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STUDENT HANDOUT

PRINCIPLES OF NIGHT VISION

1. ANATOMY AND PHYSIOLOGY OF THE EYE

a. Parts of the Eye. The eye is similar to a camera. The cornea, lens, and iris combination gathers and controls the amount of light allowed to enter the retina.

(1) The cornea is a transparent tissue covering the front of the eye much as a watch crystal covers a watch. (Contact lenses are fitted over the cornea.)

(2) The iris is a thin circular curtain which is the colored part of the eye. A person's eye color depends on the amount of pigment in the iris; light blue has the least amount and dark brown has the most.

(3) The pupil is a hole in the center of the iris. It is black because the inside of the eye is dark. The size varies with the amount of light entering the eye, i.e., it gets smaller with increased light.

(4) The lens is a transparent, semisoft material about one-half the size of a dime. It can change shape to focus on objects at different distances from the eye.

(5) The retina is the lining at the back of the eye where the image is formed. It consists of rod cells which see black and white and cone cells which see colors. The picture seen by the retina is sent to the brain along the optic nerve.

b. Light enters your eye through the pupil. The amount of light entering the eye is controlled by the iris. The light passes through the lens which focuses it onto the retina at the back of the eye. The picture seen by the retina is upside down which the brain turns right way up. The brain gets a slightly different picture from each eye and usually combines them to make one picture.

c. Types of Vision. There are three types of vision. Each type requires different sensory preceptors for identification of an image.

(1) Photopic vision. Photopic vision is experienced during daylight hours or when a high level of artificial light exists. Under these conditions, sight is achieved primarily by the cones, especially those concentrated in the fovea. Due to the high light condition, rod cells are bleached out and become less effective. Sharp image interpretation (fine resolution of detail) and color vision are characteristic of photopic vision. Under these conditions, objects are detected with peripheral vision but are viewed primarily with central (foveal) vision.

(2) Mesopic vision. Mesopic vision is experienced at dawn, dusk, and during period of mid-light levels. Vision is achieved by a combination of both rods and cones. Visual activity steadily decreases as the available light decreases. A reduction in color vision occurs as the light level decreases and the cones become less effective. Due to gradual loss of cone sensitivity, greater emphasis should be placed upon off-center vision and scanning for detection of objects.

(3) Scotopic vision. Scotopic vision is experienced when a low-level light condition exists. Cone cells become ineffective causing poor resolution of detail. Visual acuity decreases to 20/200 or less and total loss of cone sensitivity. Viewing of objects must be accomplished by off-center viewing and scanning. The natural reflex of looking directly at an object must be reoriented by night vision training. The use of scotopic vision demands a searching movement of the eyes to locate an object, and small eye movement to keep the objects in sight. A characteristic of this type of vision is that a dim image may fade away if your eyes are held stationary for more than a few seconds.

d. Visual Problems Affecting Night Vision. There are two deficiencies which may become more apparent at night.

(1) Presbyopia. This deficiency commonly occurs in individuals over 40 years of age. It is due to hardening of the lens and involves a loss of the eye's ability to focus diverging light rays from near objects. As a result, there is a decrease

in light transmission from the lens to the retina and an increase in light scattering or glare. As presbyopia increases, instruments, maps, and checklists become more difficult to read, especially in the red light. This difficulty can be corrected with certain types of bifocal lenses which compensate for this condition.

(2) Night myopia. At night, the spectrum of available light changes so that the blue wavelengths of light are dominant. Because of this condition, a person who is slightly nearsighted (myopic) will find it hard to see at night which could result in blurred vision. Special lenses can be prescribed to correct myopia. Astigmatism is an irregularity of the eye which produces an out-of-focus condition. If, for example, you focus on power poles (vertical), the wires (horizontal) will be out of focus in most cases. The typical prescription for glasses is written showing three numbers in each eye. The first number is the spherical portion of the prescription which can be compensated for by night vision goggles (NVG), the second number is the astigmatism in degrees, and the third number is the axis of the astigmatism in degrees.

e. <u>Differences Between Day and Night Vision</u>

(1) Color. One of the ways that night vision differs from day vision is in color vision. As light levels decrease, the eye shift from photopic vision (cones) to scotopic vision (rods). With this shift, the eye becomes less sensitive to the red end of the spectrum and more sensitive to the blue parts of the spectrum. Color prescription is not possible with the rods. Colors of non-lighted objects cannot be determined at night under very low light conditions. It is possible to distinguish between light and dark colors at night only in terms of the brightness of reflected light. If, however, the brightness of a color is above the threshold for cone vision, the color can be seen.

(2) Detail. Perception of fine detail is important at night. Under conditions of low light, visual acuity is greatly reduced. At 0.1 footcandle (level of full moonlight), acuity is one-seventh as good as it is in average daylight. Therefore, objects must be rather large or nearby to be seen at night. Identification at night must depend on the perception of generalized contours and outlines, and not on small distinguishing features.

(3) Retinal sensitivity. Another important distinction between night vision and day vision is the difference in the sensitivity of various parts of the retina under these two conditions.

(a) The central part of the eye is not sensitive to starlight levels. During darkness or with low-level light, central vision becomes less effective and a relative blind spot (5 to 10 degrees wide) develops. This result from the concentration of cones in the area immediately surrounding the fovea of the retina.

(b) Since the central fields of vision for each eye are laid over each other for binocular vision, a night blind spot occurs during periods of low-level illumination. If an object is viewed directly, it may not be detected due to this blind spot.

(c) Because of the central blind spot, as distance increases, larger and larger objects will be missed. To see things clearly at night, use off-center vision and scanning techniques.

2. TARGET DETECTION. With 20/20 vision, detection of a target depends on several factors including:

a. target size and distance (relative target size),

b. overall brightness (luminance),

c. brightness and color contrast between target and background,

d. location of eye focus, and the

e. angle between the central visual axis and target.

3. DARK ADAPTATION. Dark adaptation is the process by which your eyes increase their sensitivity to low light levels. People adapt to darkness to varying degrees at different rates. During the first 30 minutes, the sensitivity of the eye increases roughly 10,000-fold, with little further increase after that time.

a. Going suddenly from bright light into darkness is a common occurrence. For example, you experience this when you enter a movie theater during the day or leave a brightly lit room at night. In both cases, the sensations are the same. At first you see very little, if anything. After several minutes, you see dim forms and very large outlines. As time goes by more details of the surroundings become apparent.

b. The lower the level of light, the more rapidly you complete dark adaptation. For example, it would require less time to completely adapt to darkness after being exposed to a dark theater than after being exposed to the brightness of day.

c. Maximum dark adaptation is reached in about 30 to 45 minutes under minimal lighting conditions. If a dark-adapted eye is exposed to a bright light, the sensitivity of that eye is temporarily impaired. The amount of impairment depends on the intensity and duration of the exposure. Exposure to a flare or lighting may seriously impair your night vision; recovery to dark adaptation could take from 5 to 45 minutes in continued darkness.

d. Night vision goggles affect dark adaptation. If you adapt to darkness before donning the goggles and remove them in a darkened environment you can expect to regain full dark adaptation in 2 to 10 minutes.

4. NIGHT VISION SCANNING TECHNIQUES

a. Dark adaptation is only the first step toward maximizing your ability to see at night. Applying night vision techniques will enable you to overcome many of the physical limitations of your eyes.

b. Scanning techniques are important in object identification at night. To scan effectively, <u>scan from right to left or left to right using slow, regular scanning movement</u>.

c. Viewing an object using central vision during daylight poses no limitation. But if you use the same technique at night, you may not see the object. This is due to the night blind spot that exists during periods of low light. To make up for this limitation, use off-center vision. This technique requires that you view an object by looking 10 degrees above, below or to either side of, rather than directly at an object. This allows your peripheral vision to maintain contact with an object.

d. Even when off-center viewing is practiced, the image of an object viewed longer than 2 to 3 seconds tends to bleach out and become a solid tone. As a result, the object is no longer visible. This produces a potentially unsafe operating condition. To overcome this limitation, you must be aware of the phenomenon and avoid looking at an object longer than 2 to 3 seconds.

e. Visual acuity is greatly reduced at night. Because of the limitation, objects must be identified by their shape or outline. Your familiarity with the architectural design of the structure common to the area will determine your success using this technique.

(1) For example, the outline of a building with a high roof and a steeple can be easily recognized in the United States as a church. Churches in other parts of the world may have entirely different distinguishing features.

(2) Man-made features depicted on your map can assist you in recognition of outlines during night driving.

5. DISTANCE ESTIMATION AND DEPTH PERCEPTION

a. Distance estimation and depth perception clues are easily recognized using central vision during periods of good lighting. But as light levels decrease, your ability to correctly judge distances reduces and you tend to have visual illusions. A knowledge of distance estimation and depth perception mechanisms and clues will help you make better judgments of distance at night.

b. Distance and depth perception clues may be monocular (one-eyed) or binocular (two-eyed). The binocular clues depend on the slightly different view that each eye has of the object. Consequently, binocular perception is useful only when the object is close enough to make an obvious difference in the viewing angle of the two eyes. The monocular clues used to aid in distance estimation and depth perception are listed below.

(1) Geometric perspective. An object has an apparent different shape depending on the distance and angle from which the object is viewed. There are several types of geometric perspective clues.

(a) Linear perspective. Parallel lines such as railroad tracks or runway lights tend to converge as the distance increases from the observer.

(b) Apparent foreshortening. The true shape of an object or terrain feature appears oval when viewed from a distance. As the distance to the object or terrain feature decreases, the apparent perspective changes to its true shape or form. EXAMPLE: the shape of a body of water changes when viewed at different distances at the same altitude.

(c) Vertical position in the field. Objects or terrain features at a distance from the observer appear higher on the horizon than objects or terrain features that are closer to the observer.

(d) Motion parallax. This clue to depth perception is often considered the most important. Motion parallax refers to the apparent relative motion of still objects as viewed by an observer moving across the landscape. Near objects appear to move backwards, past, or opposite the path of motion. Far objects either seem to move in the direction of motion or remain fixed. The rate of apparent movement depends on the distance the observer is from the object For example, as you drive along a road, a picket fence whizzes by while a tree further away from the road passes more slowly. Mountains in the distance appear either fixed or to be moving with the vehicle.

(2) Retinal image size. The size of the image focused on the retina is perceived by the brain to be a certain size. To determine the distance using the retinal image, four factors (known size of objects, increasing size of objects, decreasing size of objects, and land association) are considered.

(a) Known size of objects. The nearer the object is to the observer, the larger the retinal image. The brain learns from experience to associate the distance of familiar objects by the size of their retinal image. A structure will fix a specific angle on the retina based on the distance from the observer. If the angle is small, the observer judges the structure to be at a great distance. If the angle is large, the building is judged to be close. To use this clue, you must know the actual size of the object and have prior visual experience with it. If no experience exists, an object's distance would be determined primarily by motion parallax.

(b) Increasing/decreasing size of objects. If the retinal image size of an object increases, it is approaching or moving nearer. If the image size decreases, the object is retreating or moving farther away. If the image size is constant, the object is at a fixed distance.

(c) Land associations. Comparison of a object such as a motor pool with an object of known size, such as a 5-ton truck, will help determine the object's relative size and distance from the observer. Objects ordinarily associated together are judged to be about the same distance.

6. <u>VISUAL ILLUSIONS</u>. As visual information decreases, the probability of spatial (space) disorientation increases. Reduced visual references also create illusions that can cause spatial disorientation.

a. <u>Autokinesis</u>. When a person stares at a still light in the dark, the light will appear to move. The occurrence can be rapidly demonstrated by staring at a lighted cigarette in a dark room. Apparent movement will begin after about 8 to 10 seconds. Although the cause is not known, it appears to be related to the loss of surrounding reference which normally serve to stabilize your visual perceptions. This illusion can be limited or reduced by visual scanning, by increasing the number of lights, or by varying the brightness of the light. The most important of the solutions is the visual scanning technique.

b. <u>Relative Motion</u>. A person sitting at a railroad crossing waiting for a train to pass often experiences the illusion of relative motion. Even though the car is not moving, the person feels that the car is moving. The only way to correct this illusion is to understand that such illusions do occur and that you should not react to them on the vehicle's controls. Using proper scanning techniques can help reduce this illusion.

c. <u>Reversible Perspective Illusion</u>. A vehicle may appear to be moving away when it is in fact approaching your position. This illusion is often experienced when a vehicle is driving parallel to your course. To determine it's direction, watch it's lights. If the brightness of the lights increases, the vehicle is approaching your position. If the lights become dim, the vehicle is retreating.

d. <u>Structure Illusions</u>. Structural illusions are caused by heat waves, rain, snow, sleet, or other factors that block vision. For example, a straight line may appear to be curved when seen through a desert heat wave.

e. Size-Distance Illusion. This illusion results from staring at a point of light which approaches and then retreats from the observer. Instead of seeing the light advancing or receding, you may perceive that the lights are expanding and contracting at a fixed distance. Without additional distance clues, range estimation is extremely difficult. Using proper scanning techniques can help prevent this illusion.

7. NIGHT VISION PROTECTION. Night vision should be protected whenever possible. There are various precautions which you can take.

a. Sunglasses

(1) Repeated exposure to bright sunlight has an increasingly negative effect on dark adaptation. This effect is intensified by reflective surfaces such as sand and snow. Exposure to bright sunlight for 2 to 5 hours causes a definite decrease in your scotopic visual sensitivity which can persist for as long as five hours. Additionally, your rate of dark adaptation and degree of night vision will decrease. These effects combine with each other and may persist for several days.

(2) If night driving is expected, then you should use military neutral density (N-15) sunglasses or equivalent filter lenses when exposed to bright sunlight. This precaution will maximize your rate of dark adaptation at night and improve your night vision sensitivity.

b. Night Tactical Operations and Precautions. During the conduct of a night tactical mission you can expect to experience battlefield conditions such as artillery flashes, flares, and searchlights, as well as oncoming vehicle headlights and lightning. These conditions will cause total or partial loss of night vision. When you are confronted with these conditions, use the following techniques:

(1) If a flash or high intensity light is expected from a certain direction, turn the vehicle away from the light source. When such a condition occurs unexpectedly and cannot be avoided,

save your dark adaptation by closing one eye. Once the light source is no longer a factor, the eye which was closed will provide enough night vision to keep driving. This is possible because dark adaptation occurs independently in each eye. Viewing with one dark-adapted eye, however, will cause depth perception problems.

(2) Select routes to avoid built-up areas where there is a heavy concentration of light. If these conditions are encountered, alter your route to avoid brightly lighted areas. A decrease in dark adaptation from a light source, such as a farm house or an automobile, can be reduced by turning your head and eyes away from the source of the light.

(3) When flares are used to light the viewing area or are set off near your position, move your vehicle away from the flare to the edge of the lighted area. This procedure minimizes your exposure to the light source.

(4) Use short bursts of fire when firing automatic weapons. Closing one eye or looking away from the firing will also minimize your loss of dark adaptation.

8. SELF-IMPOSED STRESS. Many self-imposed stresses limit night vision. Being aware of these restrictions is necessary to ensure that you avoid them before driving at night.

a. Smoking and Night Vision. Smoking significantly increases the amount of carbon monoxide carried by the hemoglobin of the red blood cells. This reduces the blood's ability to combine with oxygen. The smoker effectively loses twenty percent of his night vision at sea level.

b. Alcohol and Night Vision. Alcohol is a sedative that impairs both coordination and judgement. As a result, you will fail to apply the proper techniques of night vision. You begin to stare at objects, and your scanning techniques become disorganized.

c. Fatigue and Night Vision. You will not be mentally alert if you are fatigued when performing night driving. Your response to night situations which require immediate reaction will slow down and depending on your degree of fatigue, your performance may become a safety hazard.

d. Nutrition and Night Vision

(1) Missing or postponing meals can often have an effect on night driving performance. The resulting hunger pains can cause unpleasant feelings, distraction, breakdown in habit pattern, shortened attention span, as well as other physical changes.

(2) Failure to eat foods that provide sufficient vitamin A can reduce night vision. Foods high in vitamin A include eggs, butter, cheese, carrots, squash, peas and all types of green vegetables. A balanced diet normally requires an adequate amount of vitamin A. Excess amounts of vitamin A will not increase your night vision ability and may be harmful.

e. Physical Conditioning and Night Vision. Because of the physical stresses of night driving, you will become tired easily. To overcome this, you should exercise daily. Good physical fitness will help you conduct night driving with less fatigue and will improve your night scanning efficiency. However, too much exercise in a given day may leave you too tired for night driving.

f. Sleep and Rest Requirements for Night Driving. Night driving is more tiring and stressful than day driving; therefore, it is important to get adequate rest and sleep before driving.

9. NERVE AGENTS AND NIGHT VISION. Night vision is negatively affected by exposure of the eyes to very small amounts of nerve agents. Chemical alarms are not sensitive enough to detect low levels of nerve agent gas capable of causing miosis (excessive contracting of the pupils).

a. Miosis may occur gradually through exposure to low levels of nerve agent gas over a long period of time. On the other hand, exposure to a high level can cause miosis in the few seconds it takes to put on a protective mask.

b. The onset of miosis is tricky in that it is not always immediately painful. Miotic subjects may not even notice their condition even when carrying out tasks that require vision in low ambient light.

c. After an attack by nerve agents, especially the more lasting types, commanders should assume there will be some loss in night vision among personnel otherwise fit for duty. There is no drug cure for the effects of miosis without causing other visual problems that may be just as severe.

10. SOURCES OF AMBIENT (SURROUNDING) LIGHT. Sources of ambient light include the following:

a. Moon. The moon provides the greatest source of ambient light at night. It rises in the east and sets in the west; the time at which it rises and sets changes continually. The moon angle changes approximately 15 degrees per hour (1 degree every 4 minutes). Light from the moon is brightest when it is at its highest point.

b. Background Illumination. Natural light sources provide illumination at night. Apart from the light provided by the sun and moon, the following light sources add to night brightness:

(1) air glow (also called night-sky luminance),

(2) aurora (also called Northern Lights in the Northern Hemisphere and Southern Aurora in the Southern Hemisphere),

(3) starlight, and

(4) zodiacal light (also called counterglow).

c. Artificial Light. Lights from cities, automobiles, fires, and flares are normally sources of small amounts of artificial light. The lights of a large metropolitan area will, however, increase the light level around the city. The light from these sources is most pronounced when overcast conditions exist.

d. Solar Light. Ambient solar light is usable for certain periods following sunset and before sunrise. After sunrise, solar light steadily decreases until the level of light is not usable to the unaided eye. This occurs when the sun is 12 degrees below the horizon. Before sunrise, solar light becomes usable when the rising sun is 12 degrees below the horizon.

e. Lasers. Lasers will be used on the battlefield, both in training and in combat. NVG's will be affected by lasers, much as they are by other light sources. Most lasers will not cause permanent damage to NVG's. Additionally, the goggles will protect the operators eyes from the damaging effects of lasers, even if the laser is bright enough to damage the goggles. If the goggles are damaged, you will probably be able to continue the use of the goggles with a bright or dark spot at the point where the tube was damaged. If the operator thinks that a laser is being directed at him/her, the operator should look away from the source to reduce the effects of the laser on the goggles and eyesight.

11. METEOROLOGICAL (WEATHER CONDITIONS) CONSIDERATIONS. Atmospheric conditions can effect hemispherical illumination. Because weather conditions vary, light levels cannot always be accurately predicted. An awareness of these factors will assist in evaluating the ambient light. Some meteorological conditions which restrict hemispherical illumination are discussed below.

a. Due to reduced vision at night, you may fail to detect a gradual increase in cloud coverage. At night you must be alert for the following indications that the clouds are present:

(1) A gradual reduction in the light level.

(2) Obscuration of the moon and stars.

(3) Shadows resulting in varying levels of ambient light.

b. Humidity reduces the transmission of ambient light through the atmosphere. During periods of high humidity, ambient light is greatly reduced. High humidity is indicated by high dew point temperatures. An increase in the humidity content of the air will cause a decrease in the brightness of the ground lights.

c. Restrictions such as fog, dust, haze, or smoke reduce hemispherical illumination. These conditions are greater at lower altitudes and intensify as temperatures decrease and the dew point spread approaches zero.

d. At least one weather occurrence increases illumination - lightning flashes have an effect similar to that of a bright flare. The brightness of the illumination depends on the closeness of the thunderstorm.

e. The effectiveness of NVG's is greatly reduced in rain, haze, fog, snow, or smoke. As visibility decreases, you will notice a gradual reduction in light and visual sharpness. When you recognize that your visibility is reduced, try to determine the severity of the situation. If driving can be conducted safely with the goggles, continue the mission; if not, adjust your driving speed, remove the goggles, and turn on your headlights or switch to blackout drive lights and use the NVG's only when the situation permits and it is safe to do so.

f. Visual clues to the presence of visibility restrictions include:

(1) A halo around artificial lights when using the goggles. The halo effect tends to increase when atmospheric obstructions are present. Note the size of the halo effect around the artificial lights in the staging area. If the halo becomes noticeably larger, a restriction could be developing.

(2) An increase in "image noise" when atmospheric interference is present or when the ambient light level is low. This is similar in appearance to the "snow" seen on a television with poor reception.

12. VEHICLE AND DRIVER PREPARATION

a. The design of some military vehicles will affect you ability to see outside the windshield. To reduce the loss of night vision because of vehicle shortcomings, you must properly prepare the vehicle for night driving with NVG's.

(1) The windshield can reduce your ability to see outside your vehicle. The windshield must be kept clean; remove dirt, grease, bugs, and scratches before each mission.

(2) Vehicle instruments are easier to read under high levels of instrument lighting. However, the level of light needed for the best reading interferes with the goggles ability to see dim objects outside the vehicle.

(3) Interior lights also interfere with goggle performance. They reflect off the windshield, reduce outside visibility, and are subject to detection by the enemy. To minimize these effects, turn off all lights and turn off or tape all exterior lights.

b. Proper preparation of the vehicle and ground facilities for driving with NVG's will contribute greatly to the success of a night mission. The mission, however, may fail unless you are physically and mentally prepared. To ensure your readiness:

(1) keep physically fit,

(2) eat a well balanced diet,

(3) get enough rest,

(4) avoid self-medication,

(5) avoid the use of tobacco and alcohol,

(6) learn and apply the principles of night vision,

(7) avoid all bright light (including sunlight) during the day and wear sunglasses when outside, and

(8) participate in frequent night driving training operations.

c. NVG's should never be used on public highways. The effect of oncoming headlights on the device may cause some very dangerous situations as the operator will not be able to see other objects in the field of view. If the light is sufficiently bright, the devices all have a bright source protection feature that shuts down the NVG to protect it. If the bright light protection is activated, the NVG will be off at least two seconds.

d. Although unlikely to occur, drivers with NVG may face the situation described above in an NVG-controlled training area. To minimize the affect on NVG's by the headlights from an oncoming vehicle while avoiding a potentially serious accident, SLOW DOWN, look away so that the light source is just outside the goggles field of view, and pull off to the far right hand side of the road. NVG training at this point is now compromised as other vehicles with headlights on may appear. DO NOT CONTINUE DRIVING WITH NVG's unless authorized to do so by a responsible officer/individual.

e. If your vehicle breaks down while driving with NVG's, or if the goggles fail or begin to fail, SLOW DOWN and if possible, pull off to the right hand side of the road. Immediately WARN approaching NVG-equipped drivers with hand and arm signals and NVG compatible light sources such as an IR lightstick or tactical flashlight. DO NOT turn on your four-way emergency flasher lights as this may blind approaching drivers with NVG's. If your vehicle breaks down on a road hidden from approaching drivers by a curve or hill, walk back along the shoulder of the

road to a position where you can signal them to stop in time. Do not attempt to make repairs on your vehicle while it is in the exposed position on the road. If you are in a vehicle and observe the scene described above, SLOW DOWN and proceed with caution.

f. If the NVG's low battery indicator comes on, replace the battery. DO NOT WAIT until the goggles shut down due to a weak or dead battery while driving. Slow down and if possible, pull off to the far right hand side of the road. Ensure you (or the assistant operator, if accompanied by one) warn approaching traffic first before attempting to switch batteries from another NVG, or replacing the batteries if spares are available. DO NOT switch goggles as you will have to refocus the device to suit your eyesight.

g. Operating a vehicle while wearing the goggles (AN/PVS-7 series only) over the NBC protective mask will further reduce the field of view to about 20 degrees and is <u>not recommended</u>.

h. Driving with one lens focused inside and one focused outside the vehicle can cause spatial disorientation (dizziness, nausea) and is <u>not recommended</u>.

i. Assistant (shotgun) operators play an important role in driving with NVG's. Primary operators must focus their goggles for distance vision even though this will make instrument reading difficult. Assistant operators with NVG's can compensate for this by altering between distance and close-up viewing, and keeping primary operators informed of any obstacles in or outside their field of view.

j. When parking vehicles in areas where NVG tactical lighting is used, trained and NVG-equipped ground guides should direct drivers to parking spots. Neither drivers nor guides should remove their NVG's until the vehicle is in the desired parking spot. Flashlights used by ground guides should be modified for NVG compatibility.

k. Convoy driving with the NVG presents some unique problems, some of which are influenced by the type of terrain and road surface. The major concern is keeping a safe distance between the vehicles in the convoy. Resolution, bar patterns, or IR light sticks affixed to the rear center of each vehicle are a valuable aid to maintaining safe distances between vehicles.

l. Convoy movement over winding or hilly terrain can cause the loss of visual contact with the leading vehicle; therefore, a high degree of speed discipline is required in order to maintain safe distances. Dirt or extremely dusty surfaces can cause a major problem in maintaining visual contact with the leading vehicle.

m. When driving on these surfaces, the speed of the convoy must be reduced. Convoys composed of different types of vehicles should proceed at the speed of the slowest vehicle. As a general rule, the speed limit should not exceed that established for blackout driving without the use of NVG's.

n. For safety reasons, permit convoy driving with NVG only if every driver and assistant operator are NVG-equipped. If insufficient quantities of NVG's prohibit this, a mix of NVG and blackout drive may be used. The NVG-equipped vehicles should be grouped together and occupy the rear of the convoy, as opposed to being dispersed and intermixed with other vehicles not equipped with NVG's. If grouped in this manner, ensure that the last non-NVG equipped vehicle has its rear blackout drive lights off.