U.S. Department of Justice
Office of Justice Programs
National Institute of Justice

National Law Enforcement and Corrections Technology Center
BULLETIN

March 1996

National Institute of Justice
Jeremy Travis, Director

Scoping Out Night Vision

In the United States today, there are more than 50 companies that either manufacture or distribute night vision equipment. Departments considering a purchase of this equipment will encounter a potentially confusing array of technical specifications and terminology, and mistakes can be costly. To help departments evaluating night vision systems to make informed decisions, this bulletin of the National Law Enforcement and Corrections Technology Center (NLECTC) presents basic information on night vision technology and terminology, factors to consider when evaluating night vision systems, and new developments in night vision.

Background

The most widely used night vision aid in law enforcement is image intensifier (I^2) equipment. Developments in I^2 technology are categorized in terms of "generations." To date, there have been four generations of night vision devices, numbered from zero through three.

Night vision technology was originally developed to give the U.S. Armed Forces the tactical advantage of seeing at night or under other conditions of low light without using searchlights that would reveal their position. The first night vision aids—"generation zero" (Gen 0)—were sniper scopes that came into use during World War II and the Korean conflict. These were not true image intensifiers, but rather *image converters*, which required a source of invisible infrared (IR) light mounted on or near the device to illuminate the target area. The objects in the target area reflected this IR light, which the device converted to visible light. Because they cannot function without auxiliary IR light, Gen 0 devices are referred to as "active."

The development of the *image intensifier tube* brought clearer, brighter image quality to night vision. I^2 devices are called "passive" because they do not require an auxiliary source of illumination. These devices are capable of responding both to the limited amount of visible light that is available at night—moonlight, starlight—and to invisible light from the near-infrared range of the spectrum. The image intensifier tube multiplies the light it takes in many thousands of times, essentially amplifying the brightness of the image seen through the device. This process is described in more detail below. In situations where there is almost no ambient light, such as on an overcast night or inside an unlit building, an infrared light source is required. Many night vision systems have an integrated infrared light-emitting diode (IRLED) that can be used in situations where ambient illumination is low. An auxiliary infrared light source, such as a high-intensity flashlight fitted with an infrared filter, can also supply the light required to operate a passive device.

The "starlight scopes" developed during the early 1960's for use in Vietnam were the first generation (Gen 1) of I^2 devices. Some Gen 1 equipment is still in service. In Gen 1 devices, three image intensifiers were connected in a series, which achieved a high level of light amplification but also made the scopes longer and heavier than future night vision devices would be. (See figure 1.) Gen 1 devices produce an image that is clear at the center but distorted around the periphery and also subject to "streaking" and "blooming"—temporary loss of contrast—when a pinpoint source of bright light, for example, a car's headlights or the flash of a cigarette lighter, enters the field of vision. Because such bright, concentrated sources of light could induce image degradation/shut down and even tube damage, later generations of night vision devices incorporated several features to protect against bright light. Even with these safety features, care should be taken to avoid such exposures and to keep the objective (front) lens capped during the day and when the unit is not in use.

The development of the *microchannel plate* (MCP) in the late 1960's brought the second generation (Gen 2) in night vision. (See figure 2.) The MCP eliminated the need for three-stage light amplification and thereby reduced the size, weight, and distortion of the image intensifier tube. With the MCP, night vision goggles and hand-held viewers

New NIJ Publications

Available upon request is *NLECTC Bulletin*, "Positional Asphyxia—Sudden Death," dated June 1995. Currently in production is a report on the Second Annual Law Enforcement Technology for the 21st Century conference, held in June 1995 in Washington, D.C. Please contact NLECTC for availability of these publications.

became possible. The MCP also provided much more robust operation when bright lights were in the field of view.

Third-generation (Gen 3) image intensifiers were developed in the mid-1970's and became available during the early 1980's. Gen 3 introduced two major technological improvements:

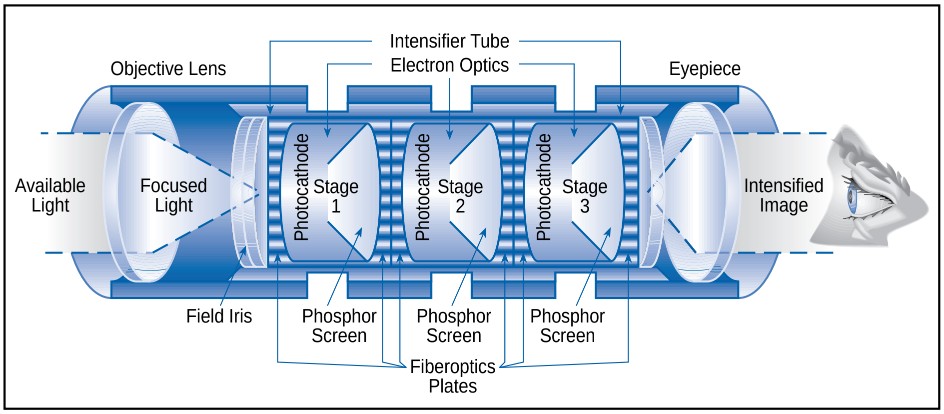
- The *gallium arsenide (GaAs) photocathode*, which increases the tube's sensitivity to registering light from the near-infrared range of the spectrum, enables it to function at greater detection distances and improves system performance under low-light conditions. (Gen 1 and Gen 2 devices use an S–20 multialkali photocathode.)
- Application of a metal oxide *ion barrier* to the MCP, which increases the life of the image tube. The operational life of Gen 3 image intensifier tubes is in excess of 7,500 hours; that of Gen 2 tubes is about 2,000 to 4,000 hours.

How Image Intensifiers Work

All I² systems employ an objective (front) lens, an image intensification tube, and an ocular (eyepiece). Available light enters the objective lens and is amplified as it passes through the image intensification tube. The process is as follows:

- The light is focused on the *photocathode*, the first component of the image intensifier tube. The photocathode is an electron-emitting, photosensitive screen located where the film in a camera would normally be. It absorbs the light's energy and converts it into electrons.
- Next, these electrons are accelerated and multiplied. In Gen 1 tubes, this was accomplished with three stages of photocathode amplification. Gen 2 and Gen 3 tubes use a single photocathode and a microchannel plate comprising more than 2 million microscopic hollow-glass conducting channels fused into a disc-shaped array. When an electron from the photocathode enters a given channel, it strikes the channel wall, initiating an avalanche process that results in several hundred electrons exiting the other end of the channel.
- The electrons exiting the MCP bombard a phosphor screen that converts their energy into a green form of visible light. The process is similar to the way images are produced on a television screen.
- Because this light is in the same pattern and proportion as the image formed by the objective lens, the image in the device's eyepiece corresponds precisely to the image being viewed.

Figure 1. **First-generation (Gen 1) image intensifier**



The tube is actually a sequence of three image intensifiers, each comprising a photocathode and phosphor screen.

Evaluating Image Intensifiers

Today I² night vision equipment is available in the form of hand-held viewers for use with one eye (*monocular*) or both eyes (*biocular or binocular*); goggles that allow the user to walk, run, or pilot a vehicle; binocular observation devices that provide magnification; and weapon sights. The first question to address when considering an investment in night vision equipment is application: For what purpose and under what conditions will the equipment primarily be used? Mobility? Stationary surveillance? Hand-held discreet observation? Videotaping? Photography? Some night vision equipment can be adapted to more than one application. The best way to make an informed purchase is to begin with an analysis of your department's needs.

This analysis should also take stock of the equipment you presently have on hand. If you plan to use your night vision equipment for photography and your department already has a 35-mm camera and an assortment of lenses, look for a night vision device that can be equipped with an adapter that will allow you to use your existing lenses. Video cameras can also be coupled to certain night vision devices with special relay lenses that are adaptable to most common lens mounts. High-intensity flashlights can be converted to invisible searchlights for use with night vision systems by attaching infrared filters.

Where will your equipment be used? Gen 2 equipment is generally a good choice for use in urban environments, where there is more ambient light. In rural environments, or in situations where the ambient illumination is extremely low, Gen 3 equipment is preferable.

Performance Factors

The best means of evaluating whether the equipment you propose to purchase will serve your needs is an onsite demonstration under your typical operating conditions. In comparing the performance specifications of different night vision systems, the following are the key parameters to consider.

Photosensitivity

This value measures the capacity of a night vision device to detect light and convert it to electrons. Photosensitivity is the chief factor determining the signal-to-noise ratio (SNR), explained below. A higher photosensitivity generally results in a higher SNR. Photosensitivity should reference a 2854K or 2856K input blackbody distribution to ensure an input spectrum with the appropriate IR component.

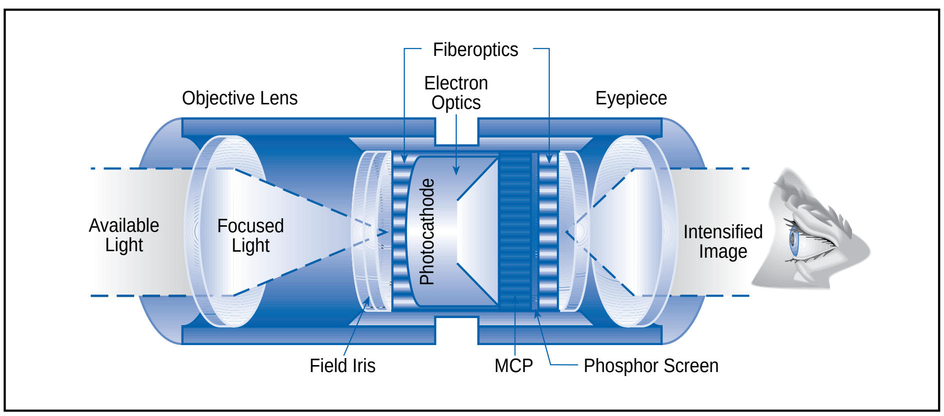
The critical variable in evaluating photosensitivity is the area of the light spectrum in which it is measured. For night vision, performance in the near-infrared range of the spectrum is crucial.

Signal-to-noise ratio

The signal-to-noise ratio (SNR) is a measurement of the amount of light reaching the eye divided by the amount of "noise," or static disturbance, perceived by the eye, and is considered to be the best single indicator of a night vision device's low-light performance. The SNR indicates the low-light resolution of the image intensifier tube, that is, how well it can distinguish between objects that are close together under low-light conditions: The higher the SNR, the smoother the image under low-light conditions. An example of an SNR-limited image is reception of a broadcast television station in a fringe area.

The SNR is dependent on several elements in a night vision device and can be calculated in various ways to get the results desired. The U.S. military generally specifies a minimum SNR of 4.5 (@1.2 x 10^{-6} FC input) for Gen 2 tubes and 16.2 (@1.0 x 10^{-5} FC input) for Gen 3 tubes. To ensure adequate low-light performance, the objective lens should have an *f*-number not exceeding 1.7 and a *t*-number not exceeding 2.0.

Figure 2. **Basic configuration of second-generation (Gen 2) image intensifier**



The microchannel plate (MCP) eliminated the need for the three-stage light amplification used in Gen 1 devices. The configuration of the third-generation (Gen 3) image intensifier is much the same, but the photocathode, MCP, and phosphor screen are much closer together. Two other factors distinguish Gen 3 intensifier tubes from Gen 2 tubes: use of a gallium arsenide (GaAs) photocathode rather than the S-20 multialkali photocathode used in Gen 2 tubes, and the application of a metal oxide film to the MCP to create an ion barrier.

Gain

This is a measure of brightness. The gain of a night vision device is the number of times it amplifies the light entering the device. *Tube gain*, measured in the tens of thousands, represents the actual degree of amplification generated in the tube. However, because tube gain is reduced by other system components—lenses, optics, filters—the more important measurement to evaluate is *system gain*, which is measured in the thousands.

Gain should always be evaluated in conjunction with photosensitivity and SNR. If the latter two are poor but gain value is high, the image produced by the system will be poor even though it is bright due to high "noise" content. A very high tube gain can lower the quality of the image by creating more tube "noise." Very high gain values may also mean that the tube is driven very hard, which would shorten its operational life. U.S. military specifications call for a tube gain of 20,000 to 35,000 and a system gain of 2,000 to 3,000.

Equivalent background input

Equivalent background input (EBI) is a measure of the tube's output brightness when there is no light entering the tube. Excessive EBI tends to reduce contrast at low light levels and high temperatures because EBI doubles for every 3-4 degree centigrade rise in temperature. To help ensure proper low-light performance, it is important to specify military-level EBI, with no more than 2.5 x 10^{-11} lumen/cm^2 at a temperature not less than 21 degrees centigrade.

Resolution

Like gain, resolution—the sharpness of image contrast—is measured both in terms of the image intensifier tube and of the overall system. *System resolution* takes into account the quality of the system's optics and is the more accurate measure of what the viewer actually sees. *Tube resolution* becomes an important criterion in comparing systems with similar optical qualities and filters. When the resolution of different night vision systems is measured in the same way, under the same conditions, and using the same magnification, a higher resolution value means a sharper picture.

Magnification and field of view

The total magnification of a night vision device is determined by dividing the focal length of the objective lens by the focal length of the eyepiece. As magnification increases, field of view (FOV) decreases, so that complete surveillance may require movement of the night vision device over the area of interest. At higher magnification, the amount of light captured may also be reduced. Long-range observation or weaponsight applications, then, require an image tube that performs well at low light levels and/or high-performance lenses.

Consider the versatility of the device in situations requiring different magnification. Some night vision devices use a fixed objective lens; others use interchangeable lenses, making possible the use of a telephoto lens if needed. Use of zoom lenses should be avoided because their optical quality tends to be poorer than that of fixed focal length lenses.

Distortion

All systems are subject to some distortion in the image they produce. Minimal distortion is critical in weaponsights and systems used for photography or video.

Distortion manifests itself as a swimming or swaying image as objects move through the field of view, or as the system is panned. Degree of distortion is usually included in the list of technical specifications provided by the manufacturer. Distortion should not exceed 5 percent across the total field of view.

Weather resistance

Fogged lenses are useless; therefore, system resistance to humidity and moisture is crucial. Look for the ability to float in devices that will be used on or around water. Look, in any case, for hermetic system seals, which protect the enclosed intensifier tube from moisture.

Human Factors

Factors affecting ease of use should not be ignored. How easy is the device to operate in the dark, when the operator cannot see the controls? How heavy is the unit? Can it be carried comfortably for extended periods of time? Does the *on/power* switch need to be depressed continually to operate the device? What kind of eyepiece does the device use? Prolonged observation with a monocular device may cause eye fatigue. Much less eye fatigue is experienced with biocular or binocular devices.

Cost

The purchase price is only the first of the costs of owning night vision equipment. Maintenance and repair must be factored into the costs of ownership. All image intensifier tubes wear out over time and must be replaced. The life of the tube should be considered when purchasing a system. The following protective features extend the life of an I^2 tube:

- *Automatic brightness control (ABC):* A circuit that automatically reduces the voltage to the microchannel plate when bright light enters the field of vision. The ABC helps protect the I^2 tube from exposure to bright light that would otherwise damage it and also provides limited protection to the user from bright flashes.
- *Bright-source protection (BSP):* A circuit that reduces the voltage between the photocathode and the microchannel plate when the system is exposed to a point source of bright light. BSP lowers the energy of electrons leaving the photocathode. The higher the electron energy to the MCP, the greater the number of ions the MCP will generate. Because ion contamination from the MCP is the primary contributor to the “death” of the image tube, BSP is an extremely important protective feature.
- *Metal oxide ion barrier:* A metal oxide film on the microchannel plate allows electrons from the photocathode to pass through the MCP, but traps ions, preventing them from contaminating the photocathode and thereby extending tube life.

When purchasing lenses for use with night vision systems, ensure that the antireflection coatings and imaging characteristics are optimized for near-infrared response (i.e., visible wavelengths up to 900 nanometers), as are some types of lenses for charge-coupled devices (CCDs). This will help ensure adequate performance in both high- and low-illumination situations.

Another element to be aware of when evaluating the cost of operating a night vision device is the type of battery it uses. Look for devices that take commercially available batteries rather than batteries that must be ordered from a supply house.

Know What You’re Getting

Although there are more than 50 companies distributing or manufacturing night vision systems in the United States today, only 2 U.S. companies manufacture the image intensifier tubes used in these systems: ITT and Litton. To know what you’re getting:

- Request a copy of the factory original *tube data sheet* for the system you propose to buy. All I^2 tubes made in the United States have a serial number. The tube data sheet will list the manufacturer of the tube, the tube serial number, and the operating parameters of the tube. This information will enable you to verify the salesperson's claims.

- Beware of systems claiming to use "surplus tubes." These tubes may actually have been rejected and removed from inventory because their quality is suspect.
- Avoid reconditioned tubes. The operational life of these tubes is usually short, and their warranty coverage is seldom comprehensive.
- Exercise caution in evaluating night vision devices that use foreign-made tubes. The substantially lower cost of these systems makes them attractive, but they may not always adhere to U.S. performance standards. As with any equipment, study the warranty carefully and find out where you can get it repaired if it does fail and how long repairs usually take. Some foreign manufacturers of night vision equipment also make extravagant claims regarding "light gain" and amplification, but remember that too high a gain will actually detract from the overall image quality and shorten the life of the image intensifier tube.
- Pay careful attention to the specific generation of the intensifier (i.e., Gen 0, 1, 2, or 3) being offered by the manufacturer.

New Developments in Night Vision: Thermal Imaging

Until recently, night vision has been nearly synonymous with image intensification. There is another night vision technology, *forward-looking infrared (FLIR)* or *thermal imaging*, which was developed for the U.S. military during the 1960's. FLIR has been in use by law enforcement for about 20 years, most commonly on helicopters and light airplanes. However, the extremely high cost of these systems (in excess of $100,000) was prohibitive for most police agencies. New developments in FLIR technology are bringing the cost down to a level compatible with I^2 systems, making thermal imaging night vision systems more accessible to the average law enforcement agency.

How it works

Everything emits heat energy in the form of infrared radiation. Although the human eye is not sensitive to this energy, it acts like light, and can be optically focused and collected. A thermal imaging system focuses infrared energy on an electronic transducer with thousands of tiny sensors. These sensors measure the difference in temperature among the objects in the scene to a fraction of a degree and compare them with the background. The thermal contrast is translated to visual contrast in shades of gray on a black and white monitor, creating a TV-like picture. These systems can be set to register heat as either white ("white-hot") or black ("black-hot").

Previously, FLIR systems required cryogenic cooling, which greatly increased their cost. The technological breakthrough that has brought the cost of these systems down is use of either a resistive or a ceramic material that allows them to operate at room temperature.

A relatively new thermal imaging system available to law enforcement agencies is a camera on a panning mechanism that is mounted to the roof of a patrol car just behind the lightbar, allowing 360˚ coverage around the vehicle. Video from the camera is displayed on a television monitor inside the car. This system can also be mounted on boats. Other applications, such as rifle sights and hand-held sensors, will soon be available for law enforcement use.

Unique capabilities

Because they measure the heat emitted by an object rather than the light reflected by it, FLIR systems can do some things that image intensifiers cannot:

- They are effective in situations of total darkness, with no need for supplemental illumination.
- They can help see through most fog and a few layers of foliage. A suspect or a vehicle with a warm engine hidden in brush or woods will stand out more clearly.
- They are not subject to image "blooming," cannot be damaged by exposure to bright light, and therefore will not automatically cut off when exposed to pinpoint sources of bright light.

Thermal imaging systems offer advantages that go beyond seeing in darkness. FLIR technology offers the ability to track suspects in a completely different way—by the heat registered by themselves and their vehicles. Thermal imaging systems can:

- Detect fresh footprints in snow. Officers in Ottawa, Canada, used a prototype of a new mobile thermal imager to track a suspect leaving a building through snow. The suspect's fresh footprints retained his body heat and glowed on the system monitor.
- Reveal the presence of a concealed weapon by thermal contrast.
- Link recently discarded evidence to a suspect by virtue of the residual body heat it radiates. In Dallas, Texas, a suspected drug dealer threw away bags of cocaine he had been holding when he heard a patrol car approaching. Because the officers were using a thermal imaging system, they were able to see the heat trajectory of the bags leaving the suspect's car window, thus positively linking the evidence to him.
- Pick out vehicles that have recently been driven. In one documented instance, a thermal imager was instrumental in the arrest of a hit-and-run suspect: Using a mobile unit mounted on their patrol car, officers in Dallas, Texas, were able to pick out the suspect's car from among the others parked on a residential street by its warm engine, which stood out among the other "cold" cars.

- Spot recently made tire skid marks.
- Pick up the warm water trail of a swimmer.

Limitations

Although thermal imaging systems offer some capabilities that image intensifier systems do not, they do have limitations:

- Thermal imaging systems do not register detailed facial features; therefore, FLIR video cannot be used to make a positive identification of a suspect. I^2 systems, on the other hand, can delineate facial features in fairly good detail.
- Because infrared energy does not pass through normal glass, thermal systems cannot be used to monitor suspects inside vehicles or through building windows. This is also the reason the system camera must be mounted on the roof of the patrol car, where it is conspicuous and at greater risk of being vandalized.
- Although FLIR systems can see through fog, such high-humidity conditions do minimize thermal contrast, degrading the quality of the image.

Performance factors

As with I^2 equipment, evaluating the thermal imaging system you propose to purchase is best done in an onsite demonstration under typical operating conditions. The following key parameters or performance specifications of the thermal imaging systems under consideration should be compared.

Sensitivity

The sensitivity of a thermal imaging system is typically described as the Noise Equivalent Temperature (NET), measured in degrees centigrade for a given optical *f*-number. This value measures the temperature resolution or the minimum temperature difference that a thermal imaging system can detect. The lower the NET value, the better the system performs. Typical NETs for law enforcement applications are 0.2 degrees centigrade. Higher performance military systems have NETs of less than 0.05 degrees centigrade.

Resolution

The resolution or sharpness of image in a thermal imaging system is measured in terms of its instantaneous field of view (IFOV) in milliradians (mrad). [Note: 17.5 milliradians is equal to an angle of 1 degree in the instantaneous field of view.) The lower the IFOV value, the sharper the image and the longer the performance range of the sensor. Typically IFOVs for law enforcement applications are in the 1.0 to 1.5 mrad range. Higher performance military applications have IFOVs of less than 1.0 mrad.

Magnification and field of view

The total magnification of thermal imaging systems is determined the same way that it is for I^2 systems: divide the focal length of the objective lens by the focal length of the eyepiece.

As the magnification of the thermal sensor increases, the field of view (FOV) decreases. Complete surveillance of an area requires movement of the sensor.

Cost

The purchase price of a thermal imaging system depends on the performance (sensitivity and range), operating temperature (cryogenically cooled or room temperature), and application configuration. As with I^2 equipment, maintenance and repair must be factored into the costs of ownership.

If the thermal imaging system requires batteries for operation, power consumption should also be considered in the purchase decision. The higher the power consumption, the more batteries will be used. Room temperature thermal imaging systems typically consume less than 8 watts of power. Power consumption for cryogenically cooled thermal imaging systems is typically more than 10 watts. Look for devices that use commercially available or rechargeable batteries, rather than batteries that must be ordered from a supply house.

Another feature to consider is the availability of a video output to display images on a remote display, television, or a standard format VCR tape. This feature is useful for both training and creating a permanent record of images viewed with the equipment.

Weight

Hand-held thermal imaging systems usually weigh less than 4 pounds. Long-range thermal systems with large optics can weigh much more and are typically mounted on a vehicle or tripod.

Choosing a System

The best way for departments to determine whether they will be best served by a thermal or an I^2 system, or both, is to evaluate their needs carefully and insist on having an onsite demonstration under realistic operating conditions.

To Comment or For Further Information:

NIJ's National Law Enforcement and Corrections Technology Center maintains a data base that identifies manufacturers of night vision equipment and other law enforcement, corrections, and criminal justice products.

For additional information, please call NLECTC at 800–248–2742, or write to Box 1160, Rockville, MD 20849–1160.

NLECTC Bulletin

The *NLECTC Bulletin* is designed as a forum for disseminating to the law enforcement and criminal justice communities the most current information on technologies relevant to your needs. We welcome your comments or recommendations for future *Bulletins*.

NLECTC is designing data bases to help respond to agencies that want to know who manufactures a specific product and what other agencies may be using that product. Your contributions to the Center's information network are important. What technologies or techniques are you using that you would like to share with colleagues? Please call or write to the National Law Enforcement and Corrections Technology Center, P.O. Box 1160, Rockville, MD 20849–1160, 800–248–2742.

JUSTNET

Contact JUSTNET (Justice Technology Information Network) for online access via the Internet and World Wide Web (WWW) to information about new technologies, equipment, and other products and services available to the law enforcement and corrections communities. Under the auspices of the National Institute of Justice, U.S. Department of Justice, JUSTNET is a service of the National Law Enforcement and Corrections Technology Center (NLECTC). By accessing the JUSTNET home page on the Internet's WWW, law enforcement and corrections representatives can take advantage of the following three primary service options, which in turn provide access to additional criminal justice Web sites:

- News and information services.
- Interactive services, including a criminal justice chat line and topic board.
- Data and publication services.

JUSTNET can be accessed at the following Internet address: http://www.nlectc.org

For a copy of the JUSTNET user's guide, call NLECTC.

Grants Program

NIJ's grants program, operated by NIJ's Office of Science and Technology, has supported research in numerous and diverse issues of importance to law enforcement executives as well as to the officer on the street. Improving fingerprint and trace evidence identification and the development of DNA standards are some of the more notable achievements. In the late 1980's and early 1990's, a renewed interest in less-than-lethal (LTL) weapons by the criminal justice system led Congress to allocate special funding to NIJ to begin an R&D program in this area.

In late 1992 and early 1993, NIJ initiated an expanded program to investigate all aspects of this issue and to develop a broad-based research program that would lead to new tools and use-of-force options for law enforcement officers. The program has evolved into one that looks not only at weapons but at the sociological aspects of the use of LTL weapons, e.g., liability and community acceptance issues.

It has also become clear, however, that technologies other than weapons may effectively address the same operational goals of reducing the incidence of death and injury to officers, suspects (or prisoners), and the public when force has to be used to effect an arrest or combat violent behavior during transport or other custodial duties.

NIJ Charter

Under NIJ's charter, relative to its grants program, the Institute is authorized to:

- Sponsor R&D to improve and strengthen the Nation's system of justice with a balanced program of basic and applied research.
- Evaluate the effectiveness of criminal justice and law enforcement programs and identify those that merit application elsewhere.
- Support technological advances applicable to criminal justice.
- Test and demonstrate new and improved approaches to strengthen the justice system.
- Disseminate information from research, development, demonstrations, and evaluations.

National Law Enforcement and Corrections Technology Center

The National Law Enforcement and Corrections Technology Center is supported by Cooperative Agreement #95–IJ–CX–K002 awarded by the U.S. Department of Justice, National Institute of Justice.

The National Institute of Justice is a component of the Office of Justice Programs, which also includes the Bureau of Justice Assistance, Bureau of Justice Statistics, Office of Juvenile Justice and Delinquency Prevention, and Office for Victims of Crime.

Regional Contacts:

Office of Law Enforcement Technology Commercialization
316 Washington Avenue
Wheeling, WV 26003
Phone: 800–678–6882
Fax: 304–243–2539
POC: Jerome Bortman (interim)

Office of Law Enforcement Standards, National Institute of Standards and Technology
Building 225, Room A323
Gaithersburg, MD 20899
Phone: 301–975–2757
Fax: 301–948–0978
POC: Kathleen M. Higgins

National Law Enforcement and Corrections Technology Center, Southeast Region
3725 Peppermill Parkway
North Charleston, SC 29418
Phone: 800–292–4385
Fax: 803–297–7776
POC: Steve Bishop

National Law Enforcement and Corrections Technology Center, Rocky Mountain Region
2050 East Iliff Avenue
Denver, CO 80208
Phone: 303–871–2522
Fax: 303–871–2500
POC: James Keller

National Law Enforcement and Corrections Technology Center, West Region
The Aerospace Corporation
2350 East El Segundo Boulevard
El Segundo, CA 90241–4691
Phone: 310–336–2171
Fax: 310–336–2227
POC: Robert Pentz

National Law Enforcement and Corrections Technology Center, Northeast Region
26 Electronic Parkway
Rome, NY 13441–4514
Phone: 315–338–0584
Fax: 315–338–6124
POC: John Ritz

Border Research and Technology Center
1250 6th Street
Suite 130
San Diego, CA 92101
Phone: 619–685–1491
Fax: 619–685–1484
POC: Chris Aldridge

Contact information for these offices is subject to change. Other sources of information on law enforcement and corrections technology are also available. Please call NLECTC at 800–248–2742 or write to Box 1160, Rockville, MD 20849–1160.

Information in this Bulletin *is drawn from numerous sources including the* Marine Aviation Manual *and material supplied by manufacturers of night vision equipment. We thank Bob Doms for his valuable input and technical review. We also thank the U.S. Army Night Vision & Electronic Sensors Directorate and the Department of Defense Advanced Research Projects Agency for their review and comments.*

U.S. Department of Justice
Office of Justice Programs
National Institute of Justice

Washington, DC 20531

Official Business
Penalty for Private Use $300

BULK RATE
POSTAGE & FEES PAID
DOJ/NIJ
Permit No. G–91