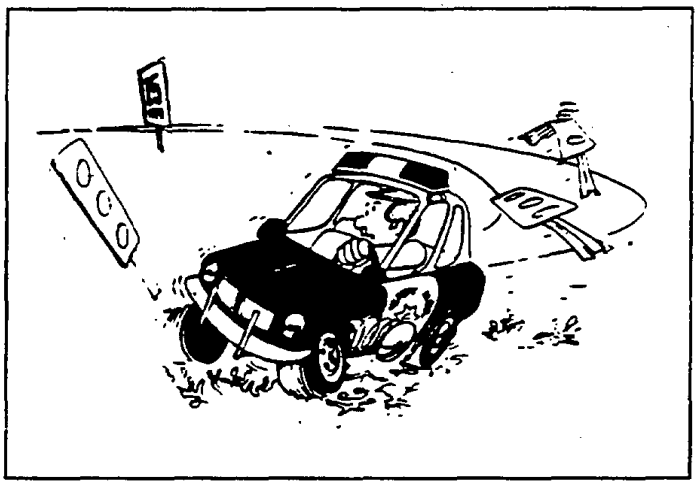
Right turns at intersections can also lead to in an accident. Under California law, a right turn may be made against a red light if it is safe to do so and there are no prohibitive signs. The problem here is, while looking toward traffic approaching from the left, a pedestrian steps off the curb to the right and into the roadway. A bicycle being ridden the wrong_ way and coming from the right is another potential hazard. Always take a second look to the right.

FREEWAY DRIVING

Generally speaking, California drivers are accustomed to operating on the freeway system. California has some of the best freeways or interstate highways in the nation; however, freeway driving requires different skills and poses different hazards than those encountered on surface streets.

Merging onto a high-speed, busy freeway is a frightening experience to those unaccustomed to such roadways. The cardinal rule is to simply attempt, as closely as possible, to match the enforcement vehicle's speed to the speed of traffic in the lane to be entered. The proper space cushion with traffic ahead on the on-ramp will give room to stop if the car ahead hesitates and enters traffic at the last moment. When reentering traffic after an enforcement contact or disabled vehicle stop, utilize the shoulder as an acceleration lane to match traffic speed before merging to the left.

Leaving the freeway should be a fairly simple task. Signal and, if possible, decelerate in the lane that is usually provided at the start of each off-ramp. If not familiar with the roadway, pay attention to ramp speed warning signs. Signs are posted for a good reason and frequently give little margin for additional speed.



A phenomenon that is peculiar to freeway driving may affect exiting the highway. When driving for a period of time at a relatively constant speed with hazards not in close proximity to the roadway (such as on a modern interstate highway), the feeling of speed may be lost. This won't be realized until leaving the freeway and beginning to slow down on the off-ramp and suddenly realizing that the curve or stop sign at the end of the ramp is coming up much faster than anticipated. If going in a straight line, hard braking, short of locking your wheels, might be in order. If entering a curve, remember that a car steers only by rolling friction, and locking the wheels will only cause the vehicle to skid in a straight line. Keep in mind that freeway off-ramps frequently have deposits of oil, debris, radiator coolant and other foreign material on the roadway surface.

When driving on a freeway or divided highway at night, consider wrong-way drivers, most of whom are either under the influence of alcohol/drugs or confused. In either case, impaired drivers will usually be found in the left lane which is perceived as the right lane. When cresting an overpass or rounding a curve at legal speeds, there may be a closing rate of 110 mph or 165 feet per second. At this speed, the only chance would be to instantly swerve the vehicle; braking would be futile. The only real defense against the wrong-way driver is to watch well ahead. When the line of sight is reduced because of the highway configuration, the odds are better driving in the right lanes.

California freeways carry a great number of out-of-state drivers. Many of these drivers are from low population states and are not prepared for the traffic density or complex interchanges on California freeways. The defensive driver should be alert for indications of confusion or distracted behavior when observing out-of-state license plates, particularly when approaching freeway interchanges. These people will frequently make lastminute lane changes or come to a complete stop in the traffic lane as they decide which highway they want to take.

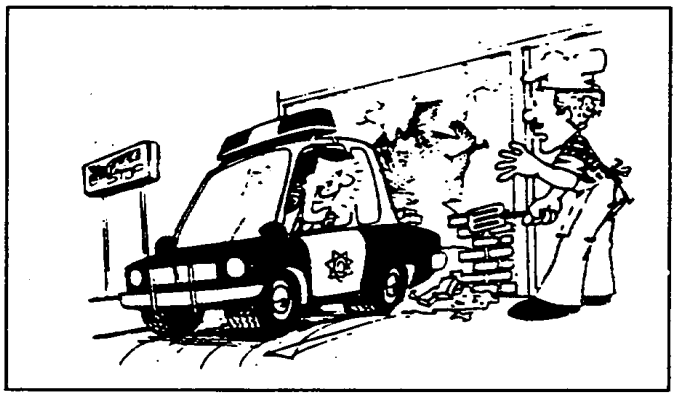
STOPPING

The location, manner and position in which to stop the vehicle can be of importance in avoiding a collision; however, the location will not always be a matter of choice. Whenever possible, choose a spot off the roadway. The most dangerous place to stop a car is, of course, in a traffic lane. While such stops are often made during stress situations and emergency circumstances, avoid them whenever possible. The shoulder of the roadway is far preferable, although hazards still exist here. When parking on the shoulder, try to find a wide spot that will place the vehicle as far off the roadway as possible. Select a location that allows traffic in both directions maximum visibility of the patrol car.

The enforcement officer has more control over the techniques of making the stop than in choosing the location. Try to plan far enough ahead so that the enforcement stop will not create a hazard for following traffic. Give an adequate signal of intentions and get off the road smoothly and quickly.

The position of the parked patrol vehicle can also be important in reducing hazards, particularly on freeway stops. If the stop is an enforcement action, attempt to guide the violator off the freeway. whenever possible. If a stop is to be made on the freeway, warn traffic behind using the emergency equipment while slowing. When the patrol car is off the roadway, turn emergency lights off. Past experience has conclusively established that intoxicated or sleepy drivers will be drawn to a flashing light during darkness, which can result in the patrol car being hit even though it is well off the roadway. During daylight hours, the flashing lights will cause passing traffic to "rubberneck" and slow, which again poses -a hazard to the stopped patrol unit and violator.

If possible, offset the patrol car and stop 10 to 15 feet behind the other vehicle and set the parking brake before leaving the patrol car. Most officers can relate stories of their patrol cars starting backward as they were climbing out. The officer should check his/her rearview mirror before leaving the car.



BACKING

Backing on the roadway is a very hazardous practice; however, there are times when it becomes necessary. Whenever backing, the officer should put his/her right arm on the seat back, raise his/her body and look over his/her right shoulder out the rear window. This gives the best visibility. Use the shoulder of the road if at all possible and try to avoid erratic movements which would confuse drivers approaching from the rear. Back slowly and smoothly, stopping as necessary to let traffic clear. Be aware of signs, paddle markers, ditches or abutments that could be in the line of travel but below the line of sight.

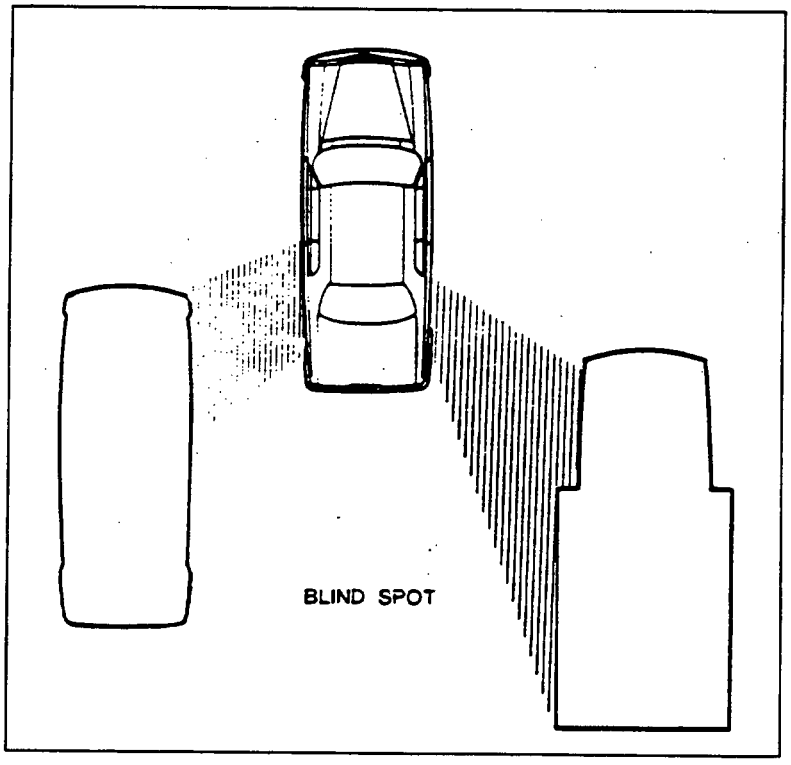
Backing out of carports, driveways or parking spaces is somewhat different. In enforcement work the officer will often be leaving such areas under stress. conditions and backing out will frequently be done hurriedly. The officer should consider the practice of backing when arriving at these locations rather than when ready to leave. Be aware when backing into parking places that the rear overhang of the car is considerably longer than the front; the curb or parking bumper might not stop the wheels before the car contacts an obstacle. It is very embarrassing to park a car with the rear bumper through a restaurant's plate glass window.

VISUAL HORIZON

In driver training one of the most frequently noted deficiencies is a failure to look far enough ahead. Average drivers are lucky to observe what is going on around them let alone be aware of what is ahead as shown by the accident rate at freeway interchanges. As an enforcement driver, maintaining an adequate visual horizon is not only necessary to avoid accidents, but it greatly increases one's ability to observe violations.

LANE CHANGES - MERGING

Recently, California reported 80 fatal and 5,062 injury accidents in one year as a direct result of lane change/merging vehicle movements. Two factors which probably contributed to many of these collisions were drivers' failure to signal their intentions to affected traffic and failure to check the blind spots to the right or left. The rear view and side view mirrors in a car play a vital role, but they don't allow the driver to see everything to the rear. There is a large area to the right rear which cannot be seen in mirrors; this blind spot can hide a pickup with a camper. The only safe way to be sure that this area is clear when changing lanes is to turn the head momentarily and look over the right shoulder.



There also exists a blind spot to the left side of the vehicle. This one is not quite as large and it is farther forward, starting right behind the left door, but it is capable of covering a passing vehicle. Simply turning the head toward the left and allowing peripheral vision to scan this area will avoid conflict. An officer should remember that many people, reluctant to pass an enforcement vehicle, will remain in this blind area for prolonged periods of time.

USE OF THE HORN

The sound of a blaring horn is very irritating and drivers frequently use it to vent anger or frustration at another erring motorist. The horn can be a valuable defensive tool if used as intended, as a warning or communicating device. A couple of short taps on the horn politely tells other drivers or pedestrians that their attention is required. A sustained series of longer bursts signals that there is a hazard, the driver is committed and cannot stop in time. When in doubt, the defensive driver should not hesitate to utilize this means of communication.

HEADLIGHTS

Frequently overlooked as a method of communication with other drivers are the headlights. The driver should have enough sense to turn the headlights on during darkness. Until now, emphasis has been placed on defensive driver's responsibility to see hazards; however, an equally vital aspect of collision avoidance is to be seen. Years ago, Greyhound bus lines began to operate at all hours with headlights turned on, initially to keep the electrical system from overcharging the batteries during long daylight runs. A significant reduction in daytime accidents was observed leading to the conclusion that people were better able to avoid the busses. Headlights should be turned on in all periods of reduced visibility, such as fog, rain or even when driving with the setting sun while eastbound. Headlights should be an integral part of Code 3 operation and can be of assistance in warning opposing left-turners, pedestrians and cross traffic under any driving situation.

CHAPTER 6 CODE 3 DRIVING

LEGAL ASPECTS

Code 3 operation is authorized by Section 21055 of the California Vehicle Code when the emergency vehicle is being driven to an emergency call, while engaged in rescue operations, or in the immediate pursuit of an actual or suspected violator. Driving Code 3 presents potential risks that would not normally be encountered when driving in adherence to the provisions of the Vehicle Code; therefore, special care is needed when the decision is made to operate Code 3. The Department's policy, found in HPM 70.6, Officer Safety Manual, outlines the factors, circumstances, and considerations requiring attention and evaluation in making the decision to operate Code 3, while operating Code 3, and in making the decision to discontinue Code 3 operations. It is important that officers give proper regard, and adhere, to these items, as discussed in HPM 70.6.

Code 3 operation invariably involves speeds in excess of the posted limits or in excess of the flow of other traffic. Therefore, Code 3 operation can create hazards not found in routine patrol and thus obligate_ the officer to maintain an enhanced awareness of these potential hazards. Officers must use reasonable judgment in determining when to drive Code 3. The nature and type of call should be evaluated to determine whether a Code 3 response is warranted in a particular circumstance. For example, injury accidents and calls for officer assistance often, but not always, require a Code 3 response. Moreover, other factors, such as (but not limited to) the distance of the responding officer from the incident, the proximity of other - possibly closer - units to the incident, and the weather, road, and traffic conditions, should be accounted for when deciding whether a Code 3 response is appropriate.

The decision to respond Code 3 requires continual reassessment during the response. Factors that may support a decision to initially respond Code 3 may change, making a continued response Code 3 either unnecessary (e.g., other units are 10-97 at the location of the request, the situation has stabilized) or unwarranted (e.g., change in weather/traffic).

CHAPTER 7 SPECIAL CONDITIONS

Driving conditions encountered by Highway Patrol officers in California are among the most diverse in the world. Some of the heaviest traveled multi-laned freeways in existence as well as one-lane, unpaved, desert roads are located within the state. There are mountain passes above 8,000 feet and miles of fog-shrouded coastal roadways. Almost every extreme of weather condition exists in California. Add to these problems the fact that there are approximately 26 million vehicles registered within the state, and untold thousands of visitors traveling through. The job of patrolling these roadways and securing the orderly flow of traffic becomes more challenging each year.

Each CHP Area has its own unique driving problems. Many Areas publish driving tips in their Standard Operating Procedures (SOP) and conduct training programs for officers new to the squad. This is probably the most effective way of assuring that an officer from the desert knows how to drive in the snow when transferring to a mountain area. This chapter will discuss special driving conditions created by weather and other emergency .situations.

RAIN

Every officer in the state must be familiar with driving in the rain as stopping rates increase in rainy weather. The first rains of the season can result in very slippery driving conditions, sometimes almost as slippery as snow. The rain mixes with dust, dirt, motor oil drippings, and the oil released from the asphalt pavement by the sun. An officer should always anticipate a reduced coefficient of friction with the first rain following a dry spell.

Rain also reduces vision, particularly at night. Water on the pavement reflects the headlights into the air instead of up the road. Often on a rainy night, roadway markings are all but impossible to see and a driver cannot differentiate the shoulder from the roadway. The water on the windshield

further reduces vision and it goes without saying that good windshield wiper blades are vital. Frequently, a good scrubbing with a paper towel and soap will restore a wiper blade thought to be worn out. If that does not work, or if the rubber has deteriorated, the blades should be replaced. -Oil film on the windshield should be washed off with soap. If a driver is operating in heavy traffic conditions, this oil film will reappear after a time. Fogging windows can become a real nuisance to an officer getting in and out of the car on a rainy night. Usually, this can be minimized by keeping the temperature inside the patrol car cool. When the temperature is warm within the car, the moisture on a raincoat or damp jacket is evaporated, and this damp, warm air then condenses on the cold glass causing the windows to fog. Repeated several times, the environment within the vehicle becomes a steambath and visibility to the sides and rear is nonexistent. Opening the back windows one-half inch, turning on the rear defroster, and operating the front defroster with the temperature adjustment cool gives the best' results. Rags or paper towels can be used to periodically wipe condensation off the glass.

HYDROPLANING

The phenomenon known as hydroplaning is frequently misunderstood. Dynamic hydroplaning exists when a film of water begins to separate the normal contact area of the tire tread from the roadway. There are three contributing factors in dynamic hydroplaning; water depth,* tire pressure, and vehicle speed. Before hydroplaning can exist, there must be a sufficient depth of standing or flowing water to submerse the tire tread. Normally, with good tires, one-half inch of water is enough and with worn tread, very little water is needed. When a sufficient quantity of water is present on the roadway, the speed at which the car will hydroplane can be computed by multiplying the square root of the tire pressure by 10.3. As an example, . with a tire pressure of 25 P.S.I., multiply 5 X 10.3 and that hydroplaning will occur at 51.5 mph. In the case of patrol cars, recommended tire inflation is 35 P.S.I. This gives a hydroplaning speed of approximately 61 mph, although partial hydroplaning may occur well before this. It should be emphasized and understood that the preceding figures give the speed at which total hydroplaning should be expected. In total hydroplaning, the front tires are completely separated from the roadway. Directional. stability might be maintained in a straight line only by the contact of the rear tires with the pavement within the tire "wipes" created by the front wheels.

However, at this point, a gust of wind, lane change or curve in the road would result in loss of control. During inclement weather, an officer should ascertain that the patrol car is equipped with good, deep tread and that all four tires are properly inflated. Tests at the Academy indicate that an increase of up to 4 P.S.I. over recommended cold inflation pressure can be beneficial on wet pavement. Even with good tires properly inflated, the only certain defense an officer has against hydroplaning is to reduce speeds below the critical levels when water begins to accumulate on the roadway. A slight advantage can be gained by driving in a lane that allows you to stay within the tire "wipes" of other traffic.

SNOW AND ICE

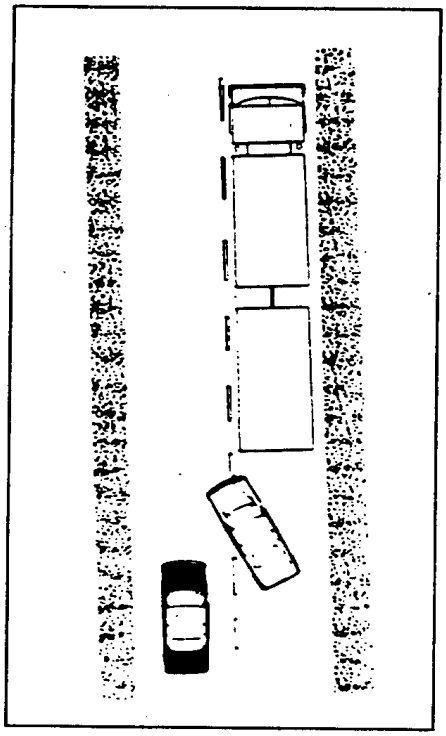
Snow and ice can team up to make one of the most dangerous driving conditions an officer can encounter. Frequently, a snow storm will reduce visibility to only a few feet. Probably the single most hazardous factor is the sharply reduced coefficient of friction. Glare-ice can produce a coefficient of friction as low as 5 %, and the variation in traction on one mile of roadway can be tremendous. The uninitiated should use extreme caution because an icy stretch may not be visible to the eye. This is frequently called black ice because it can be non-reflective and looks like bare pavement. Speed should be kept low and all control of the car must be preplanned, smooth, and deliberate. The techniques of skid control must be instinctive to a snow driver. Remember what effect reduced traction has on other drivers. Never stop at the bottom of a hill, low side of a banked curve, or anywhere traffic may not see the patrol car or would slide into it.

Ice and snow tend to accumulate more in some places than in others. Obviously, a shaded portion of roadway would have ice longer than a sunny stretch. Bridges and overpasses always freeze up sooner than the adjacent roadway because the cold air under them reduces the temperature of the pavement surface. At night, areas that melted from the daytime sun will frequently produce long, icy stretches. When driving under these conditions, expect lengthened stopping distances and sharply reduced traction on curves, then when the emergency occurs the prepared officer can cope with it.

FOG, DUST, AND SMOKE

These three can occur in sufficient concentration to reduce visibility to near zero. When this happens, speed must be sharply reduced. To calculate the reaction distance, take the speedometer reading and add the first digit. Example: 30 mph = 33 feet. If visibility is limited to less than 33 feet, adjust your speed accordingly. A person who attempts to drive at normal speeds during periods of reduced visibility is foolish. When driving under these conditions at night, headlights should be maintained on low beam as high beams only reflect the light back and increase the glare further reducing vision. When driving for a prolonged period of time under these conditions, the eye strain and concentration can cause a sort of hypnosis or trance. Officers should make frequent stops in a safe place, walk around the car and relax their eyes for a moment. Of prime importance is the ability to be seen by other traffic. Do not hesitate to utilize emergency flashers to the rear and turn on headlights during daylight hours.

When the right circumstances exist, fog can accumulate in relatively small, dense patches. This is frequently called tulle fog because it is normally associated with lowlands or depressions on the highway. When these conditions are observed, a driver should watch well ahead and be prepared to slow rapidly. In a few hundred feet visibility can change from good to only a short distance in front of the car.



GRADES

Ascending a grade puts a larger demand on the engine than does driving on level roadways, and means a lesser rate of acceleration than the car is normally capable of. When passing other traffic on a hill, an officer must allow a longer distance to complete the pass. Think about other drivers in the line of traffic which is being passed. Frequently, another car will change lanes abruptly in front of an officer in order to pass a slow truck. If the passing speed is too great, a collision will be unavoidable. Plan a pass that will allow a hole to pull back into if the passing movement takes longer than anticipated.

Descending a grade brings other potential hazards into focus. It is very easy to let the speed creep up. Stopping distance will be appreciably lengthened because of the increased energy requiring the braking system to convert to heat. When appropriate, select a lower gear before descending a hill as the engine compression will assist in keeping speeds down and will offer a certain amount of deceleration when stopping.

NIGHT DRIVING

Probably the most common error committed by drivers.during darkness is driving beyond the vehicle's headlights. Most busy freeways or business districts have enough lighting to eliminate this problem. On rural or unlighted roadways, a driver should periodically assess the limits of visibility within the scope of the car's headlights. As discussed in fog driving, speed should be adjusted to allow adequate reaction time.

At night, most drivers' depth perception and rate of closure are affected. Before crossing or entering another roadway, look twice and ascertain that cross' traffic isn't going faster than it appears. Keep in mind also that other traffic may have a similar closure rate problem. Severe right-of-way collisions can occur at night and many times the responsible drivers admit seeing the other traffic, but underestimating the speed of the other car.

It is a common occurrence to come over the crest of a hill or around a curve at night and be greeted by the blinding high beams of an oncoming vehicle. Usually, the other driver will lower the beams almost immediately, but at times will not respond to repeated blinking of high beams and the other driver keeps the high beams on.

Fight the urge to respond in kind, although this is often hard to do. The officer should not stare at the other car's headlights, but attempt to focus his/her eyes on the right shoulder of the road. This will help to see possible hazards and minimize the constriction of the pupil so that night vision can return to normal as quickly as possible.

WHEEL OFF THE ROAD

At some point in time, the right side wheels may drop off the pavement and onto a soft or low shoulder. This seemingly harmless situation has been the direct cause of many fatal accidents. The instinctive reaction to jerk the car back onto the road can be deadly. Invariably, the tires will hang up momentarily on the edge of the pavement. When the steering wheel is turned more, the car will suddenly swerve. across the roadway into opposing traffic -or go into a broadside skid. Either case is a recipe for a serious accident. If the wheels drop off the pavement, ease off the throttle and straddle the edge of the road. Keep a firm grip on the wheel and do not brake until the speed is reduced. After slowing down considerably, steer the car back onto the road.

BLOWOUT

Modern tires are very durable; however, under the proper circumstances, tires can and do blow out. This is an emergency for which the average officer cannot be completely prepared because it happens quickly and seldom gives advance warning. The actions will obviously depend upon the circumstances at the moment, but following are some general rules.

Expect the car to pull to one side or. the other. Do not jerk the wheel but attempt to guide the car gradually in the safest direction.

DO NOT INSTINCTIVELY BRAKE! Braking will cause the car to pull more severely to the side the blowout occurred on, particularly if it was a front tire.

Do not try to stop as quickly as possible in order to save the tire; it is no doubt already ruined. Continue on slowly until a stop off the roadway can be made at a safe place.

HOOD UP

Federal regulations require that automobile hoods have a secondary or safety latch. This device is intended to function as a fail-safe if the primary latch opens, thereby preventing the hood from flying up while the car is in motion. As with anything mechanical; this system has been known to fail. If the hood releases at high speed, the results can be serious, especially if the wind forces it backwards and into the windshield.

At lower speeds, the upraised hood will block the driver's vision to the front. Usually, there will be a gap at the bottom of the hood just above the dashboard. If this is impractical, the other only choice will be to roll down the left window and attempt to look around the hood slowing down and pulling off the road.

Officers in mountainous areas of the state have experienced the hood latch releasing as a result of ice and snow accumulating under the grill.

ANIMALS IN THE ROAD

Most drivers share a common desire not to kill or injure a family pet. In residential or urban areas, pets can appear in the roadway suddenly and without warning. When this occurs, even the most experienced of drivers may have to fight the instinct to brake or swerve. If there is no traffic around, a driver may be able to take evasive action and continue on without incident. If traffic is heavy or an officer is driving fast, it may be wise to strike the animal rather than to lose control or cause an accident that injures people. Either course of action will have to be decided upon instantly. The enforcement driver would be well-advised to periodically consider the possible alternatives to this and other driving emergencies. Then, when the emergency presents itself, reaction time will not be wasted in decision making.

The size of an animal can dictate what action is called for. As an example, a house cat would seldom damage an automobile, but a 2,000 pound bull could total a car and kill the driver. If faced with an imminent collision with a large animal, it might be appropriate to swerve through a fence or into a ditch. The car might be damaged but the driver could walk away from it. Experienced mountain and country road drivers usually know at which areas and what time of the year deer or livestock might be expected on the roadway and then exercise caution when the potential exists.

During darkness, the outline of a deer or cow may be almost impossible to see in the headlights but nature provides the alert driver with a sort of warning device. Animals are fascinated by bright lights and will usually stare at them. The light from the car's headlamps will then be reflected back to a driver by the animal's eyes. When a driver can see what appears to be two or more small lights or reflectors at the shoulder of the road, he/she should immediately reduce speed and prepare to take evasive action. Deer usually travel in groups at night. Knowledgeable mountain drivers always slow if a deer crosses the roadway, even if well ahead of the car, because it is a certainty that there are additional unseen deer in the area.

POWER FAILURE

Modern enforcement vehicles are equipped with large engines, heavy duty suspension systems, transmissions, and brakes, plus the added-on emergency equipment. The result is a patrol car that weighs substantially more than the average pleasure vehicle. The Department has purchased enforcement vehicles equipped with power brakes and power steering which have given the field officers a car that is pleasant to drive for prolonged periods of time and is safer than its counterpart without power-assisted equipment. Both the power brake system and the power steering are dependent upon engine operation to function properly. In the past, engine failure was an infrequent occurrence. Under the following circumstances, most modern automobiles will maintain power steering and power brakes, even with a dead engine. If the car is in motion when the engine dies, power steering will continue to function down to a low speed, if the transmission is left in gear. The pressure in the torque converter of the transmission will allow the momentum of the car to turn the engine over, which will operate the power steering pump. The driver should expect to lose power-assisted steering as speed decreases. The testing of many vehicles has shown this speed can range from 15 to 25 mph dependent upon make, model or vehicle condition. At this low speed, a driver should be able to maneuver the car off the roadway to a safe stopping place. If a driver experiences engine failure at low speeds, or places the transmission in neutral when the engine dies, the power steering will cease to function immediately. Field officers should remember if they elect to push a disabled vehicle, that the driver will not have power steering and may not be strong enough to control the car.

The power brake system is actuated by engine vacuum. When the engine fails to run, vacuum is no longer produced.' If the system is functioning properly, the power brake system has a reserve tank or canister that stores a limited amount of vacuum. Upon engine failure, this reserve vacuum will ordinarily provide two power-assisted brake applications. Again, this . should normally be adequate to bring the car to a safe stop off the highway. In the absence of power-assisted brakes, the operator should simply remember that a great deal more pressure will have to be applied to the brake pedal, but the car will still stop.

These guidelines refer in particular to departmental enforcement vehicles but are generalizations that would apply to most modern cars.

CARRYING GASOLINE

Occasionally, the field officer will have reason to transport gasoline for a disabled motorist. Gasoline should never be carried in the trunk of the patrol car because few containers are completely leakproof. The closed environment of the trunk is ideal to build up potentially explosive gasoline fumes. The mobile radio is mounted in the trunk and switches inside the radio can produce electrical sparks which can ignite gasoline fumes. When gasoline is transported in the patrol car, it should be carried on the right front floorboard. It would also be wise to open windows to permit ventilation.

CHAPTER 8 FIELD TRAINING

RESPONSIBILITY OF THE SUPERVISOR

Up to now, this guide has been directed toward all CHP drivers regardless of their rank or specific assignment. This chapter of the guide, however, will be directed primarily to the supervisor of all commands.

This chapter will discuss the supervisor's responsibilities to:

- Educate
- Instruct
- Correct
- Set an example
- Motivate
- Follow-up

None of these activities should be new to supervisors. These are normal daily activities. For the, purposes of this guide, however, the focus is on supervisory responsibilities with regard to driving safety.

THE SUPERVISOR EVALUATES

The environment in which a Highway Patrol officer works should produce an attitude of extreme desire to personally avoid the horrible effects of accidents. But does it? Often not! ! Psychologists could probably give numerous reasons for this strange fact. Some supervisors, after a ride with a subordinate may say, "I'll never ride with that officer again!" Whether these supervisors know it or not, an evaluation of that particular driver's ability has been made and corrective action is required. Unfortunately, these supervisors have also made a decision to do no more about the situation than to avoid it.

Other supervisors say, "They teach them how to drive at the Academy, don't they?" and based on that assumption, do little else to determine the member's driving abilities or weaknesses. The Academy training must be reinforced by constant supervision and a sincere interest in the well-being of the officers. These supervisors have evaluated the driving of the subordinate but have probably based the evaluative judgment based on insufficient data.

How, then, should driving be evaluated?

First of all, the supervisor should ride with the officers. He or she should ride with them long enough and often enough to get a reasonably complete picture of the officers' driving habits. If the driving is unacceptable, tell them so and tell them why. This experience probably provides one of the most fertile fields available for training, since both the supervisor and the officer are personally involved at the time.

Second, talk to the officer about his/her driving. Be conversational, do not make it a quiz or an opportunity to nag. Find out what they do (or what they think they will do) in an emergency situation. Do they know, or do they remember, what evasive actions they might take in a variety of accident-causing situations? A lot can be learned by attentive, evaluative listening while an officer describes some past driving experience.

There are a lot of other indicators that a supervisor can use to establish a picture of the way an officer drives. Some of these are as simple as listening to what other members say about the officer's driving, looking at their driving records, or observing their driving from another vehicle. The supervisor will, of necessity, choose those methods of evaluation that best suit each individual case. One method or possibly a variety of methods may be used. The important thing is that the supervisor makes a conscientious, purposeful, and deliberate evaluation of the driving practices of every subordinate under his/her direction or command.

THE SUPERVISOR INSTRUCTS

The concept of the supervisor as an instructor is certainly not a new one to the California Highway Patrol. It is part of the CHP training philosophy that the most important person in the total training effort is the individual supervisor.

The manner in which instruction is given to a subordinate will depend to a large degree upon the evaluation the supervisor has made of this subordinate's driving skills. Instruction may take any of the recognized forms such as demonstrating, telling the employee, assigning selected readings or merely providing an open climate for questions and answers.

Do not be misled by the feeling that "these officers have heard all this before." Perhaps it is true, but a tried and true principle of learning is that retention increases with repetition. Consider, too, that the employee may never have heard these same things directly from his/her supervisor before and instruction has a way of becoming more important when it comes from the boss.

THE SUPERVISOR CORRECTS

Undesirable driving habits do not tend to disappear; rather, bad driving habits (like good driving habits) tend to be reinforced with usage and harder to unlearn. When a supervisor spots a dangerous or hazardous activity existing in a subordinate's driving, it is vital that the necessary steps to correct the situation are initiated as quickly as possible. It is another learning principle that correction tends to be more effective if it follows the unacceptable act as quickly as possible.

Remember, in making corrections you are not rejecting the officers, but merely his/her actions or conduct in a specific situation. Try to make this clear to the officers that you are not attacking them but rather the problem of a dangerous or unsafe driving habit.

THE SUPERVISOR SETS AN EXAMPLE

Setting a good example is to complement all of the above activities. The supervisor must set an example at all times. Remember while evaluating the employee's driving, he/she is probably forming an evaluation of the supervisor's driving.

It is always a great deal easier to spot unacceptable habits in others than to see these habits in ourselves and, for this reason, a supervisor must constantly be on guard to make his/her driving activities as exemplary as possible.

In this area of example-setting, the supervisor has a further, more sensitive training job to do. In order for setting an example to be effective, all the supervisors in the command must set an equally good example.

THE SUPERVISOR MOTIVATES

Nearly every California Highway Patrol officer is capable of driving safely and will do so provided he/she makes the effort. The best way to help an officer become a safe and skilled driver is to somehow make him/her want to be such a driver. How can that be done? Some may say that it is quite impossible to motivate another person and that all motivation must come from within that person. Those who embrace this philosophy say that the supervisor must merely create the kind of climate in which each employee will want to do a specific act. In any event, there is no hard-and-fast rule about motivating human beings.

Individuals have different motivations and different factors which will cause them to become motivated. The effective supervisor has the responsibility of discovering what these factors are for each of his/her subordinates.

For one, it may be merely the encouragement of the supervisor to do a better job; for another, it may be group or social pressures from his/her peers; for some, only an expressed or implied threat of disciplinary action or the promise of a reward will motivate.

The important thing to remember is not to believe that what motivates one officer will motivate all. That includes even those two items generally thought to be universal motivators --- better wages and promotion.

THE SUPERVISOR FOLLOWS UP

Once a ride with the officer has been completed, the officer's driving has been carefully evaluated, corrections have been made when and where necessary, and instructions have been given designed to improve his/her driving, it would seem that the job is finished. Not quite. All of the good intentions, not to mention hard work, may be to no avail if there is no follow up to see if the desired effect has taken place. This follow-up is a vital part of the training process since it should indicate to the supervisor those areas of skill, knowledge or attitude which show a need for reinstruction or further instruction. It also has the salutary effect of demonstrating to subordinates that the supervisor does care about the officer's activities, at least enough to follow up and see that things are going properly.

The point at which the supervisor will follow up will again be largely a matter of individual judgment. Follow up may be shortly after correction or instruction has been given or, may be of advantage to wait a longer period of time to give the instruction a chance to "take."

In summary, the supervisor's most immediate responsibilities are:

- Evaluate the driving performance of each subordinate;
- Instruct in all those areas where need has been expressed or indicated by the supervisor's evaluation;
- Correct undesirable driving habits found in the subordinate's driving;
- Motivate all subordinates under his/her direction to become better and safer drivers and;
- Follow up in order to determine that instruction and correction have had the desired effects and that driving performance has improved.

These are neither more or less than the everyday responsibilities of a supervisor. Focus them on the specific area of safe driving and they will bring results.

COMMENTARY DRIVING

HPM 10.6, Occupational Safety Manual, requires that uniformed members receive a minimum of one hour formal instruction in defensive driving annually.

Commentary driving is a means of supplementing the defensive driving requirement and will provide our uniformed members with annual behind-the-wheel training. When conducted properly, it will reinforce and strengthen an individual's defensive driving tactics and attitudes. A conscious awareness of routine driving tasks and potential hazards encountered on the highways is expanded by this method of training.

Commentary driving is not solely an evaluation process but also a training technique. The role of the instructor should be one of teaching in areas of identified needs, not that of a "Ride-Along Checklist Examiner."

Every effort should be made to place the student in a relaxed atmosphere so that his/her normal driving habits can be recognized.

Commentary driving instructors need not be expert professional driving instructors. A great deal of success has been obtained by using instructors from within the peer group. Training is accomplished to a great extent through group participation. The instructor should possess the ability to communicate on an instructional basis, have a sincere interest in driver improvement and be knowledgeable in the techniques of collision avoidance.

Ideally, one instructor should handle three students. More than three students make it overcrowded and uncomfortable within the vehicle and less than three detracts from the group exchange of information necessary to the success of the training session._

Prior to actual training, the instructor should review the student's past driving record and training. This review may provide ideas on training needs and areas of necessary concentration. This can be done either during informal predriving conversation with the student or by requesting information contained in the CHP 442, Individual Accident, injury and, Safety Recognition Record.

Training begins with the instructor driving first, demonstrating commentary driving. He/she verbally announces each movement made while operating the vehicle and every hazard or potential hazard observed. Care should be taken to confine verbalization to significant actions and anticipations. Constant chatter on meaningless points is distracting, tiring and detracts from the value of the program.

Following an adequate demonstration period, the student begins driving. Routes selected should be varied. The instructor should point out gross errors but otherwise make mental notes of general driving habits. After a period of time the instructor invites the other students to make suggestions or to note hazards that the driver may have missed. The instructor then adds his/her comments. The other students gain by the group participation. The length of time each student drives is dependent upon his/her individual skills, but generally, the time will run from 30 minutes to an hour.

Annex B is a list of collision avoidance tactics to serve as a pretraining refresher for instructors. It should not be used as an evaluation "checklist" during the training session.

VEHICLE PLACEMENT

Training in maneuvering a patrol car in confined areas has been shown to be effective in reducing the accident rate of many agencies. Elaborate facilities are not necessary. An abandoned air field or parking lot and a number of traffic cones will serve as the basis for a significant training course. Again, soliciting the cooperation and involvement of other agencies may assist in procuring the necessary location and materials. Exercises should be designed to correct deficiencies and strengthen skills in driving areas found to be relevant to the particular group of trainees. Annexes C through K diagram and describe a number of exercises that may be utilized. The exercises are in no way intended to be inclusive and may be modified to conform to the facility available.

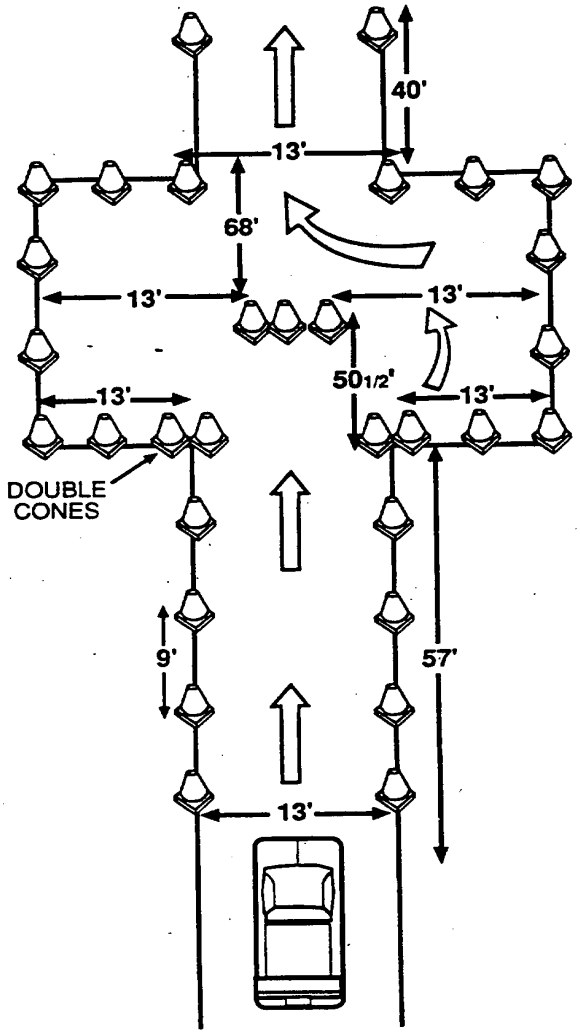
SKID-CONTROL TRAINING

The skid pan installed at the Academy is the subject of considerable conjecture and speculation on the part of the public. Many people assume its role is to teach officers to drive on slippery roads or to learn any one of a number of legendary driving skills thought to be possessed by Highway Patrol officers. It is true that skid pan training can be applied to slippery roads such as snow or ice but this is not its primary role. The physical forces affecting a vehicle at high speeds are present, but not apparent, at low speeds. The skid pan is simply a device that amplifies the behavior of an automobile at low speeds. The cadet/officer can safely experiment and master the techniques of countersteering, smoothness, emergency stopping and the like.

In-service driver training has demonstrated that even experienced officers benefit from refresher training on the skid pan. Skills can be strengthened and bad habits become readily apparent with reduced traction. The installation of a skid pan in each Division of the state would be very desirable for training but unfortunately prohibitive due to the high installation costs.

Many areas of the state, however, have a natural skid pan available to them with the first snowfall or freezing weather of winter. A layer of snow or water applied and allowed to freeze converts a parking lot into an effective skid pan. In the past, officers attending in-service driver training would sheepishly admit to sliding their car around on a snow-covered parking lot. They were somewhat surprised to learn that the driver training staff encouraged this as a training technique. Care should be exercised so that the public does not come to erroneous conclusions, and if possible, training should be conducted in a location not visible to the general public. Acceptance can be gained by contacting news sources and explaining the manner and intent of such training. In the past few years increased interest in skid control training or snow driving has prompted a number of commands to initiate such a program. The results have been very encouraging and cooperation has been won from other agencies such as CalTrans, sheriffs' offices, and local police departments wishing to participate in the training.

ANTI-LOCK BRAKE SYSTEM EXERCISE



The officers shall be advised the Anti-Lock Brake System (ABS) exercise is not an exercise in proper braking techniques, but only an exercise in the function of the ABS.

Brief the officers prior to performing the exercise. Three stops should be made on dry pavement at 40, 45 and 50 mph and if the pavement is wet the speeds should be reduced to 35, 40 and 45 mph.

This is not a last minute lane change exercise, so you want to advise the officer well in advance which lane to take (either left or right). As you approach the entrance, you should call out "now" so the officer knows where to apply the brakes. The officer should have the brake pedal depressed as hard as possible by the double cones in order to activate the ABS in a straight line.

The officer shall maintain firm steady braking pressure until the maneuver is complete. Make sure they realize that ABS activates in panic situations only, and this should not preclude them from using proper braking techniques.

(COMMENTARY DRIVING COLLISION AVOIDANCE TECHNIQUES
(Pretraining Refresher For Instructors)

A. Predriving.

1. Visual check around vehicle to note any hazards.

2. Adjusts seat and mirrors.

3. Fastens seat belt.

4. Checks lights, brakes and gauges.

5. Releases parking brake.

B. General Driving Habits.

1. Good posture and hand position.

2. Makes intentions known to other drivers.

3. Accelerates smoothly.

4. Stops smoothly.

5. Watches well ahead in traffic.

6. Prepares for hazards.

a. Distracted or confused drivers and pedestrians.

(1) Establishes eye contact.

(2) Taps horn when in doubt.

b. Traffic and roadway conditions.

7. Drives at safe speed for conditions.

a. Flows with traffic.

b. Not appreciably faster or slower.

8. Uses adequate space cushion.

    a. Advocates 2-second rule.

    b. All sides clear when possible.

    c. Safe distance when stopped in traffic.

9. Doesn't wander within lane.

10. Cautious at intersections.

    a. Anticipates "stale" green lights.

    b. "Clears" intersection before crossing.

    c. Leaves intersection quickly when clear.

11. Checks mirrors frequently.

12. Aware of traffic advisory signs.

13. Looks over right shoulder before backing.

C. Freeway Driving.

1. Merges at proper speed.
2. Drives in lane with fewest potential hazards.
3. Minimizes lane changing.
4. Doesn't rely totally on mirrors while changing lanes or merging.
    a. Clears blind spot.
    b. Glances over shoulder.
5. Avoids blind spots of other drivers.
6. Anticipates movements of overtaken traffic.

7. Provides an "in" for merging traffic.

8. Prepares for exits well in advance.

D. Conclusion of Driving.

1. Selects safe area to stop.

2. Makes intention to stop known to other drivers well in advance.

3. Sets parking brakes.

4. Cautious when opening door.

E. Attitudes.

1. Observes traffic laws.

2. Courteous to other drivers and pedestrians.

3. Stays calm in annoying situations.

4. Resists urge to experiment with horsepower.

5. Accepts advice and criticism in a constructive manner.

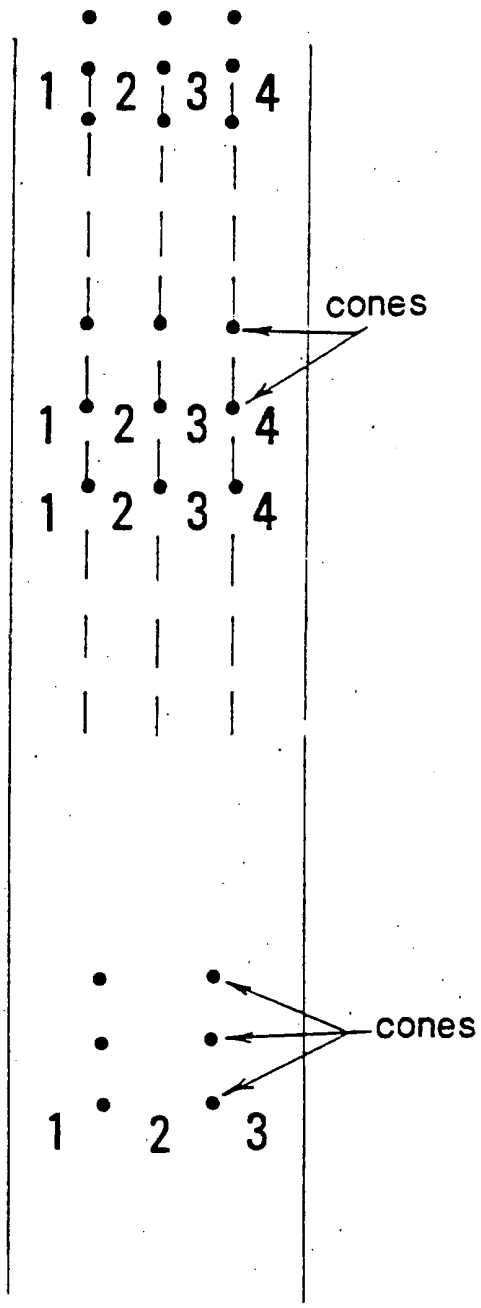
LANE CHANGE EXERCISE

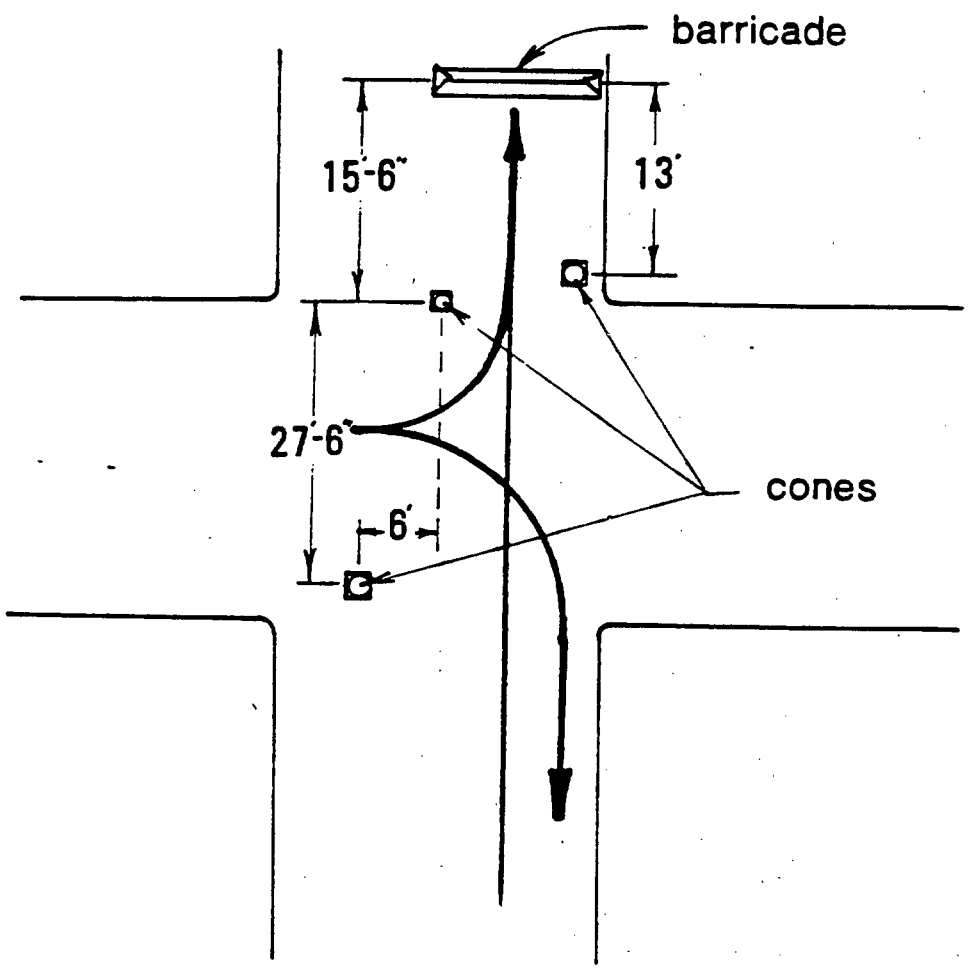
Upon radio command, the student accelerates a patrol vehicle to a specified speed on a roadway approximately 40' in width. While passing through a 10' cone-marked lane at the center of the roadway, the instructor gives another radio command directing the lane to be taken. The student must quickly change lanes to place the vehicle into one of four 10' wide cone-marked lanes within a distance of approximately 60 feet. In place of a command to change lanes, the student may be given a command to stop. The student must quickly stop the vehicle in a straight line, in a distance of approximately 60' or less. The student is instructed that this is best accomplished by applying the brakes just short of a locked-wheel skid.

> Teaches rapid decision-making and quick response to an outside stimulus. Also, teaches the importance of proper vehicle handling techniques under conditions of abrupt lane changes and emergency stopping.

As the student becomes proficient at the exercise, he/she will be required to complete the exercise driving a specially equipped vehicle with an instructor as passenger. At the moment of changing lanes, the instructor mechanically induces a brake and steering failure in the vehicle.

> Allows the student to experience a failure of the power brake/steering system under controlled and supervised conditions.



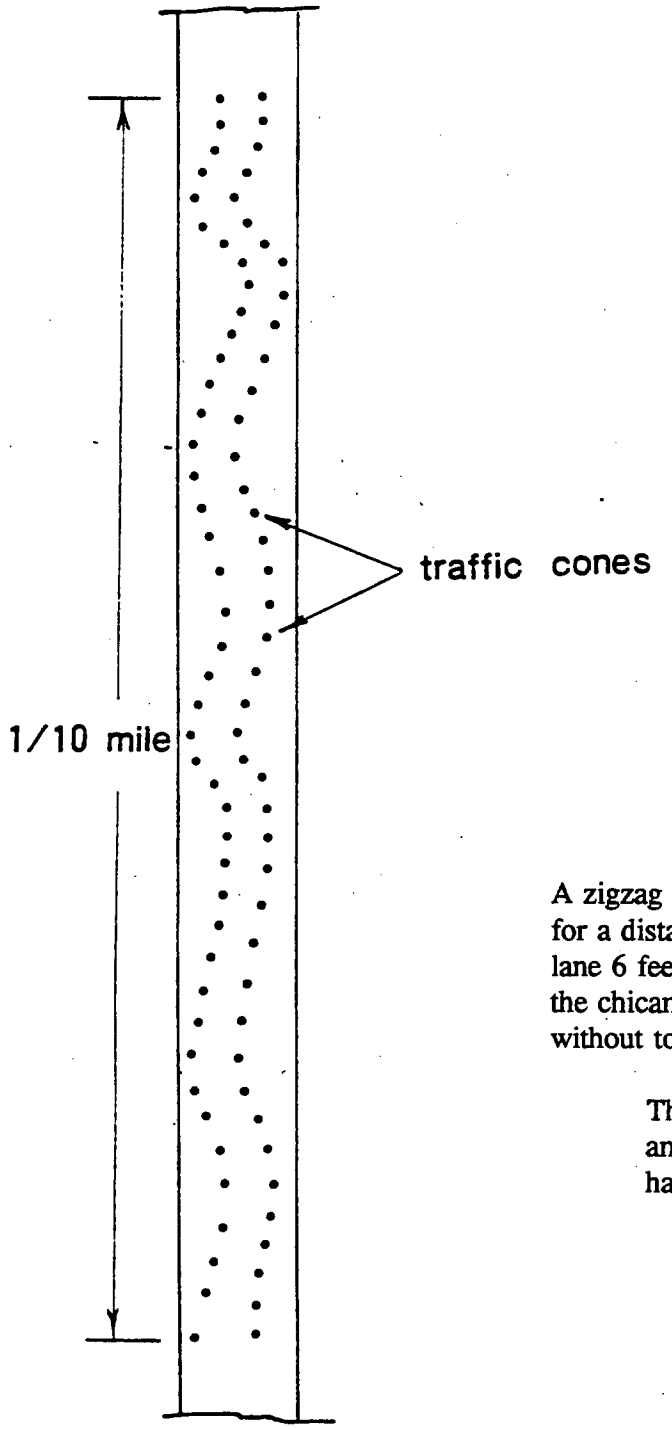


BOOTLEG TURN

The student drives up to a wooden barricade blocking the lane. The student places the front bumper within 6 inches of the barricade. He/she then backs to the left shoulder, stopping at the edge of the pavement without striking a cone placed 3 feet beyond minimum turning radius and at the right rear. The student then turns right proceeding opposite the original direction.

The student learns front bumper placement, a technique of backing for the purpose of changing direction; and skill and judgment in maneuvering within a limited area.

ZIGZAG LANE



ZIGZAG LANE

A zigzag lane is constructed with traffic cones for a distance of 500 feet. The cones form a lane 6 feet to 10 feet apart. The student enters the chicane and drives as rapidly as possible without touching any of the cones.

The student learns vehicle placement and quick responses by constantly having to turn back and forth.

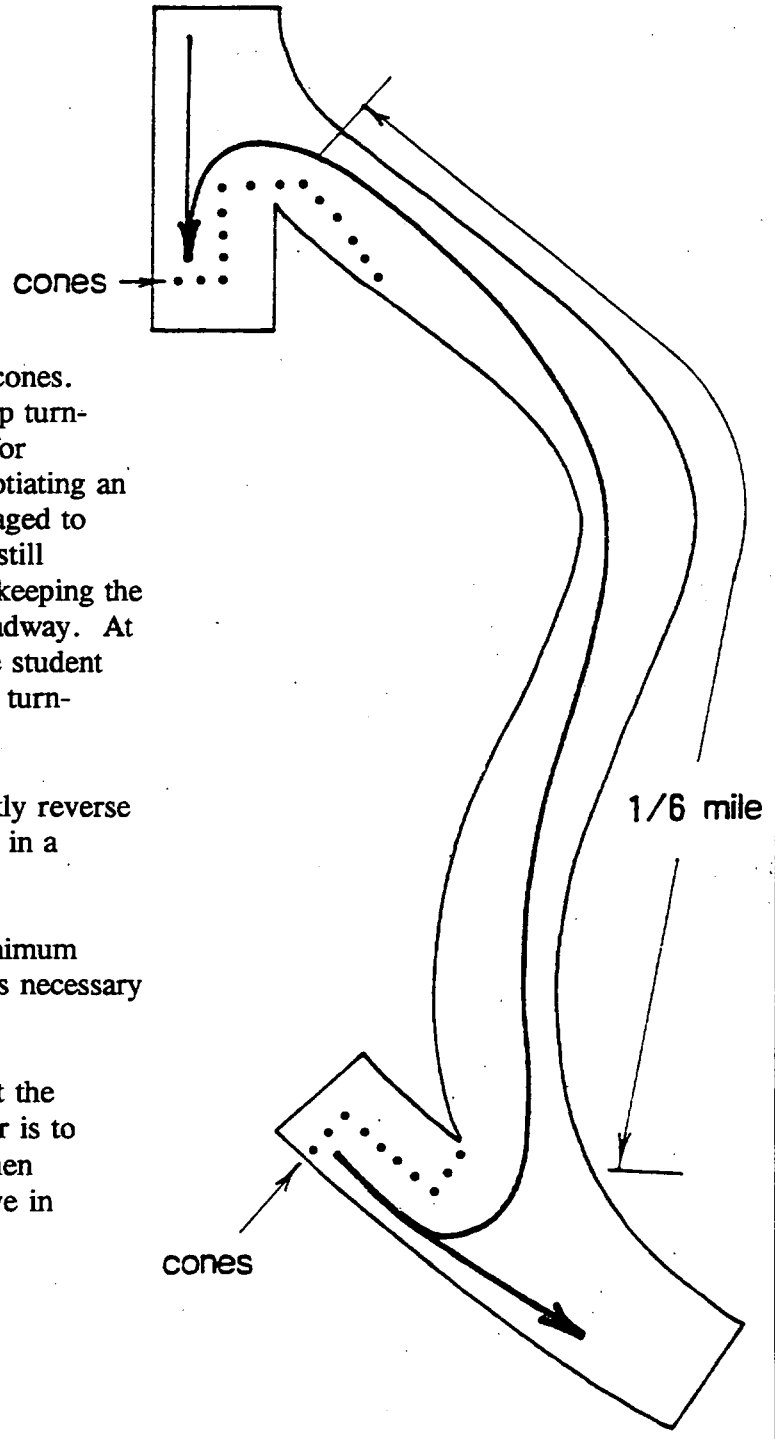
HIGH-SPEED BACKING

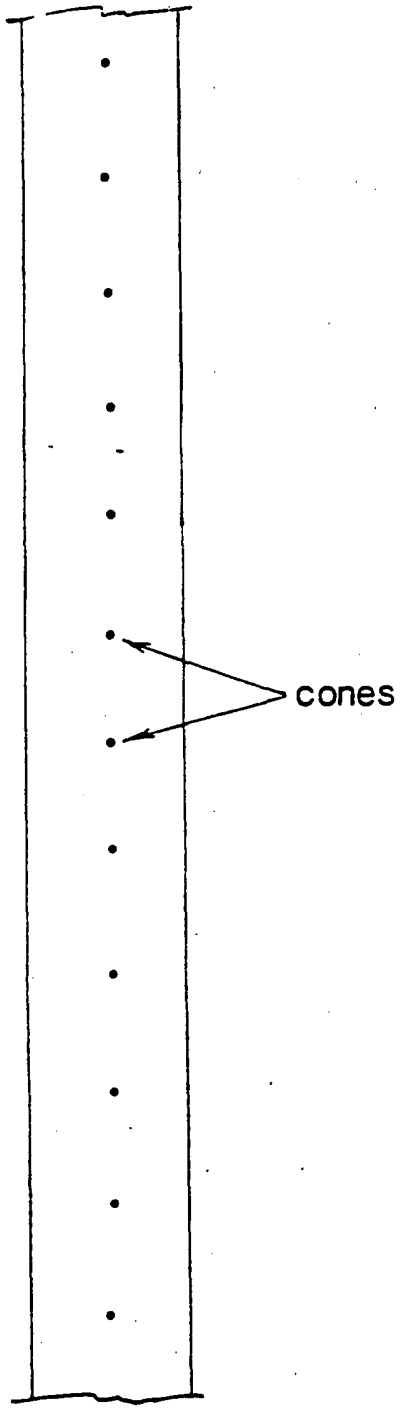
The student stops the vehicle at a point on the roadway blocked by cones. He/she backs the vehicle in a sharp turn-around, then proceeds in reverse for approximately 1/6 mile while negotiating an "S" curve. The student is encouraged to drive as rapidly as possible while still maintaining complete control and keeping the vehicle on the right side of the roadway. At the completion of the exercise, the student again reverses direction in a sharp turn-around delineated by cones.

The student learns to quickly reverse the direction of the vehicle in a limited space.

The student learns that minimum steering wheel movement is necessary when backing a vehicle.

The student also learns that the normal response of a driver is to overcorrect the steering when the vehicles begins to weave in reverse.



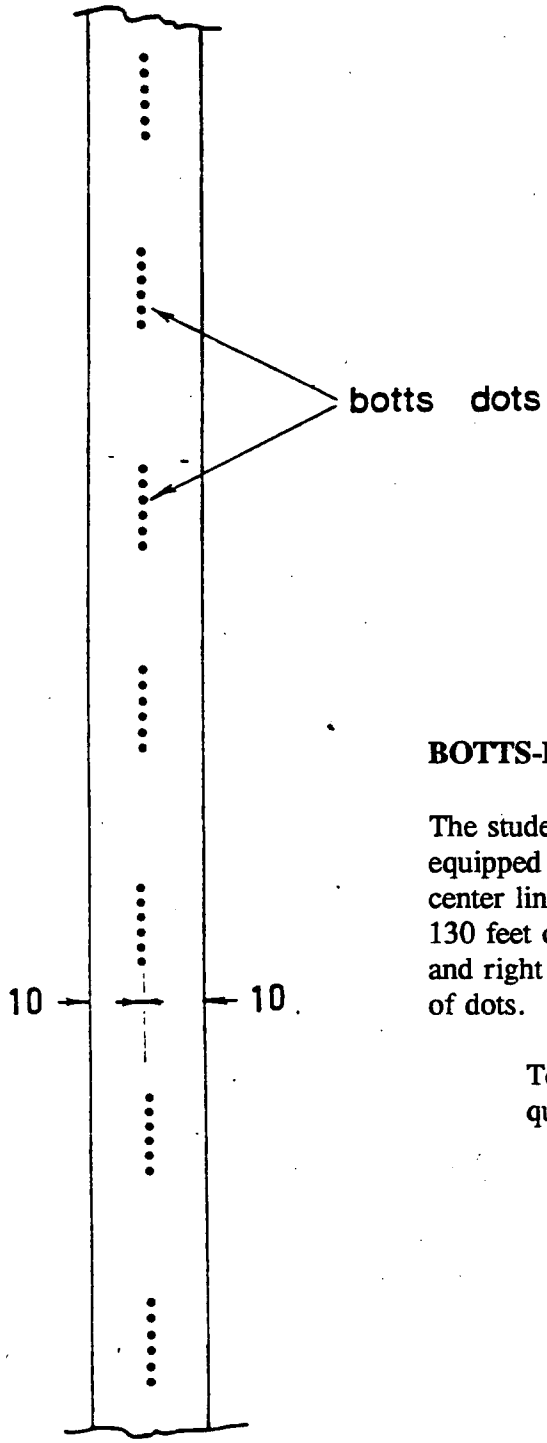


SERPENTINE

The student weaves the vehicle left and right between cones spaced 50 feet apart at the center line of the roadway.

Develops proper hand position, rhythm and timing of steering input.

Increases the student's ability to perceive the spatial relationship of the vehicle with respect of fixed obstacles.



BOTTS-DOTS

The student drives the vehicle forward on a roadway equipped with seven 80-foot sections of botts-dots on the center line. Each 80-foot section of dots is separated by 130 feet of smooth pavement. The student places the left and right tires on the dots, alternating with each section of dots.

Teaches wheel placement and smooth, quick lane changing.

OFF-SET LANES REVERSE AND OFF-SET LANES FORWARD

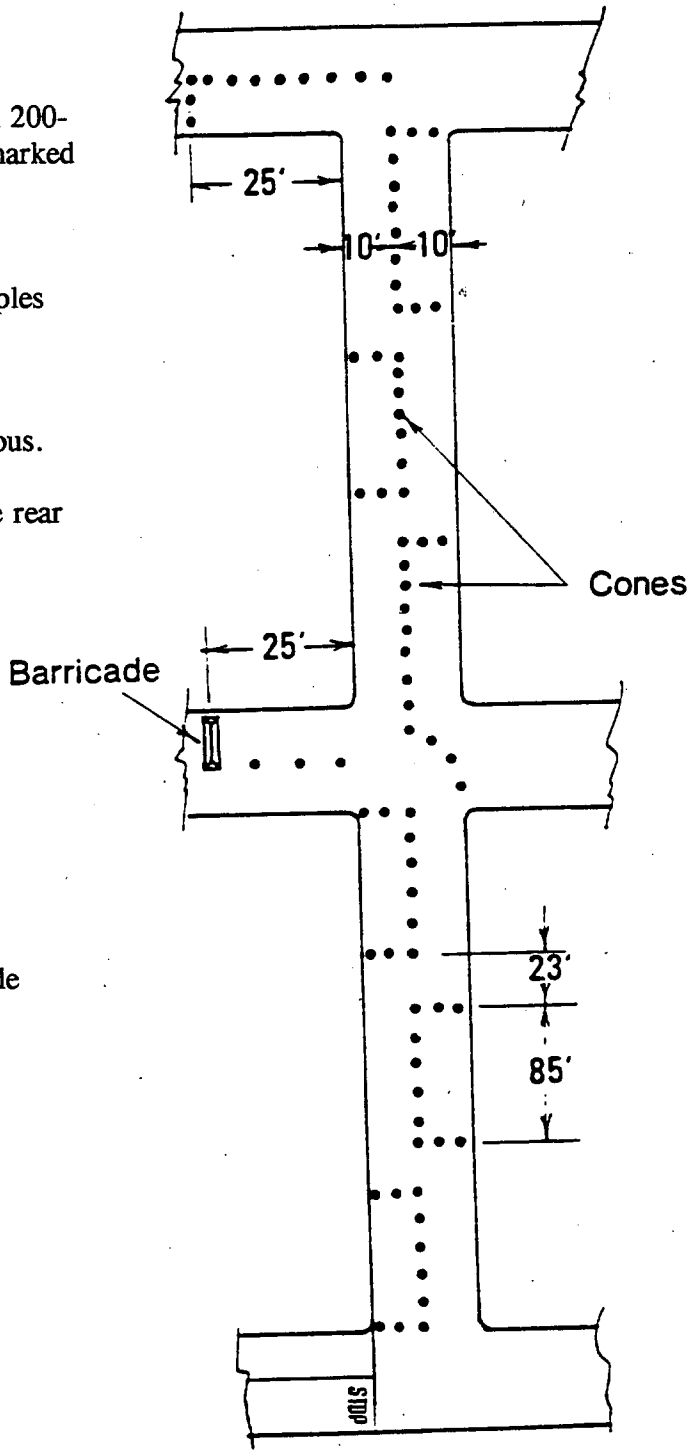
OFF-SET LANES REVERSE

The student backs the vehicle through a 200-foot, 10-foot wide, double offset lane marked by traffic cones.

Teaches smoothness of steering, coordination, control and principles of reverse steering.

Demonstrates how lack of full visibility makes backing hazardous.

Develops habit of looking to the rear rather than relying on mirrors.

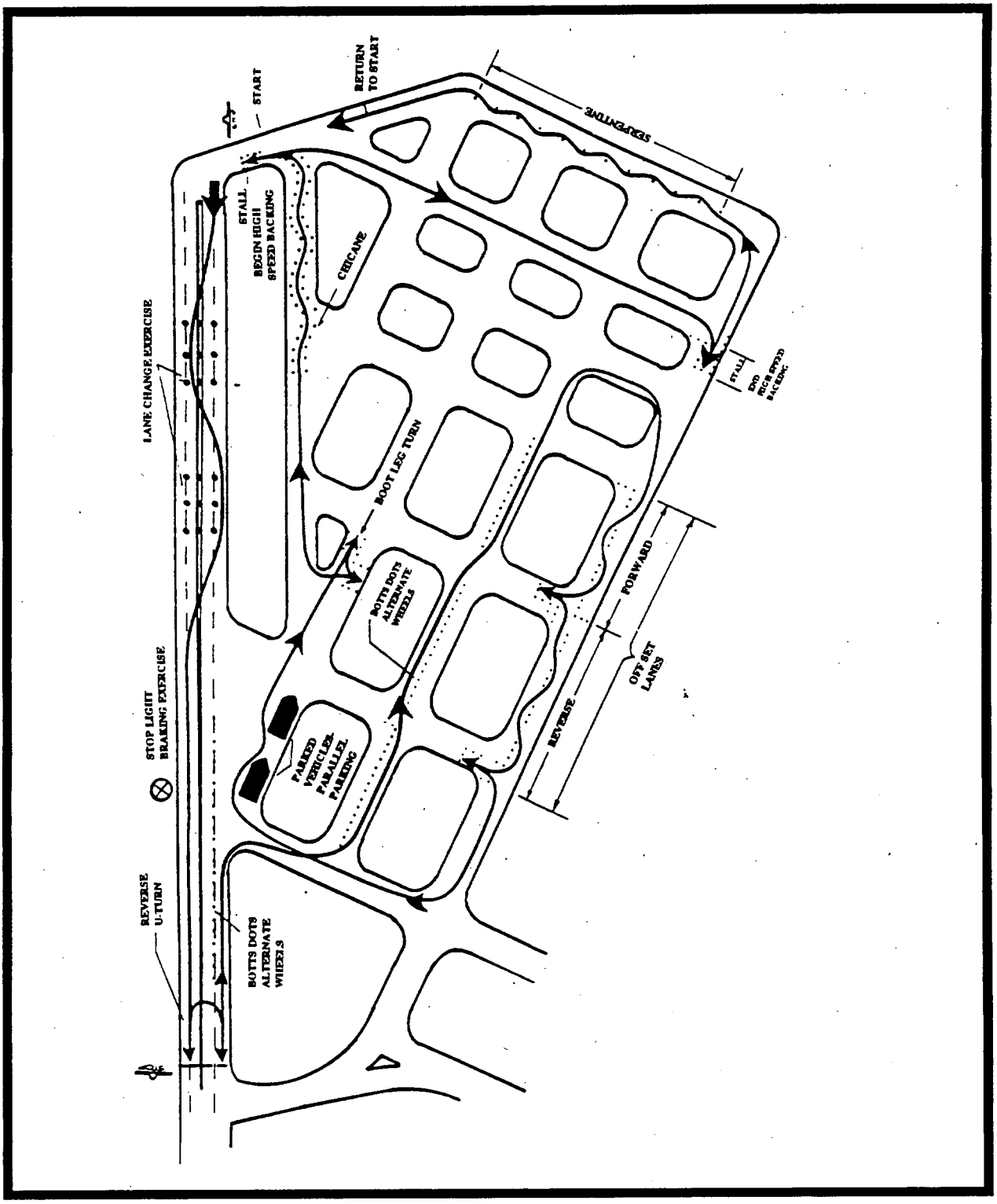


OFF-SET LANES FORWARD

The student drives the vehicle forward through a 200-foot, 10-foot wide, double offset lane marked with traffic cones.

Student learns smoothness of steering coordination and vehicle placement.

EXAMPLE OF EXERCISES LINKED INTO CONTINUOUS ROUTE



EXAMPLE OF EXERCISES LINKED INTO TWO CONTINUOUS ROUTES PROVIDED CONFLICTING TRAFFIC

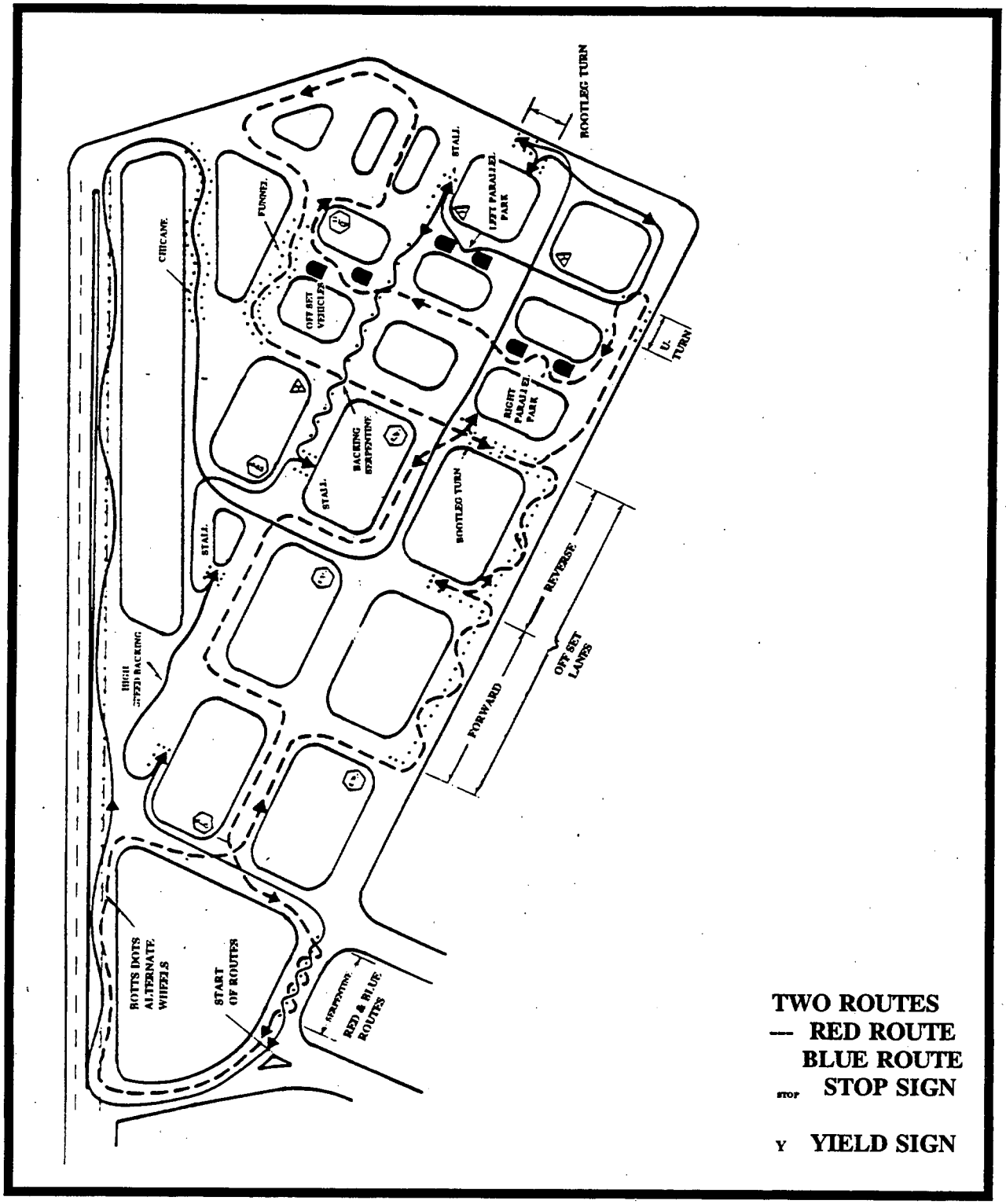


TABLE OF SPEEDS AT WHICH TOTAL HYDROPLANING WILL OCCUR WHEN STANDING WATER EXCEEDS TIRE TREAD DEPTH

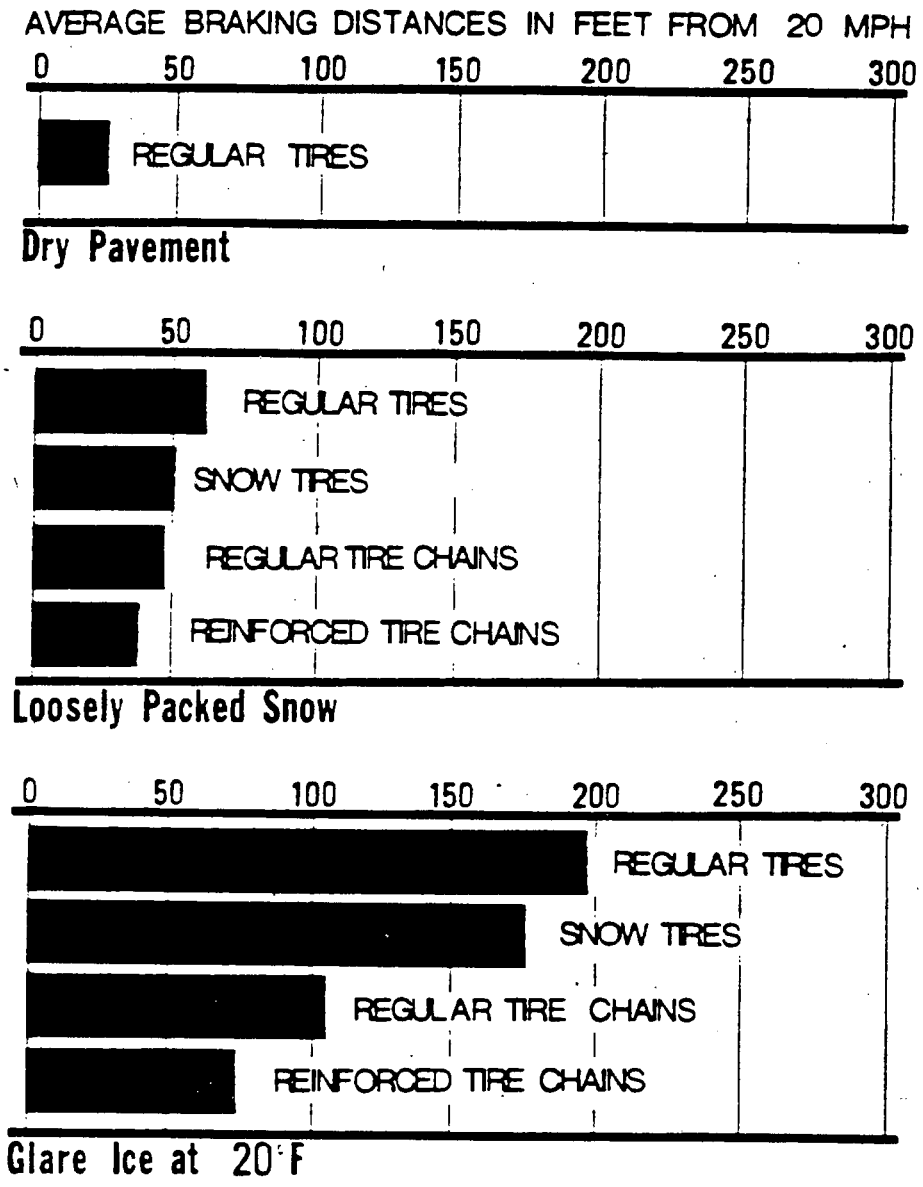
(Based upon formula $\sqrt{\text{tire pressure}} \times 10.3 = \text{speed in mph}$)

TIRE PRESSURE IN P.S.I.	SPEED IN M.P.H.
15	39.9
20	46.1
25	51.5
30	56.4
35	60.9
40	65.1
45	69.1
50	72.8
55	76.4
60	79.8
65	83.0
70	86.2
75	89.2
80	92.1
85	95.0
90	97.7
95	100.4
100	103.0

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
CONCRETE								
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
ASPHALT OR TAR								
NEW, SHARP	.80	1.00	.65	.70	.50	.80	.45	.75
TRAVELLED	.60	.80	.55	.70	.45	.70	.40	.65
GRAVEL								
PACKED, OILED	.55	.85	.50	.80	.40	.80	.40	.60
LOOSE	.40	.70	.40	.70	.45	.75	.45	.75
ICE								
SMOOTH	.10	.25	.07	.20	.05	.10	.05	.10
SNOW								
PACKED	.30	.55	.35	.55	.30	.60	.30	.60
METAL								
GRID OPEN	.70	.90	.55	.75	.25	.45	.20	.35

COMPARATIVE STOPPING ABILITY - CARS



COMPARATIVE STARTING ABILITY - CARS