

## CHAPTER 23

# NIGHT VISION GOGGLE DRIVING TECHNIQUES AND PROCEDURES AND OPERATIONS UNDER BLACKOUT CONDITIONS

Night operations in combat, combat support, and combat service support units have played an important role in many US Army battles. In fact, the ability to conduct effective tactical transportation operations during hours of darkness and limited visibility is a long-standing Army objective. Today's technology provides the wheeled vehicle operator with the ability to meet these objectives using night vision goggles (NVGs). Your ability to safely and effectively drive using NVGs depends on your understanding the device's limitations and capabilities, the amount of ambient (available) light, driving ability, proficiency with NVGs, familiarity with the terrain, and availability of NVGs.

## NIGHT VISION GOGGLES

### General Characteristics

Night vision goggles are image-intensification devices that improve visibility during periods of low light levels. They amplify available ambient light, such as moonlight and starlight. NVGs, however, do not magnify an image. An object viewed through the goggles looks the same size as if it were seen in the day without the goggles. Objects that are hard to see during the day are also hard to see at night through the goggles. NVG performance is directly related to the amount of ambient light. During periods of high ambient light, resolution is improved and objects can be identified at greater distances. However, visual acuity (the accuracy with which an object is seen) with NVGs will never be as good as it is with the naked eye during daylight conditions.

Rain, haze, fog, snow, or smoke and viewing into shadows and other darkened areas greatly reduce the effectiveness of NVGs.

Vision using NVGs equals the vision of an unaided driver with less than perfect vision. The best case for a driver with 20/20 vision wearing the goggles is 20/40 with the AN/PVS-7 and 20/50 with the AN/PVS-5.

The goggles affect depth perception and distance estimation. For the first 20 feet in front of the user, the NVG decreases depth perception. From 20 to 500 feet, depth discrimination roughly equals that of the unaided eye. NVGs reduce depth perception beyond 500 feet and distance viewing. This is due mainly to reduced visual acuity and lack of peripheral vision. Peripheral vision lets a person see things on the side of the field of vision while concentrating on looking straight ahead at an object. Color discrimination is absent when goggles are used.

*Single Color Vision.* The picture seen with NVGs is green. It is also less distinct than normal daylight vision. As a result, it is hard to distinguish between certain objects or features. Shadows, for example, are hard to distinguish from puddles of water, walls, or ditches and vice versa when viewed through the goggles at night.

*Color Adaptation.* Because of the green color in NVGs, you may see one of two things when you remove the goggles after several minutes. If you look at the lighter of two backgrounds, you may see the complement or opposite of the green color to which you had become adapted. If you look at the darker of the two backgrounds, you might see an after-image of the green light to which you had become adapted. Do not be concerned about this after-image. It is a normal physical reaction.

### Second Versus Third Generation Night Vision Goggles

NVGs have been produced over a period of 25 years. There are two distinct generations (models) of devices with militarily significant performance differences. AN/PVS-5 devices are second generation.

AN/PVS-7 devices have been produced in both second and third generation versions. External examination will not determine if a PVS-7 is second or third generation. Commanders should ask supporting maintenance units to identify second and third generation PVS-7 devices during routine

maintenance checks. (PVS-7 devices can be upgraded from second to third generation by changing the tubes. However, the cost of changing the tube is high and is not necessary unless the tube is not functioning properly.)

Third generation devices have increased performance and longer tube life. Normally, a second generation device operating under quarter moon conditions and a third generation device operating under starlight conditions provide the operator with equal quality images. Under bright light (full moon) conditions, the performance of the two devices will seem exactly alike.

Second generation devices have a tube life projected at 2,500 hours. They tend to fail slowly, so maintenance personnel must periodically check the devices to ensure they are performing at a satisfactory level. An operator may not notice the gradual loss of performance normal for second generation devices.

Third generation devices have a tube life designed to last 7,500 hours. When they eventually fail, they tend to fail quickly. Check them periodically in accordance with the applicable technical manual and local policies.

Second generation devices are sensitive to all visible light as well as light in the near infrared spectrum. All flashlights, even those with blue-green filters, will be seen by second generation devices and may make it harder to see other objects in the field of view.

Third generation devices are sensitive to yellow and red visible light as well as light in the near infrared. They have reduced sensitivity to blue or green light. Flashlights with blue-green filters minimally affect the performance of third generation devices.

### **Operational Characteristics and Care Considerations**

Take special care in dusty, sandy, and humid conditions. Never store NVGs wet or in a wet carrying case.

Moisture may form on the eyepieces when they are first placed on the head. This is caused by heat and moisture given off by the body. It is more noticeable in cold temperatures when there is a significant temperature difference between the goggles and the

body. Demisting shields are provided to prevent collection of moisture on the lenses. Do not use antimisting chemicals or chemically treated cloths on the demisting shield or lenses.

Install the lens covers when not wearing the goggles. Do not hang the goggles from your neck by the safety strap without covering the objective lenses (the objective lenses may be scratched).

When installing or removing a battery, be sure the selector switch is in the OFF position. If the switch is on, intermittent electrical contact is made when unscrewing or screwing the battery cap. This causes a flicker or power surge to the tubes, which may cause burn spots on the tubes.

Always remove the battery before storing the goggles to avoid turning the switch on accidentally when placing the goggles in the case. If the goggles are stored for a long period of time with the battery installed, corrosion can develop.

#### **CAUTION**

For lithium batteries, this increases the possibility of battery venting, which can cause serious injury to personnel and equipment.

Avoid rough treatment of the NVGs. Mistreatment may cause the tubes or the electrical system to fail. If the goggles do not operate when the switch is turned on and the battery is fully charged, check the wiring for breaks or the battery terminals for the presence of oxidation.

Never operate the NVGs during daylight hours. Doing so commonly causes tube failure.

You may use the infrared (IR) light on the goggles to illuminate the instrument panel or to read maps when you do not want to turn on the interior light. However, continuous use of the IR light shortens the battery life.

#### **CAUTION**

Use of the IR light makes the NVG an active system. As such, it can be detected by the enemy and will severely limit vision outside the vehicle.

Resolution checks are required on NVGs every 180 days using either the TS-3895U/V test set or the alternate test method (direct support level). Perform this test as instructed in the applicable systems' technical manual:

- AN/PVS-5 (A, B, C models): TM 11-5855-238-10.
- AN/PVS-7A TM 11-5855-262-10-1.
- AN/PVS-7B: TM 11-5855-262-10-2.

**Proper Focusing Procedures**

Improper focusing adjustments significantly reduce visual acuity and increase eye fatigue.

*Eye Relief.* Eye relief is the distance between the NVG eyepiece lens and the eye. It is recommended that the eye relief for the NVG be 1 inch. This distance may not be achievable because of helmet/-helmet liner configurations and facial features, such as deep set eyes or protruding foreheads. If eye relief is too little, an unnecessary strain is placed upon the eyes, which accelerates fatigue. However, if the eye relief is too large, a significant loss of field of view can occur.

*Interpupillary Distance (IPD).* IPD is the distance between the pupils of the eyes. It is also called eye span. The center of the intensifier tubes should align with the pupil of the eyes. The distance between the center of the tubes should equal the user's IPD. If the tubes are not aligned, the eyes tend to drift towards the center of the tubes. This leads to focusing problems and eye fatigue. It has also been attributed as the cause of short-term reduction of near depth perception.

IPD is adjusted with the interpupillary lever clamp on the AN/PVS-5 series. On the AN/PVS-7 series, it is adjusted by moving the eyepieces apart or closer together. The common method of aligning the tubes is the subjective overlapping of the images until a single, clear, circular field of view is reached. This procedure, however, makes most people bring the tubes too close together. A more objective and accurate method involves using a millimeter ruler to measure from the outside edge of one objective lens (or eyepiece lens) to the inside edge of the other.

This will require all NVG users to be measured for their distant IPD at their clinic. Record and memorize this value given in millimeters.

*Eyepiece Lens Adjustment.* The eyepiece focus rings, also referred to as the diopter adjustment rings, focus the image at the eyepiece lens. They allow those who wear corrective lenses to accommodate for certain problems, such as farsightedness. However, they will not correct astigmatism. It is recommended that corrective lenses be worn with the NVG. (Eyeglasses can only be worn with the AN/PVS-7 series. AN/PVS-5 users may wear contact lenses.)

*Objective Lens Adjustment.* The objective focus knob is adjusted as a function of distance (called focal range) from the object. The focal range of the NVGs is between 10 inches and infinity. The vast majority of driving with NVGs requires the optical infinity setting. You must focus the goggles outdoors at night or indoors with a small light source, such as a 7 1/2-watt light bulb. Focusing on a small light source or lettering on a nearby sign is not sufficient for proper adjustment ! You need a visual acuity chart that can be hung on a tree at slightly lower than eyesight. Because it is closer to the optical infinity distance, 20 feet is the desired distance between the user and the chart.

Focus one knob at a time. DO NOT close the other eye. Instead, block the eye with the palm of your hand or with a 3 x 5 card. First, rotate the objective focus ring to get the clearest focus on the eye chart. Next, position the eyepiece focus ring at its full counterclockwise setting. (For reading use, first turn to full clockwise setting.) Rotate the eye focus ring clockwise (counterclockwise for reading). STOP when the image is clear. Do not continue clockwise because the image will remain clear at the expense of eye fatigue. If you feel you have gone too far clockwise, start the ring back counterclockwise until the image blurs; then start again clockwise until the clearest image is reached.

The appropriate line on the visual acuity chart should now be readable at the distances given below.

	<u>10 Feet</u>	<u>20 Feet</u>
AN/PVS-5 Series	20/25	20/50
AN/PVS-7 Series	20/20	20/40

Failure of the visual performance checks is determined when the following lines on the eye chart are not readable at the distances given below.

	<u>10 Feet</u>	<u>20 Feet</u>
AN/PVS-5 Series	20/30	20/70
AN/PVS-7 Series	20/25	20/50

**Defective Tubes**

Tube operation must be checked before each mission. If any of the following tube conditions exist (Figure 23-1), take the appropriate action before using the goggles.

*Shading.* Both tubes should show a perfect circle. If shading is present, you will not see a fully circular image (Figure 23-1A). Shading always begins on the edge and moves inward. Replace the tubes if this condition exists.

*Edge Glow.* This is a bright area in the outer portion of the viewing area (Figure 23-1B). To check for this defect, cup your hand over the lens to block out all light. Replace the tubes if this condition exists.

*Bright Spots (White Dots).* A pinhole in the phosphorous screen causes this condition. Spots may flicker or appear constant (Figure 23-1C). Check by cupping your hand over the lens to block out all light. If bright spots or white dots are visible, turn in the NVG to direct support (DS)

maintenance where it can be properly checked with a TS-3895U/V test set.

*Dark Spots.* Black marks that may look like spots or streaks are acceptable as long as they do not interfere with the mission. No action is required when such dark spots occur (Figure 23-1D).

*Fixed Pattern Noise (Honeycomb).* A faint honeycomb pattern occurs most often in high light levels. This condition is acceptable as long as the pattern does not interfere with the mission (Figure 23-1E).

*Flashing, Flickering, or Intermittent Operation.* The NVG may appear to flicker on and off, or the output may flash. This can occur in one or both tubes. If you see more than one flicker, consult the troubleshooting chart in the operator's manual.

**DRIVING WITH NIGHT VISION GOGGLES**

**Threat Night Capability**

Threat forces consider darkness an advantage. They do not stop operations at night but continue to operate using night vision devices. Most threat night vision devices are infrared. They include driving aids on vehicles. (FM 17-95 discusses this topic in detail.)

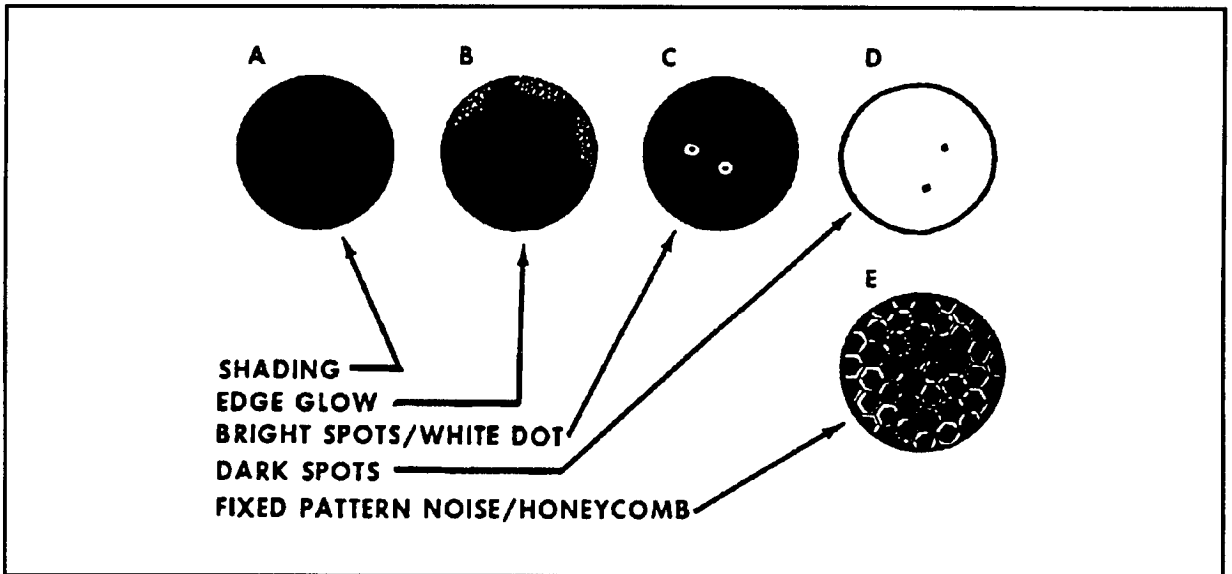


FIGURE 23-1. Tube Defects.

## Effects of Light

Any detectable light source in the vehicle's cab may affect your ability to see with NVGs. The adverse effect of panel lights on the goggles is greatest during low ambient light conditions.

*Vehicle Lighting System.* NVG compatibility is best achieved by eliminating all interior and exterior light sources. Tape lights that cannot be controlled to reduce the amount of light they emit. Instruments and gauges can normally be read with NVGs without instrument lighting.

### WARNING

Vehicles without NVGs may not see you. Ensure the route selected is in an area where other traffic (commercial and tactical) is precluded. If the route does not preclude this, establish some form of traffic control.

*Dark Adaptation.* No dark adaptation period is necessary for effective viewing through NVGs. In fact, viewing through goggles for a short period of time lessens the normal dark adaptation period. After using NVGs, it takes about 2 minutes to reach the 30-minute dark adaptation level.

*Lasers.* Lasers are used on the battlefield, both in training and in combat. Lasers affect NVGs much as other light sources do. Most lasers will not cause permanent damage to NVGs. In fact, the goggles protect the operator's eyes from the damaging effects of lasers, even if the laser is bright enough to damage the goggles. If the goggles are damaged, you can probably continue to use the goggles with a bright or dark spot at the point where the tube was damaged. If you think that a laser is being directed at you, look away to reduce the effects of the laser on the goggles and eyesight.

*Object Identification.* Viewing an area lit by artificial lights, such as flares, will limit your ability to see objects outside the lighted area. Your ability to see objects within the lighted area depends on the brightness of the light and the object's distance

from you. Try to keep the light source outside the field of view of the goggles.

Using goggles will enable you to detect light sources that are not visible to the unaided eye. You can detect light from vehicles, flashlights, IR light sticks, and burning cigarettes at great distances. The capability of goggles to detect these light sources improves as the ambient light level DECREASES.

When using NVGs, some objects will be more difficult to distinguish (low contrast against the background) than during the day when color clues are available.

## Weather Considerations

Rain, haze, fog, snow, or smoke greatly reduces NVG effectiveness. As visibility decreases, you will notice a gradual reduction in light and visual sharpness. When you realize your visibility is reduced, try to determine the severity of the Condition. 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. Use NVGs only when the situation permits and it is safe to do so. Table 23-1 lists countermeasures to use when faced with specific vehicle lighting conditions that degrade NVG performance, such as using NVGs in conjunction with blackout drive.

Visual clues to the presence of visibility restrictions include —

- A halo around artificial lights when using goggles. The halo effect tends to increase when atmospheric obscurations are present. Note the size of this halo effect around lights in the staging area. If the halo becomes noticeably larger, a restriction could be developing.
- An increase in "image noise" when atmospheric interference is present or when ambient light level is low. This is similar in appearance to the "snow" seen on television with poor reception.

**TABLE 23-1. NVG Lighting Countermeasures.**

Specific Conditions	Impact on NVGs	Countermeasures
Driving with external and internal lights off. (Vehicles without NVGs may not see you.)	None.	NA.
Blue-green instrument panel lights on. (Vulnerable to threat detection with NVGs.)	Minimal on third generation tubes; will degrade performance of second generation tubes.	Turn to lowest light level or turn off. Tape over noncritical lights. (May allow warning lights to go unnoticed.)
Instrument panel lights on. (Vulnerable to threat detection with NVGs.)	Will degrade all NVG performance.	Turn to lowest light level or turn off. Tape over noncritical lights. (May allow warning lights to go unnoticed.)
Headlights on. (Vulnerable to threat detection.)	Not recommended. Will shorten life of NVGs and blind oncoming drivers with NVGs.	Use blackout (BO) lights.
Chemlights on front of lead vehicle and rear of trail vehicle. (Vulnerable to threat detection.)	Will degrade lead vehicle's distance vision to some degree under low light conditions.	Tape over part of chemlight. Use BO lights.
Blackout marker lights on. (Vulnerable to threat detection with NVGs.)	At low light levels (heavy overhead canopy or starlight), will degrade NVG performance.	Tape over all but one of four markers on rear of vehicle. Tape over brake marker.
Blackout markers with blackout drive. (Threat detection easy with NVGs.)	Will enhance near vision, but degrade distance vision. May blind oncoming drivers with NVGs.	Turn off BO drive or ensure BO hood is adjusted so light only shines down.
Normal parking/brake lights. (Vulnerable to threat detection.)	Will seriously degrade all NVG performance and may blind oncoming drivers with NVGs.	Use BO lights.

### Ground Speed Limitations

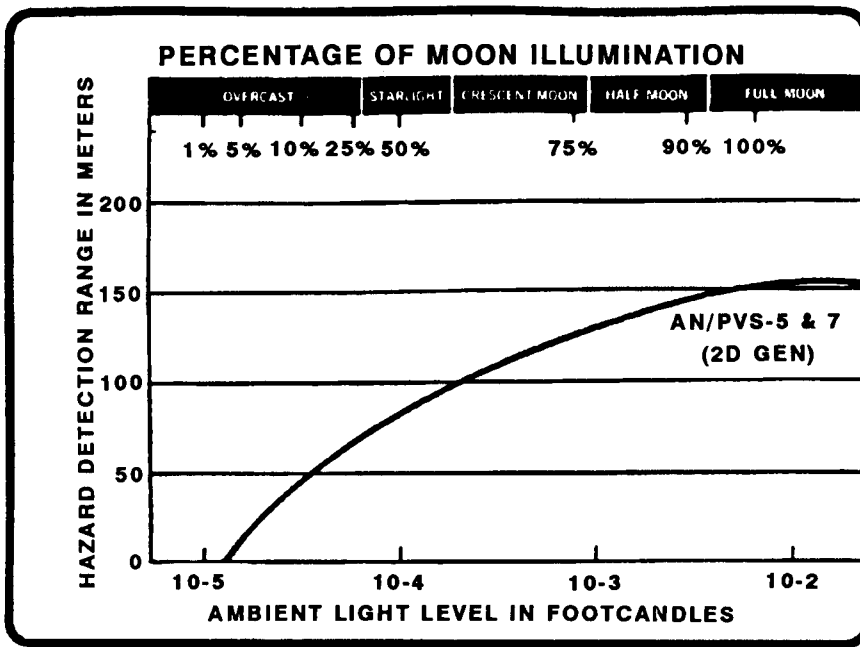
Most drivers tend to overdrive their capability to see. To avoid obstacles, you must understand the relationship between the NVG visual range capability and speed.

Different light levels affect the distance at which you can identify an object. This, in turn, limits the ground speed at which you can safely drive. The range limitation graph (Figure 23-2) shows how to determine the maximum range that an object can be identified. It also gives the commander a good rough estimate of the goggle's working range. The graph addresses a hazard 3 meters in length and 15 centimeters in diameter (the size of a small pole or a bare tree limb) with 30 percent contrast.

To find the minimum range at which an object can be detected in a given ambient light condition,

follow the chart along the top at a point representing the ambient light condition. Move down until the range curve is intercepted. Read the minimum range (meters) an object can be identified at the left.

After computing the range at which an object can be detected, use the ground speed limitation graph (Figure 23-3) to determine a safe speed for driving with goggles. This graph gives the commander a good rough estimate of ground speed limitations for nonconvoy movements. Follow the graph along the left side at the predetermined detection range. Move right until the 10-second driver response line is intercepted. (This line measures the time it takes for the operator to react to an object at a given distance and a given speed.) From the intersection, move down and read the safe ground speed for driving with the AN/PVS-5 or AN/PVS-7.



THIS GRAPH IS NOT EXACT.

FIGURE 23-2. Minimum Hazard Recognition Range.

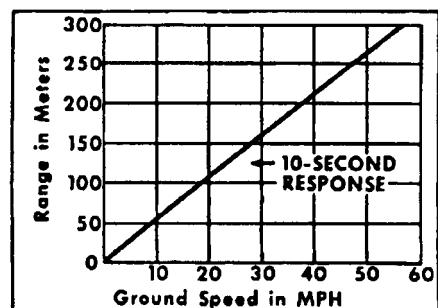
AR 600-55, Chapter 8, requires commanders to establish speed limitations for all modes of driving while wearing the NVG. In deciding what those limitations are, they must consider the following factors as a minimum:

- The type of NVG being used for driving, the age of the tubes, and the generation of tubes (second or third) of the goggles. For example, an AN/PVS-7 equipped with third generation tubes will outperform an AN/PVS-5 with second generation tubes in terms of improved resolution.
- The type of vehicle used for training.
- Weather conditions.
- Mode of driving, such as convoy, off-road, and cross-country.
- Terrain.
- Amount of light available (Appendix D).
- Type of mission.

**NOTE:** As a general rule, driving with NVGs should never exceed 25 MPH under any circumstance. Speed under convoy conditions should not exceed the limitations established for normal convoy movement without NVGs.

### Vehicle Preparation

The design of some Army vehicles will affect your ability to see outside the windshield. To reduce the loss of night vision because of vehicle shortcomings, properly prepare the vehicle for night driving with NVGs.



THIS GRAPH IS NOT EXACT.

FIGURE 23-3. Ground Speed Limitations.

Dirty windshields can reduce your ability to see outside your vehicle. Keep them clean. Remove dirt, grease, bugs, and scratches before each mission.

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 goggle's ability to see dim objects OUTSIDE the vehicle. Interior lights also interfere with goggle performance. They reflect off the windshield, reduce outside visibility, and are subject to enemy detection. To minimize these effects, turn off all interior lights and turn off or tape all exterior lights.

### Driver Preparation

Proper preparation of the vehicle and ground facilities for driving with NVGs 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 —

- Keep physically fit.
- Eat a well-balanced diet.
- Get enough rest.
- Avoid self-medication.
- Avoid the use of tobacco and alcohol.
- Learn and apply night vision principles (Appendix D).
- Avoid all bright lights (including sunlight) during the day. Wear sunglasses when outside.
- Participate in frequent night driving.

### Driving With Goggles and Emergency Procedures

The ability to drive with NVGs is developed through training. The more you drive with goggles, the more you learn about them. As a result, you gain confidence in your ability and in the capability of the device. On the other hand, overconfidence is a main fault associated with NVG use. After

wearing the device for only a short time, you may feel you have complete visual acuity and depth perception when in fact you do not.

Driving techniques and visual clues used during unaided night driving (without NVGs) also apply to aided night driving (with NVGs). The advantage of NVG use is improved ground reference and object identification. However, the field of view is greatly reduced. Use a continual scanning pattern to make up for this. To view an area while using NVGs, turn your head slowly until the goggles point in the desired direction. Rapid head movement can induce vertigo, which may lead to dizziness and nausea.

#### WARNING

Never use NVGs on public highways. The effect of oncoming headlights on the device may cause some very dangerous situations; the operator will be unable 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 source protection is activated, the NVG will be off for at least 2 seconds.

Although unlikely to occur, drivers with NVGs may face the situation described above in an NVG-controlled training area. To minimize the effect of headlights from an oncoming vehicle on NVGs, SLOW DOWN. Look away so that the light source is just outside the goggle's field of view. Pull off to the far right-hand side of the road, and stop the vehicle. NVG training at this point is now compromised as other vehicles with headlights on may appear. DO NOT CONTINUE DRIVING WITH NVGs unless authorized by a responsible officer or individual, such as the range control officer.

If your vehicle malfunctions while you are driving with NVGs, or if the goggles fail or begin to fail, SLOW DOWN. Pull off to the far right-hand side of the road, and stop the vehicle. Immediately WARN approaching NVG-equipped drivers with hand and arm signals and NVG-compatible light sources, such as an IR light stick or tactical flashlight. DO NOT turn on your four-way emergency flasher lights; they may blind approaching drivers with NVGs. 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 slow down in time. Do not try to repair your vehicle while it is in an exposed position on the road! If you are in a vehicle and see the scene described above, SLOW DOWN and proceed with caution.

If the NVG's low battery indicator turns on, REPLACE the batteries. DO NOT WAIT until the goggles shut down due to a weak or dead battery while driving. Slow down, pull off to the far right-hand side of the road, and stop the vehicle. You (or the assistant operator if accompanied by one) must warn approaching traffic FIRST before you try to switch batteries from another NVG or replace the batteries if spares are available. DO NOT switch goggles or you will have to refocus the device to suit your eyesight.

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

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

The assistant (shotgun) operator plays an important role in driving with NVGs. The driver must focus the goggles for distance vision even though this makes instrument reading difficult. An assistant operator wearing NVGs can compensate for this by alternating between distance and close-up viewing and telling the driver the status of warning lights, speedometer, fuel gauge, and other instrument readings. Depending on the vehicle configuration, the assistant operator may need to sit directly behind the driver to gain a better view of the instrument panel. The assistant operator must also use a slow scanning pattern and tell the driver of any obstacles inside or outside his field of view.

When parking vehicles in areas where NVG tactical lighting is used, trained ground guides equipped with NVGs should direct drivers to parking spots. Neither drivers nor guides should remove their NVGs until the vehicle is in the desired parking spot. Modify flashlights used by ground guides for NVG compatibility (Table 23-2). Alternative light sources for use during tactical operations are available in the Army supply system. Table 23-2 lists NVG-compatible items and their stock numbers.

**Table 23-2. NVG-Compatible Light Sources.**

ITEM	NSN
30-min high-intensity light stick (yellow), 6"	6260-01-074-4230
12-hour low-intensity light stick (green), 6"	6260-01-074-4229
3-hour IR light stick, 1 1/2"	6260-01-247-0364
3-hour IR light stick, 6"	6260-01-195-9752
3-hour IR light stick, 15"	6260-01-247-0366
3-hour IR flexible band, 7 1/2"	6260-01-247-0365
IR transmitter (battery-operated)	6240-01-275-8080
IR paper	6230-01-074-4230
Filter, flashlight (green)	6230-00-504-8341
Filter, flashlight (blue)	6230-01-189-1480

## Convoy Driving

Convoy driving with the NVG presents some unique problems, some 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 valuable aids to keeping safe distances between vehicles.

Convoy movement over winding or hilly terrain can cause the loss of visual contact with the lead vehicle. Therefore, a high degree of speed discipline is required to maintain safe distances. Dirt or extremely dusty surfaces also cause problems keeping visual contact with the lead vehicle. When driving on these surfaces, the convoy's speed 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 NVGs.

For safety reasons, permit convoy driving with NVGs only if every driver and assistant operator are NVG-equipped. If insufficient quantities of NVGs prohibit this, a mix of NVG and blackout drive may be used. Group the NVG-equipped vehicles together at the rear of the convoy. Do not disperse and intermix them with other vehicles not equipped with NVGs. If grouped in this manner, be sure the last non-NVG-equipped vehicle has its rear blackout drive lights off.

## Motorcycle and All-Terrain Vehicle (ATV) Operation

Motorcycles and ATVs may be operated with NVGs. Since a motorcycle or ATV operator does not have an assistant driver, the limitations of NVGs may require him to slow down proportionately more than a wheeled vehicle operator when using the goggles. A motorcycle or ATV operator usually requires much more training with NVGs than a wheeled vehicle operator to achieve equal levels of proficiency and safety. The additional weight that the goggles place on the operator's head and the position of this weight may require the motorcycle or ATV operator to redevelop his sense of balance during training.

In general, operate the motorcycle or ATV with headlights off, or at most, with blackout marker

lights on. Turn instrument lights off. Users of AN/PVS-5 goggles should focus both tubes for distance vision, even though this makes instrument reading difficult.

The limited field of view of NVGs will have a greater impact on motorcycle and ATV users than on other vehicles. Operators must practice and train to turn their heads from side to side to make up for the loss of peripheral vision.

## NVG Training Mission Planning and Briefings

Night driving operations are more easily conducted when ambient light sources provide the greatest amount of hemispherical illumination. Try to schedule qualification training on a night when the moon offers NOT LESS THAN 25 PERCENT ILLUMINATION (quarter moon) and is positioned at least 30 degrees above the horizon.

Every NVG training mission should be planned and briefed with all possible situations considered, to include deteriorating weather, disorientation, loss of depth perception, and equipment failure. All primary and assistant drivers must know their responsibilities under each situation. Communication between driver and vehicle commander is critical. The driver must constantly advise the vehicle commander of any reduction in vision.

At a minimum these subjects should be discussed during a night vision goggle briefing:

- Weather, including winds, sunset, moonrise, moonset, percent moon available, ambient light level, and effect of cloud coverage on ambient light levels. Weather forecasts should cover from 1 hour before training begins through 1 hour after training ends. If actual weather conditions deteriorate, modify night training as necessary.
- Light-level planning calendar. The commander, helped by supporting weather personnel, can develop a light-level calendar to predict when optimum levels of ambient light will exist. Further, a computer program termed NIGHTVIS provides NVG users with accurate forecasts of favorable/unfavorable times of use. You can get this user-friendly software

program by writing to Commander, US Army Atmospheric Sciences Laboratory, ATTN: ALCAS-AE-A, White Sands Missile Range, NM 88002-5501.

- Visibility restrictions, such as smoke, haze, or fog.
- Hazard map review for obstructions located in the training area.
- Mission to be performed.
- Vehicle and site preparation/lighting.
- Driver and assistant driver duties and responsibilities.
- Parking and recovery plans.
- Emergency procedures, such as what to do if a tube fails while driving.
- Medical evacuation/fire support.
- Personal equipment.
- Safety.

Draw all charts, drawings, and diagrams to scale as accurately as possible. Conduct a reconnaissance of the selected route during the day and night. The area should have a variety of road and terrain conditions available; for example, heavy/little overhead canopy, hilly roads, off-road terrain, unimproved roads, and good and poor contrast. It should also be an area where other traffic is precluded.

Conduct the formal briefing far enough in advance of the scheduled departure to allow time to resolve any problems raised during the briefing. Schedule a final briefing just before departure time to—

- Update weather conditions.
- Confirm time schedule.
- Discuss any mission changes.
- Ensure goggles are properly focused.
- Ensure a sufficient quantity of spare batteries are available.

- Review safety precautions and emergency procedures.
- Give the commander time to reemphasize important aspects of the mission.

Commanders/team leaders should hold individual briefings after the formal briefing. Each driver should be required to discuss the entire mission.

## Support Requirements

Support requirements for conducting safe NVG driver training include the following:

- Before driving a route at night, check it during the day for obstructions. Post a hazard map in the briefing room. Update it when a new obstruction is detected.
- Set up the tactical site/staging area lighting system for night training. Tactical lights for both aided and unaided vision are required when operating at a tactical site.
- A command and control vehicle equipped with NVGs must be on the route during qualification and refresher training. Establish communication between the command and control vehicle and the TOC. MEDEVAC and fire support personnel must be on site or on standby.
- Get an eye chart from your servicing medical company. Make it available for drivers to properly focus the NVG before the start of actual driving.
- If the route selected does not preclude other traffic, such as commercial traffic, military police support may be needed for traffic control purposes.

### WARNING

Before training begins, all support personnel not involved with NVG training should be briefed on what will be going on and what they should and should not do; for example, random use of flashlights or other lights and walking around and between vehicles.

## TRAINING PROGRAMS

### Command Considerations

Commanders must fully understand the limitations and requirements of night driving operations. The success of any night operation depends on the amount and quality of preparation and training conducted before the mission. Night operations require extensive training and maximum support and attention from commanders.

Commanders must establish and support night training programs. Mission goals must be realistic and developed around the proficiency and experience of the unit in night operations.

Using drivers in day and night roles reduces their ability to operate effectively at night. Because night driving is more tiring than day driving, commanders must ensure that personnel get every opportunity to rest. When drivers are scheduled for night driving, commanders should consider limiting workloads to night driving only.

Maintenance requirements for day and night driving are greater than those required for day operations alone. To allow enough time for maintenance, commanders should decrease day operations when night missions are scheduled. Maintenance personnel may have to be divided into two shifts to support day and night operations.

Commanders should be alert to signs of fatigue, overconfidence, or carelessness that personnel engaged in night driving display. A carefully planned and executed night driving safety awareness program is essential for accident-free operations. Commanders must ensure that leaders at the lowest level emphasize and enforce the spirit and the standards of this program.

Commanders must ensure that proper facilities are available for night training. Failure to provide the proper training environment reduces an individual's ability to perform night driving and creates an unsafe situation.

Until the entire unit is fully trained in all aspects of night missions, commanders may consider dedicating a platoon or company solely to tactical night operations. Once established and proficient,

this element can then help train the remainder of the organization.

Since the introduction of NVGs, many units have established aggressive NVG training programs. Their experience has shown that night tactical missions are much more effective under ALL ambient light levels when conducted with the use of NVGs.

### Psychological and Physiological Training Considerations

Training with NVGs is relatively new and challenging. Initially, some drivers may be bothered by sore neck muscles, headaches, and fatigue. Some may develop anxiety due to reduced depth perception. Most of the mental and physical effects of NVGs can be reduced if the following considerations are included in NVG training programs.

The first NVG driving lesson should be conducted over a short range, for example, 3 to 5 kilometers, and when a high ambient light level exists. This procedure introduces the driver to NVGs during ideal conditions; the short route helps prevent fatigue. As training progresses, conduct longer training periods in lower ambient light levels. Using these procedures increases the student's endurance and confidence.

Students experience greater fatigue during night driving. Duty hours for drivers, instructors, data collectors, and support personnel undergoing night training should not exceed 8 continuous hours a day. (Instructors conducting NVG training should be restricted to 4 hours of instruction within a 24-hour period.) A typical duty day would be 1600 to 0200 hours. To comply with this requirement, duty should be limited to driving and academic training only. Additional duty, requiring a soldier's presence during the day, should be avoided when possible.

**NOTE:** Aviation experience has shown that 1 hour of flying with NVGs equals 3 hours of flying without them.

Commanders should consider using reversed cycle training for personnel selected to receive NVG training. This procedure means training at night and resting during the day. It enables the soldier to physically and mentally adjust to night operations

and provides continuity to a unit night training effort. Individual soldiers require at least 5 days to begin physical adaptation to a night training cycle. Physical adaptation is essentially complete after 2 to 3 weeks, but training efficiency is again reduced during the period of adjustment back to day cycle.

### Training Prerequisites

Driving proficiency with NVGs can be maintained only through a training program that requires frequent NVG driving. Drivers who do not maintain NVG proficiency must receive refresher training.

In accordance with AR 600-55, Chapter 8, students must be licensed motor vehicle operators, receive NVG academic subjects before receiving hands-on training in a vehicle, and pass a written exam. Academic training makes students aware of the limitations of NVG driving and ensures a safer operating environment.

AR 600-55, Appendix J contains a list of mandatory academic subjects and driving (hands-on) tasks for driver qualification or refresher training, as well as instructor qualification requirements.

An NVG-equipped instructor must be in the cab of the vehicle at all times during qualification/refresher training.

### Exportable Training Package

TC 21-305-2 is an exportable training package for units authorized either the AN/PVS-5 or AN/PVS-7 series NVG. It is available through normal publication channels. This training circular includes lesson plans, advance sheets, paper copies of viewgraph transparencies, a sample training calendar, eye charts, written examination and quizzes with answer sheets, and a performance evaluation checklist (road test). Lesson plans contain the conditions and standards for those mandatory academic and hands-on tasks outlined in AR 600-55, Appendix J.

Two training videotapes support this training and must be ordered separately through your local training and audiovisual center (TASC). The videotapes provide instruction on operational functions, care, preventive maintenance,

and proper wear of the AN/PVS-5 series and AN/PVS-7B NVG. TC 21-305-2 provides instructions for ordering either video.

### Standing Operating Procedures

Standing operating procedures should cover all aspects of a unit's training program. Each operator should become thoroughly familiar with the contents of the SOP and of this chapter. The information that follows is minimal and is provided for guidance only. Each SOP must be developed to meet the particular training needs of the unit. The following information should be addressed:

- Hemispherical illumination limitations for NVG training.
- Rest requirements for personnel undergoing NVG training.
- Vehicle lighting configurations for night and NVG driving.
- Command and control vehicle for tactical operations.
- Additional light sources authorized for NVG driving.
- Care and security of the NVG.
- Weather requirements for night and NVG training.
- Vehicle speed limitations.
- Emergency procedures while driving with NVGs, such as goggle failure and vehicle breakdowns.
- Driver and assistant driver responsibilities.
- Qualification/refresher training requirements.
- NVG instructor qualification requirements.
- NVG licensing procedures (SF 46/OF 346).
- NVG-related accident reporting procedures.

## OPERATIONS UNDER BLACKOUT CONDITIONS

When operating under blackout conditions, be sure your blackout marker lights are functioning properly. Lower the windshield to improve visibility. Drive at reduced speeds. If in a column, watch the rear blackout marker lights of the vehicle ahead to be sure you are following at the correct distance. Remember, the white blackout stoplight of the vehicle ahead is on the right and left side.

### Blackout Marker Lights

To show the location of vehicles during blackouts, military vehicles are equipped with four blackout marker lights. Two of these lights are on the rear corners of the vehicles and the other two are on the front (Figures 23-4 and 23-5). They do not illuminate the road but indicate the position of a vehicle as much as 250 yards ahead, depending on the weather. They cannot be seen from an airplane flying higher than 400 feet.

When operating a vehicle in a convoy under blackout conditions, if practicable post a person equipped with a screened flashlight or large white piece of material in the rear of your vehicle to warn the following driver if he approaches too closely. An alert rear guard can usually detect a vehicle at a reasonable distance, even one with no lamps. In blackout operation, vehicles will maintain a speed of 5 to 10 MPH (8 to 16 kilometers per hour).

**NOTE:** When a vehicle is disabled on the side of the road, the driver is posted at the rear of the disabled vehicle with a screened flashlight or large white piece of material to warn approaching vehicles of the danger.

**Taillights.** Each rear lamp has two pairs of "cat's eyes" that show red when on. Each pair appears as one red light when you are 60 to 180 feet (20 to 60 yards) away and as two pairs of cat's eyes in each light at less than 60 feet.

Remember, one point of light tells you that you are too far behind the vehicle ahead. Two lights assure you that you are following at a proper distance. Four lights warn that you are getting too close.

Normally, the blackout stoplight is a separate unit mounted on the right and left taillights. It flashes a white light when brakes are applied.

**Front Lights** Each front light has one pair of cat's eyes. They show white when on. Each pair appears as one light when you are more than 60 feet away. When you are 60 feet away, you can see one pair of cat's eyes in each light. This warns you that the vehicle is near.

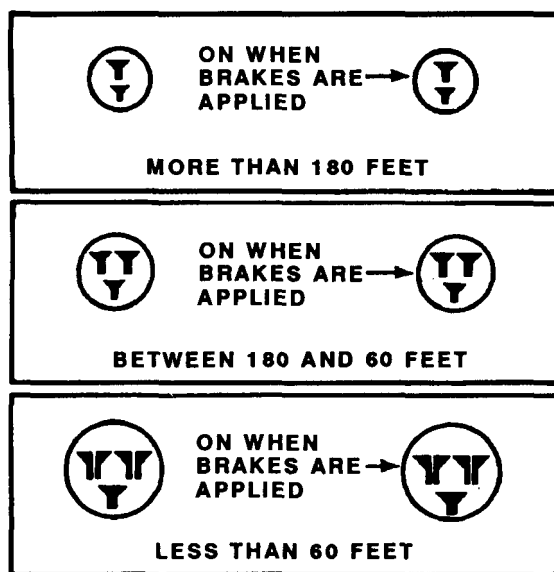


FIGURE 23-4. Rear Blackout Marker Lights.

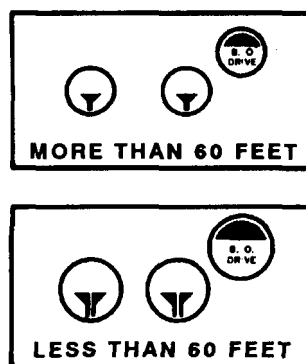


FIGURE 23-5. Front Blackout Marker Lights and Blackout Driving Lights.

### Blackout Driving Light

The blackout driving light is mounted to the left of the left headlight (Figure 23-5). It furnishes a diffused light beam for limited illumination when you are driving under blackout conditions.