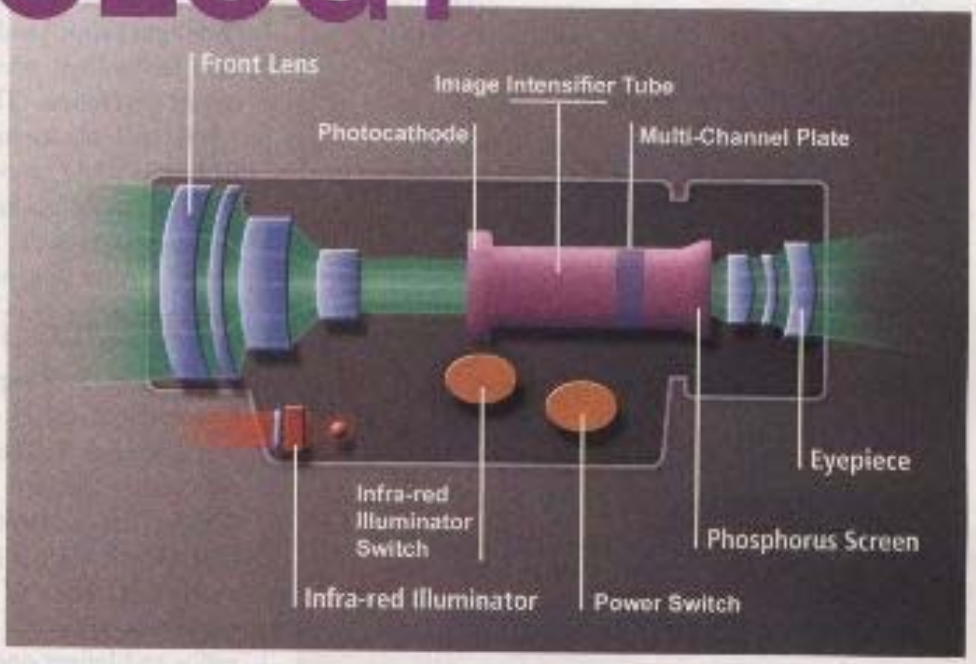
THE CRITICAL NEED FOR IMAGE INTENSIFIER TECHNOLOGY



One of the biggest concerns of police officers is to know whether the suspect with whom they are dealing is armed or unarmed. Even during daylight, it can be hard to detect a gun. In low-light conditions it becomes practically impossible. Knowing whether the suspect is armed helps officers make the right decision and take appropriate actions toward him. The latest developments in night vision technology provide unprecedented accuracy in making such decisions, while dramatically reducing the limitations of night vision devices (NVDs).

Advancements of image intensifier technology, at the core of all NVDs, have led to continuous improvements in night vision performance from World War II to the present day. Today, night vision equipment has become an indispensable tool for the military and an increasingly valuable resource for law enforcement community, especially when it comes to weapons detection.

How Does Night Vision Work?

NVDs gather light available in the visible and near-infrared (NIR) parts of the spectrum and focus it via the objective (front) lens on the photocathode of the device that is called image intensifier tube (IIT). Inside of the IIT, incident light leads to the emission of photo-electrons that are later accelerated and greatly multiplied while traveling through the IIT. At the end, those electrons hit phosphorous screen, producing visible green-tinted image that is observed by user through the ocular (eye piece).

The green image then generated in the night vision eyepiece is a re-creation of what the user is observing. The human eye can differentiate more shades of green than any other color, which is why a green phosphor is used for NV applications.

Above is a diagram that represents a basic structure of the typical NVD.

The first application for night vision was for American snipers in World War II. These devices were frequently called the "sniperscope" and "snooperscope." They were relatively simple, allowing users to see NIR light, such as moonlight and starlight. The early NVDs allowed snipers to engage their targets without the target being aware. However, infrared (IR) illuminators emit a visible bead of red light. As NVDs became employed by both sides during World War II, savvy "targets" started to look for the "active" IR red light, which betrayed the sniper's position.

The first breakthrough in the development of image intensifier tubes came during the 1960s in the form of the

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"Starlight Scope," which was to be used as rifle-mounted sight or as a handheld scope. In 1964, the U.S. Army issued its first night vision equipment to be used by the troops fighting in the Vietnam War. The tricky NIR illuminators could be quickly switched "on" or "off," making it safer when additional IR light was required.

Generations of NVDs

Technological advances over the past 40 years created substantial differences in the performance of NVDs. Generation 1: First developed in 1960s, these were commonly known as the "Starlight Scope" and were characterized by the use of vacuum tube technology, which resulted in improved gain and good center resolution. These devices have an amplification of 1,000x and require full moon conditions to operate effectively. IR beams could be switched on or off.

Generation 2: The development and use of micro-channel plates (MCPs) in the 1970s allowed for quarter moon operation and a smaller size of image intensifier tubes, marked Gen 2 NVDs. Generation 2 was further improved by the introduction of Generation 2+, improving gain at high and low levels. Generation 2 and 2+ devices have an amplification of 20,000x.

Generation 3: The introduction of a new type of photocathode (using gallium arsenide, or GaAs) marked the Gen 3 NVDs. The Generation 3 IIT amplifies light up to 30,000 times. Generation 3 technology allows for starlight operation, enables detection of objects at greater distances under much darker conditions, and provides improved signal-to-noise ratios and longer operational life of the image intensifier tube than its predecessors.

Beyond Gen 3: Pressing for even higher levels of performance, the U.S. government funded research for the next level of image intensifiers, with the goal of improving yet further the resolution and varying light-level operating range of NVDs. Significant advances in the IIT technology were made that resulted in introductions of "thin filmed" and "unfilmed" or "filmless" IITs. These types of IITs offer great light amplification characteristics, much improved signal to noise ratio and—especially in conjunction with autogated power supplies—significant reduction of halo.

Autogated power supplies, along with other benefits, allow NVDs to be used not only in the darkness but also when light levels are very high such as in the brightly lit rooms during building searches, etc. Often referred to as Pinnacle, "gated," or "thin-filmed," these advanced IITs represent the highest level of technology that is currently commercially available to the qualified users. However the terms "Generation 4" and

even "Generation 5" are often used for marketing purposes without official recognition from the U.S. government.

Weapon Detection Study

To understand how well NVDs of different generations and under different light conditions can identify a threat, N-Vision Optics conducted a photographic study between night vision generations in various light conditions. Noteworthy is that this study was both with and without IR illumination.

We used a Bluegun® training pistol tucked under the belt for all pictures throughout the study. We started with a daylight image. This photo showed that when there is no color contrast between weapon and clothes, i.e., black shirt and blue gun, even in daylight it can be hard to spot a weapon.

The reflecting capacity of the weapon depends on its finish, which impacts the resulting image. Some weapons have a more reflective finish than others, and those would reflect light better than the custom rubber handle added to our Bluegun polyurethane pistol. Weapons with a matted finish might be more difficult to see.

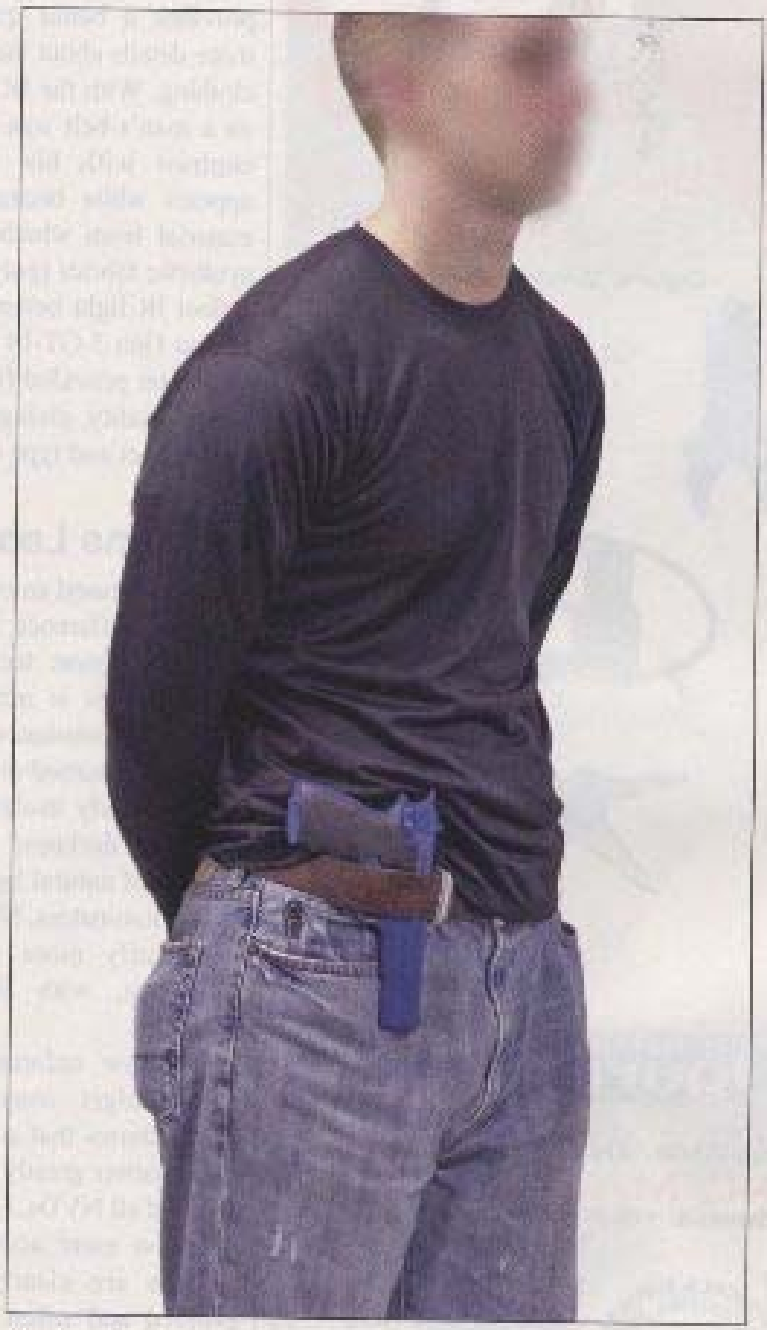
For example, the matte-finished barrel of the polyurethane Bluegun training pistol is impossible to notice in all the photos taken for this study. This study includes 14 different combinations of NVD generations and light conditions. For the complete set of all photos taken in the study, go to the Web site.

Under the darkest ambient light conditions, and with the Infrared Illuminator off, the N-Vision Gen 3 GT-14 monocular showed a silhouette but no face and no weapon. None of the earlier generation devices even showed a silhouette. Even when the light was increased from no moon to a quarter moon, the Gen 1 devices did not provide a silhouette. Under these quarter-moon light conditions, the Gen 2+ devices and the Gen 3 devices showed more detail in the subject, including folds in the clothing but still no face and no weapon.

Under slightly more light, half-moon conditions, we see a good illustration of the improvements of Gen 2+ over Gen 1. What was barely a shadow, not even a silhouette, is now a man with his hands behind his back, but the weapon is still not visible. With the Infrared Illuminator still turned off and using a SuperGen (SHD3) image intensifier tube at half-moon, facial and clothing details are more clearly visible. But when it comes to detecting a weapon, with the IR turned off, there was almost no difference between the Gen 2+ devices, the SuperGen 2+ devices and the Gen 3 devices.

Infrared Illuminator Turned On

The use of an infrared illuminator provides a dramatic



Regular daylight conditions show a blue gun under a brown belt against a black shirt and light blue jeans.

increase in ability for weapon detection. The majority of night vision devices today have built-in IR illuminators with an option of using the device with or without it. In our study, we used the same external IR illuminator in order to avoid inaccuracy that may have been caused by different capabilities of each unit's IR illuminator.

Even under dark (no moon) night conditions, the IR illuminator allows to clearly identify a gun on a suspect even with the use of Gen 1 equipment. The study shows that a Gen 2+ device

provides a better quality image, with more details about the suspect's face and clothing. With the IR turned on, the gun on a man's belt was clear thanks to the contrast with his shirt, which now appears white because of the type of material from which it is made. Some synthetic fabrics (polyester, nylon, satin) reflect IR light better. The use of an N-Vision Gen 3 GT-14 monocular with IR turned on provided further improved the image quality, giving more details about the suspect and type of weapon.

Lessons Learned

An increased amount of light makes a dramatic difference in the effectiveness of night vision technology. Increased ambient light is much more important when IR illuminator is turned off. But when IR is turned on, increased ambient light is nearly irrelevant. When used in complete darkness or with very low amount of natural light, without the aide of IR illuminators, NVDs will not be able to identify more than the suspect's silouhette, with limited recognition detail.

For law enforcement professionals with budget constraints, this study demonstrates that supplemental infrared illumination greatly enhances the capability of all NVDs, i.e., make threat identification more accurate. While Gen 3 devices are clearly the most highly evolved and safest choice, when used with the IR illuminator switched on, even lower generation devices can provide critical details about a suspect and help officers make vital decisions.

With the IR illuminator on, the suspect's weapon is clearly visible at the crucial distance of 21 feet. At a distance closer than 21 feet, a suspect with an edged weapon in hand could close the gap and stab an officer before he can draw his handgun and fire.

While Gen 3 devices with IR illuminator on provide the best image quality over earlier generations of night vision; even Gen 3 devices in extreme low-light situations require IR illumination to ensure the highest level of threat identification. The user will have the best view of a suspect's weapon with a Gen 3 Device with the IR illuminator on.

One concern with most IR illuminators is that they betray the officer's location to the suspects or accomplices. The IR illuminator dramatically increase accuracy of threat identification, but they also "announce" the location of the user. Because of the vulnerability from the visible light of most IR illuminators, the safest and most accurate option for law enforcement officials is a Gen 3 device that offers an IR illuminator that is invisible to the human eye.

An IR illuminator with a Gen 3 device provides the most accurate image for weapon detection. It should be noted however, that most IR illuminators (internal and external) may expose the user's position and appear as a small red dot somewhat similar to a cigarette light. The most desirable solution for today's law enforcement professionals is a Gen 3 device with an internal IR illuminator completely invisible to the human eye. The N-Vision Optics GT-14 is an ultra-small, multi-functional NVD that has a built-in IR illuminator invisible to the human eye.

"Increasingly, we are seeing criminal charges against police who have mistakenly fired upon individuals that they have misidentified as threats," said Thomas Aveni, an industry expert in officer-involved shootings and former police officer.

"The mere presence of a weapon in itself isn't generally enough to justify the police use of deadly force. It is therefore critical for today's law enforcement officers to be provided with the equipment

The Gen 2+ devices are much improved over the Gen 1 devices. What was barely a shadow, not even a silhouette, with Gen 1 is now clearly a male with his hands behind his back.

The use of an infrared illuminator makes all the difference. Under dark (no moon) lighting conditions with an IR, both the Gen 1 and Gen 2 (shown) devices picked up the pistol.

This is state of the art. Under full dark conditions, the Gen 3 device with IR turned on is clear enough to see details in a once-hidden pistol.

and training necessary to enhance their own safety as well as that of innocent civilians. Such an investment in equipment and training would ultimately mitigate some of the substantial expense associated with litigation and officer administrative leave."

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