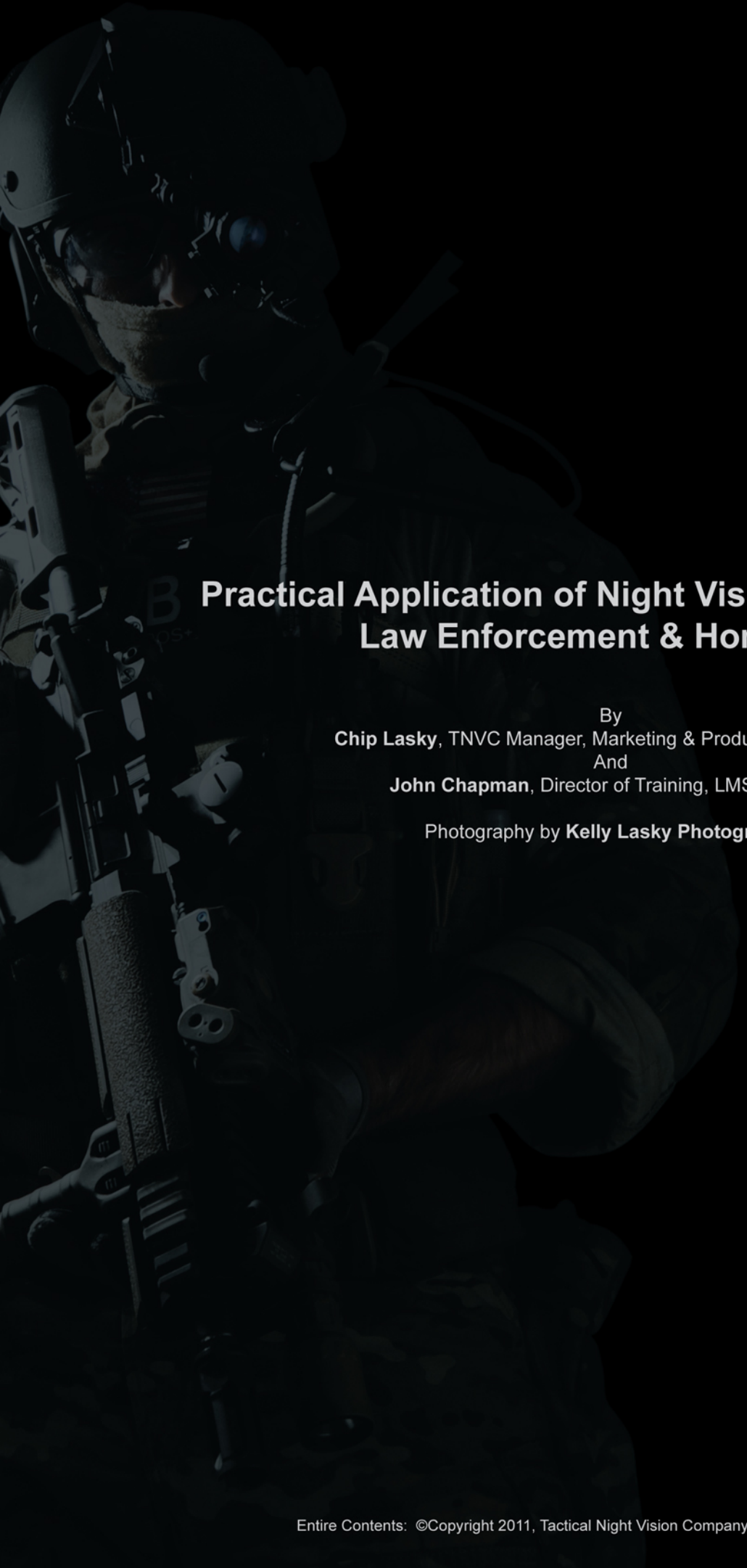

Practical Application of Night Vision for Domestic Law Enforcement & Homeland

By
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And
John Chapman, Director of Training, LMS Defense

Photography by **Kelly Lasky Photography**

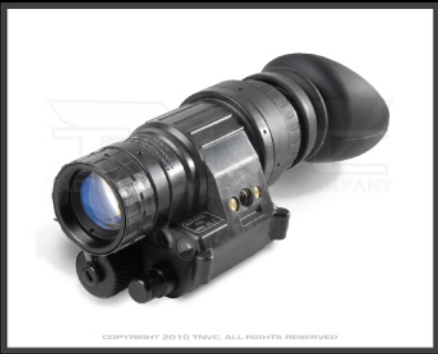
The purpose of this informational paper is to provide the reader with the strengths and weaknesses of the most commonly available night vision systems when applied to the US domestic law enforcement and homeland security mission. On August 17 and 18, 2010, Chip Lasky and John Chapman conducted a series of tests with the mandate to gather realistic data in order to 1) determine the effectiveness of commonly available nightvision when utilized in real world circumstances; and 2) utilize this data to determine a minimum level of capability appropriate for domestic law enforcement and homeland security missions. The reason for this undertaking is to provide the law enforcement professional a basis for understanding the capabilities and limitations of various image intensifiers on the market. This informational paper is intended to dispel the confusion surrounding the appropriateness of various devices and their associated image intensifier tubes. This article is not meant to address the technical merits or deficiencies in these devices so much as to provide a realistic portrayal of their capabilities in side-by-side comparison.

To accomplish these goals, we developed a realistic set of scenarios based on real world circumstances likely to be encountered by the user community. We then utilized the five most common night vision devices covering the three most common image intensifier generations available to the domestic user community to observe these scenarios from the responder's perspective. Each device was tested in each scenario to gather data in three modes: 1) Passive observation using only the available environment's ambient light; 2) passive observation using each unit's internal infrared (IR) Illuminator; and 3) Passive observation using a secondary IR Illuminator (Surefire M1 IR Illuminator). A professional photographer then captured photos through each device in each mode, using the same shutter speed and other camera settings. These camera settings were determined by setting up the camera in the mode and shutter speed most favorable to the device with the tube that gathered the least amount of light (the ATN Viper Gen1+).

The need to rapidly and accurately identify threats such as a weapon in a suspect's hand is overwhelmingly obvious for those going into harm's way. This was a requisite in developing the scenarios for this article. The idea is to best describe, through photo documentation, the ability to detect and identify threats in accordance with domestic laws of Use of Force. We chose several different locales in which law enforcement personnel are likely to encounter a suspect while using night vision.

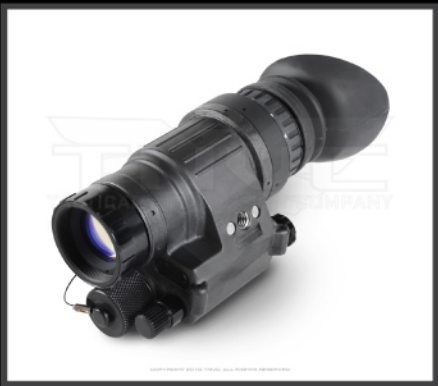
Photo documentation was collected with a Nikon D700 Digital SLR Camera. Images are shown as-is with no alteration or retouching. Raw data files are available for peer review.

The five devices tested were:



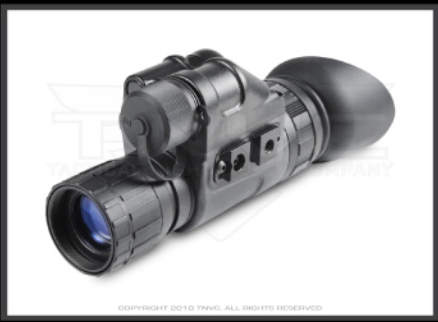
ITT PVS-14 Night Enforcer Gen3 PINNACLE Auto-Gated Image Intensifier (ITTE-NEPVS-14-17)

- Gen3 U.S. ITT PINNACLE
- Resolution: 64-72 lp/mm Typical
- Thin-Film
- Auto-Gated
- Adjustable/ Variable Gain
- 1x +0.03 Magnification
- 40º + 2º Field of View (FOV)
- F/1.2 Objective Lens
- EFL 26mm Ocular Lens
- Diopter +4 to -6
- 10″ to Infinity Focus



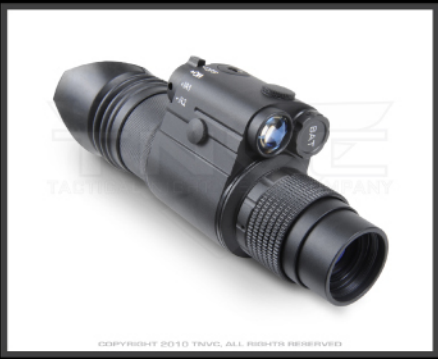
Litton (L3) PVS-14 Gen3 Auto-Gated Image Intensifier

- Gen3 U.S. Litton Auto-Gated
- Resolution: 58 lp/mm Typical
- Thin-Film
- Auto-Gated
- Adjustable/ Variable Gain
- 1x Magnification
- 40º Field of View (FOV)
- F/1.2 Objective Lens
- EFL 26mm Ocular Lens
- Diopter +2 to -6
- 10″ to Infinity Focus



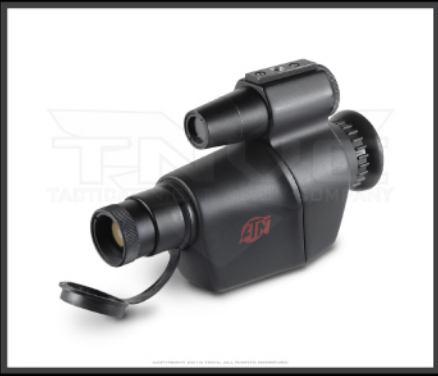
GT-14 Gen2 Super High Performance (SHP) Image Intensifier

- Gen2 Super High Performance (SHP)
- Resolution: 51-64 lp/mm Typical
- Non-Filmed
- Non-Gated
- Automatic Brightness Control
- 1x Magnification
- 40º Field of View (FOV)
- F/1.2 Objective Lens
- EFL 23mm Ocular Lens
- Diopter +5 to -4
- 10″ to Infinity Focus



D-300 Gen2+ MILSPEC Image Intensifier

- Gen2+
- Resolution: 28-38 lp/mm Typical
- Non-Filmed
- Non-Gated
- Automatic Brightness Control
- 1x Magnification
- 40º Field of View (FOV)
- F/1.2 Objective Lens
- EFL 25mm Ocular Lens
- Diopter +2 to -4
- 10″ to Infinity Focus



ATN Viper Gen1+ Image Intensifier (NVG0VIPR10)

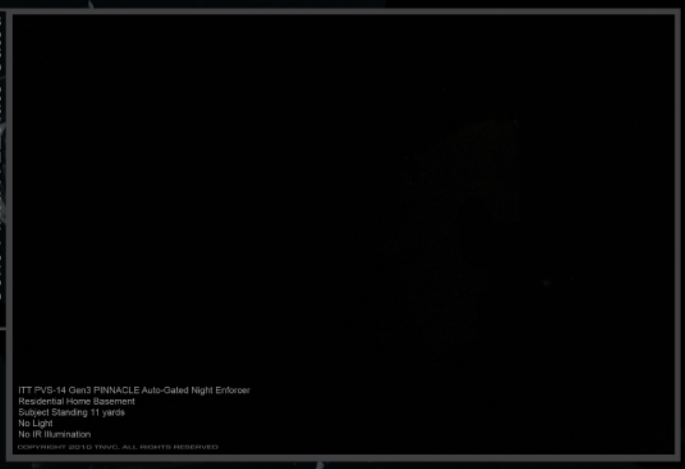
- Gen1+
- Resolution: 40 lp/mm Typical
- Non-Film
- Non-Gated
- Automatic Brightness Control
- 1x Magnification
- 20º Field of View (FOV)
- F/1.4 Objective Lens
- EFL 35mm Ocular Lens
- Diopter +5 to -5
- 1 m to Infinity Focus

These devices were selected because they can display the various generations and levels within generations of image intensifier technology. The units are all monocular-type and can be hand-held or head-mounted for a hands free capability. Emphasis was placed on individually-operated devices used in a “search and observe” capacity.

Test Scenario 1 – Residential Home Basement (Subject at 11 yards)

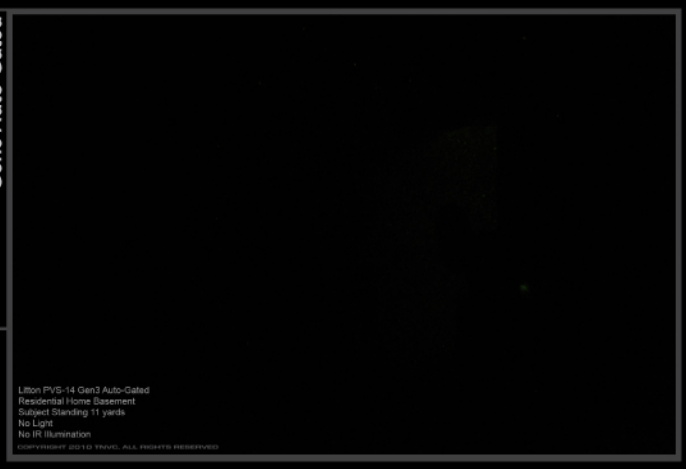
This scenario was designed to simulate the stealth search of a normal residential home, but can be expounded to include commercial and industrial basements and internal rooms. The point of this exercise is to convey the limitations of image intensifier technology. Even the most advanced Gen3 PINNACLE tube requires ambient light. The amount of ambient light is directly proportional to the performance of the device. Basements and other complete no-light environments are often encountered

Gen3 PINNACLE Auto-Gated

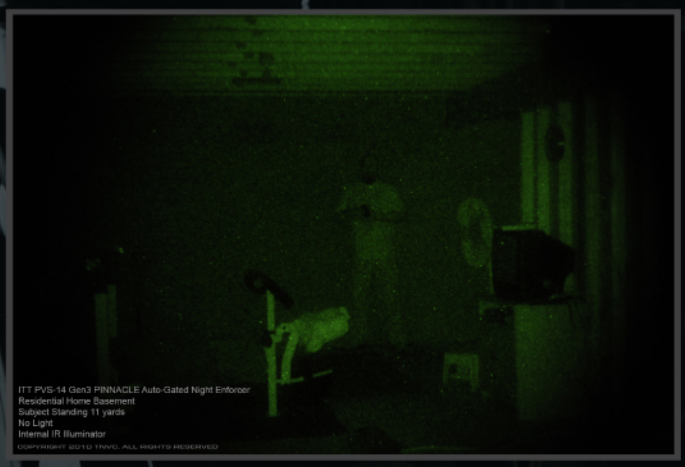


Without any ambient light or artificial IR light, the PVS-14 Gen3 PINNACLE Auto-Gated image intensifier does not produce any sort of useable image.

Gen3 Auto-Gated

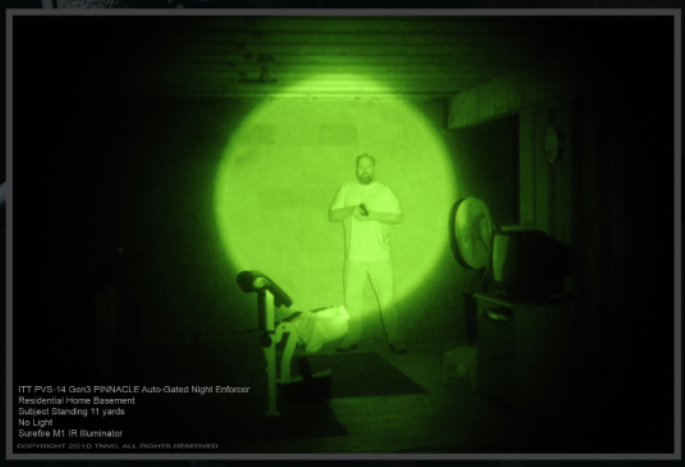


Without any ambient light or artificial IR light, the PVS-14 Gen3 Litton Auto-Gated image intensifier does not produce any sort of useable image.

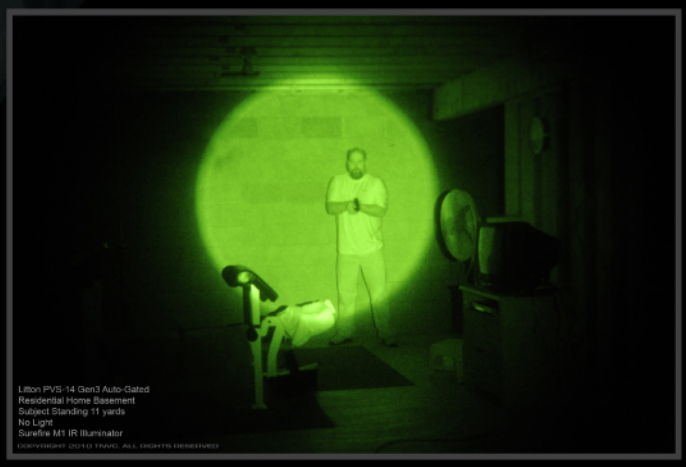


The Gen3 PINNACLE Auto-Gated Image Intensifier is able to gather enough light to provide the user an image when the internal IR illuminator is activated. Because there is no practical ambient light, the image is very dark and loss in resolution hampers the ability to discern detail, even at short distance, but the unit is useable in this condition. Light-colored objects such as the metallic weight bench, step stool, wood joists/wall studs, and the subject's shirt help to produce some contrast in the image. The subject's hands can be seen raised around the chest, as if something is being held, but it is difficult to identify a weapon

The Litton Gen3 Auto-Gated unit displays a similar image to the upgraded PINNACLE tube when the internal IR illuminator is activated. The subject is visible, but details are unresolved. It cannot be determined if a weapon is present and positive identification of the subject's facial features cannot be made. Smaller details of the surroundings can be made out for better situational awareness.



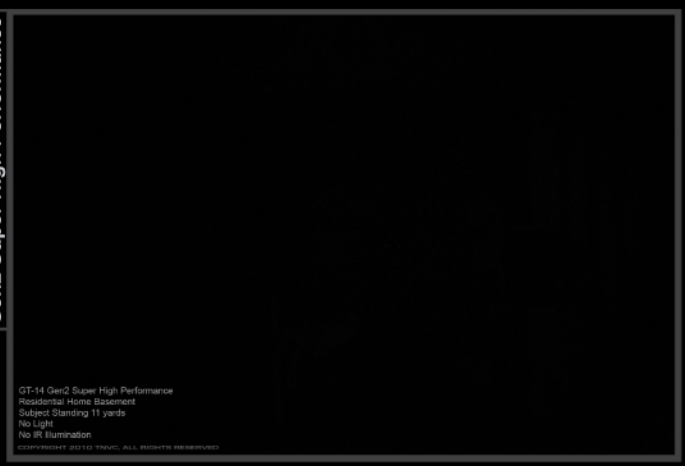
The use of the Surefire M1 Illuminator heavily boosts the performance of the Gen3 PINNACLE Auto-Gated tube. Detail can be easily observed. A handgun is clearly visible in the subject's hands and facial features are seen enough to actually recognize the person. It is clear the subject is standing in front of a cinder block wall and has an escape route from the room to his left. Furniture and appliances can be made out, including a weight bench, television, area fan.



Adding in the Surefire M1 creates a big difference. The subject can clearly be seen, recognized, and a weapon identified. Feature of the room are now clear such as the cinder block wall and opening into a separate room to the subject's left.

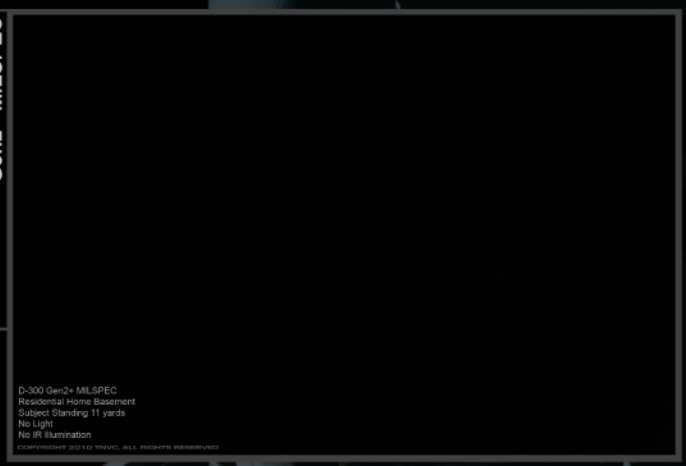
by professionals going into harm's way. These situations require a more advanced and sensitive image intensifier to aptly resolve details in the image. Even the most powerful device will struggle to gather enough light in a completely dark environment. As with most residential basements, no light source was present when the power to the light fixtures was off. This series of images was displays only the image intensifier by itself and with the aid of a Surefire M1 IR illuminator.

Gen2 Super High Performance

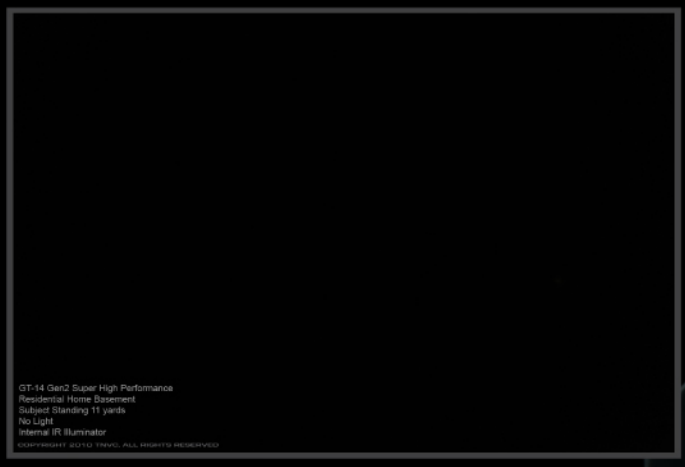


The Gen2 SHP image intensifier is ineffective in total darkness without the use of an IR light source. No details of the subject or surroundings are visible.

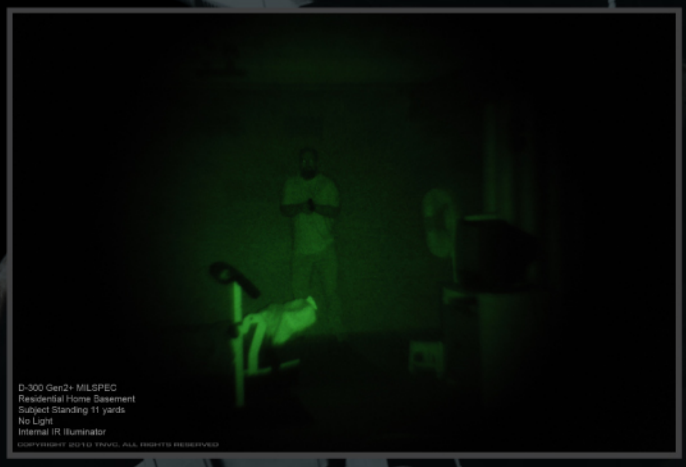
Gen2+ MILSPEC



With no ambient light available, the D-300 Gen2 MILSPEC tube produces no image.

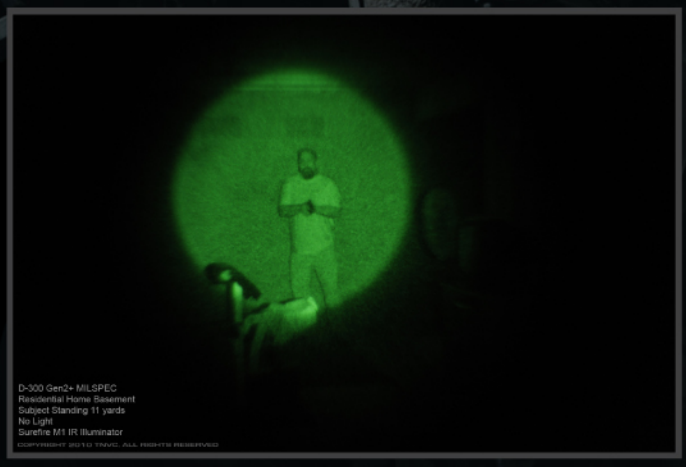


Activating the internal IR Illuminator does not add anything to the image.

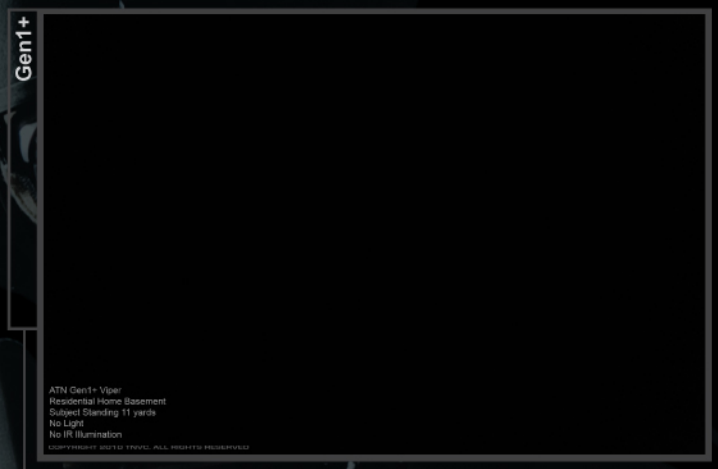


Turning on the internal IR illuminator produces an image, but it is very faint. The subject can be seen, but details are very vague. Little contrast is produced. The subject appears to be holding something in his hands, but positive ID cannot be made.

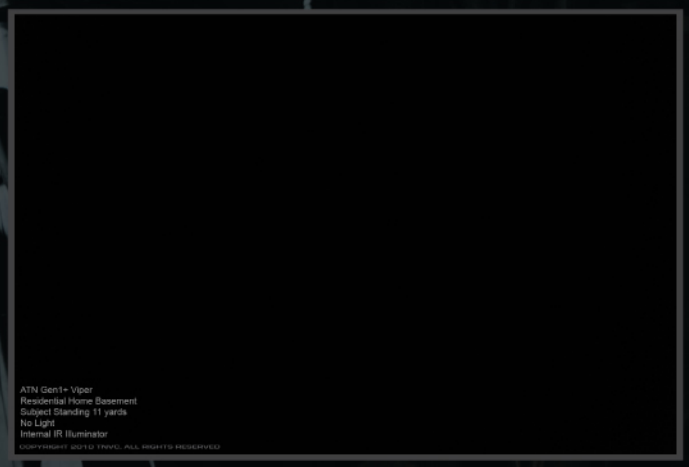
The Addition of the Surefire M1 greatly helps the image quality and resolution. The subject can be clearly seen along with the weapon in his hand. In comparison to the Gen3 devices, this image lacks some fine detail. Edges and contrast are not as crisp. Facial features are visible, but not as clear. Contrast created by the way his shirt hangs is not as crisp, making it somewhat more difficult to identify if he is concealing anything beneath clothing.



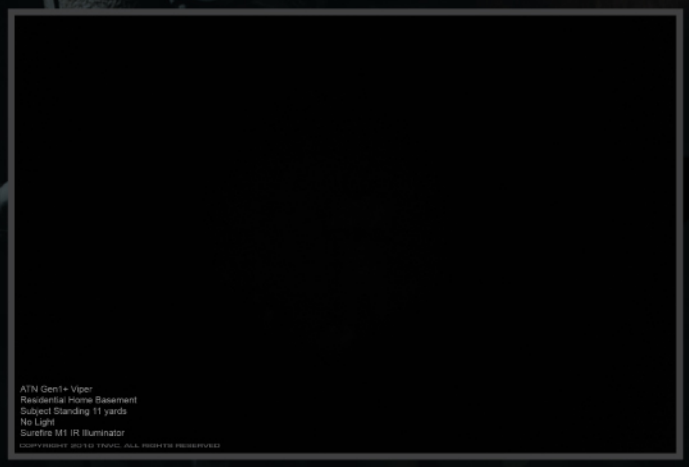
The external IR illuminator drastically upgrades the image. However, it is nowhere close to Gen2 SHP, let alone the Gen3 devices, under the same conditions. Details are very fuzzy and the subject cannot be properly identified. It is a little easier to see the weapon in his hands, but the lack of resolution hampers positive ID. Note the sharp drop-off of any image outside the IR spot light. The lower sensitivity of the Gen2 MILSPEC tube can only resolve details within the IR light. Situational awareness is severely hampered.



The Gen1+ image intensifier produces no image on its own, under pitch black conditions.



Even with the built-in IR illuminator activated, the Gen1+ tube still cannot produce an image under pitch black conditions.



Surprisingly, the Gen1+ tube will not provide any image even when the Surefire M1 is activated under these conditions. Although the external illuminator is powerful, the relatively weak light-gathering capabilities of the Gen1+ tube cannot bring in enough light to provide any form of useable image.

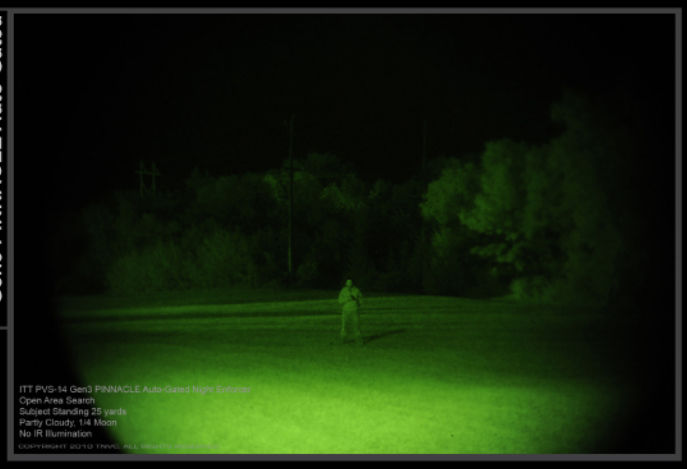
Thoughts

As evidenced by the photos, pitch black environments really show the limitations of image intensifiers. Because image intensifier technology relies on the presence of ambient light, even the most advanced unit will not produce an image without the aid of an IR illuminator. Clearly, the latest Gen3 devices' more sensitive tubes have a distinct advantage over the older technology in terms of image resolution and clarity. An IR light source is required for operating in these conditions and allows the Gen3 devices to produce clear images capable of identifying a subject's face, the presence of a weapon, and environmental details for better situational awareness. The Gen1+ tube proved absolutely worthless in this evolution.

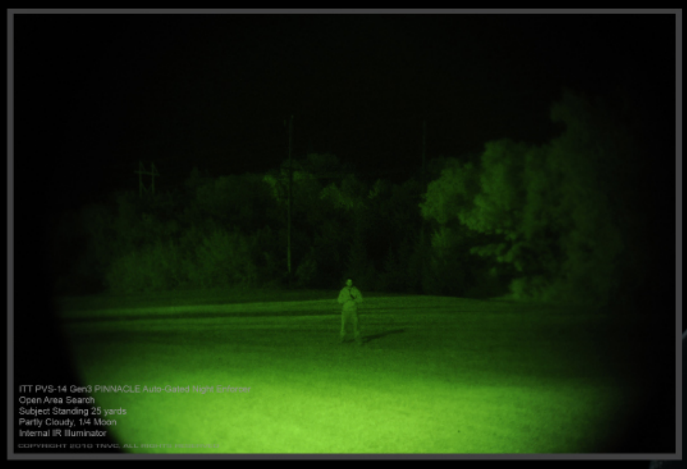
Test Scenario 2 - Open Area Search / Close Range (25 Yards)

This scenario was designed to simulate the search of an open area for a subject. The environmental lighting was common to a city park close to the street at night. Conditions were somewhat clear with minimal cloud cover and less than a quarter moon visible. The purpose of this evolution was to best illustrate acquisition ranges of an armed subject in a rural environment through various levels of night vision gear. In contrast to the previous location, this field will display performance when natural ambient light is introduced.

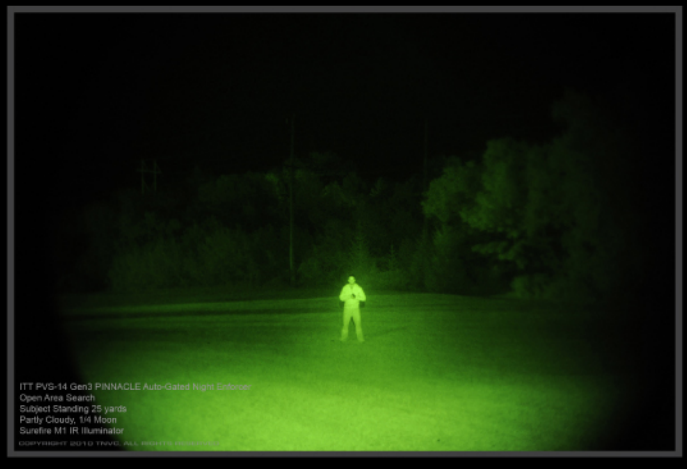
Gen3 PINNACLE Auto-Gated



The Gen3 PINNACLE Auto-Gated tube in the PVS-14 Night Enforcer clearly shows the suspect at 25 yards. His arms can be identified as holding an object (appearing like a pistol) in front of his chest, though positive identification of a weapon cannot be made. The subject can be identified as wearing long pants and a jacket. The light gathering ability of the device produces good contrast, even without the aid of IR illumination.

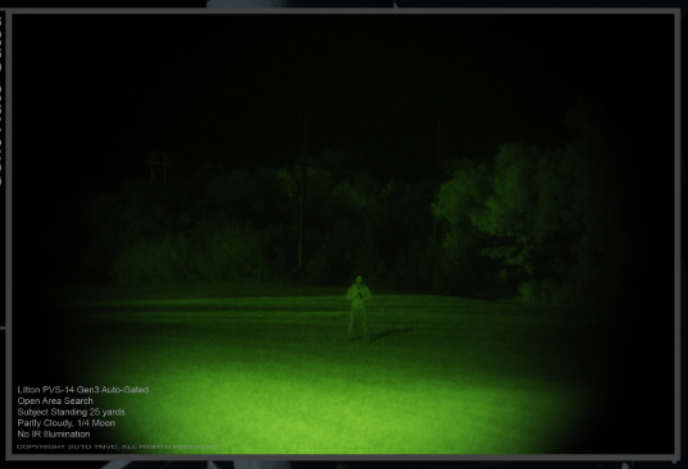


Built-in IR illuminators are generally low power and meant for searching when there is little to no ambient light available. Because of this, the internal IR illuminator of the PVS-14 Night Enforcer has no practical effect on this scenario where decent ambient light is present.



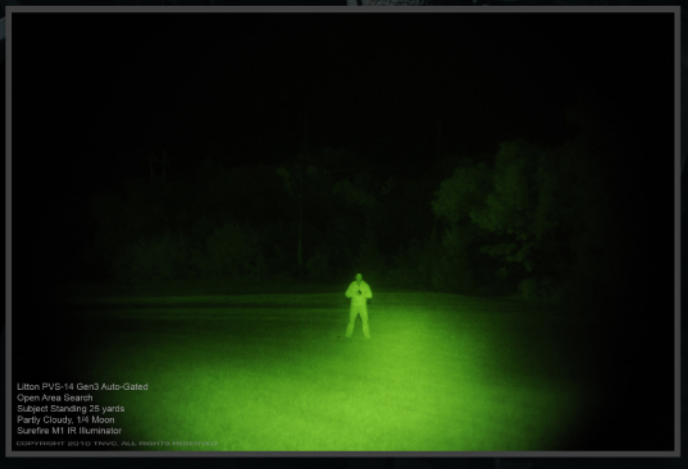
The external Surefire M1 provides enough power to be useful in open space search and observe scenarios. It provides a significant amount of IR reflection on the subject, causing him to greatly contrast with the environment due to the IR reflection. While there is little more detail seen here compared to the image without IR illumination, the subject is much more visible against the far tree line where there is less light. The entire image area appears brighter.

Gen3 Auto-Gated



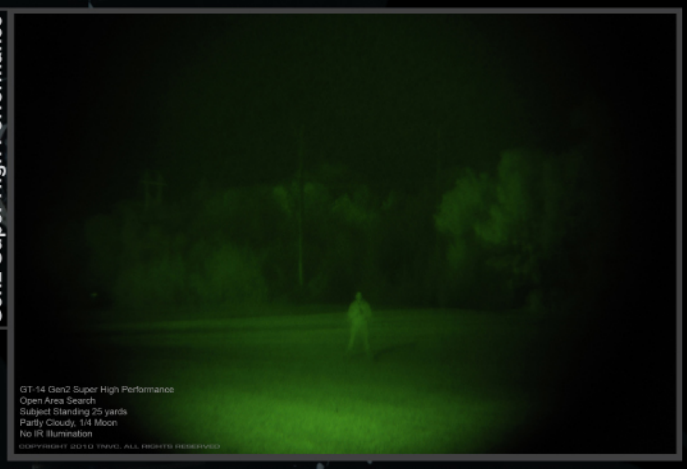
Without any ambient light or artificial IR light, the PVS-14 Gen3 Litton Auto-Gated image intensifier produces a clean, crisp image of the suspect at 25 yards. Clothing is identifiable as well as the possible presence of a weapon. Decent resolution and contrast is seen all the way back to the tree line.

Activating the internal IR illuminator of the Litton Gen3 Auto-Gated unit produces a faint lightening effect of the image. Slightly more contrast can be observed in the subject's clothing and grass around his feet. But, like the PINNACLE unit, the Gen3 Auto-Gated tube is sensitive enough on its own, that the addition of the IR illuminator amid decent ambient light does little to enhance the image.

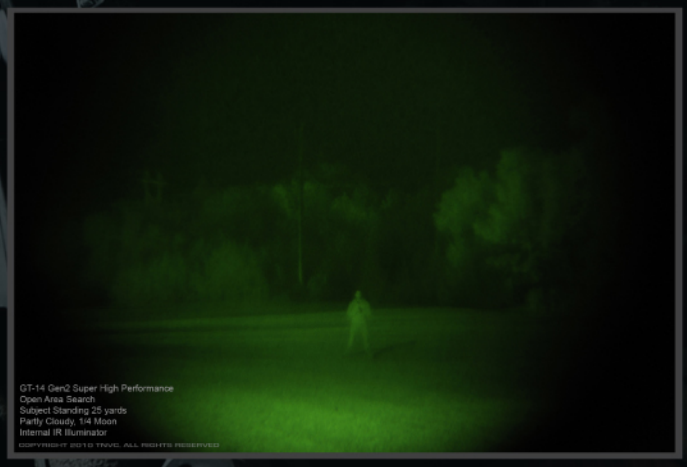


A clear difference is observed when the Surefire Mi Illuminator is used in-conjunction with the Gen3 Auto-Gated device. The subject is heavily lit-up with ample contrast against the darker, far away tree line.

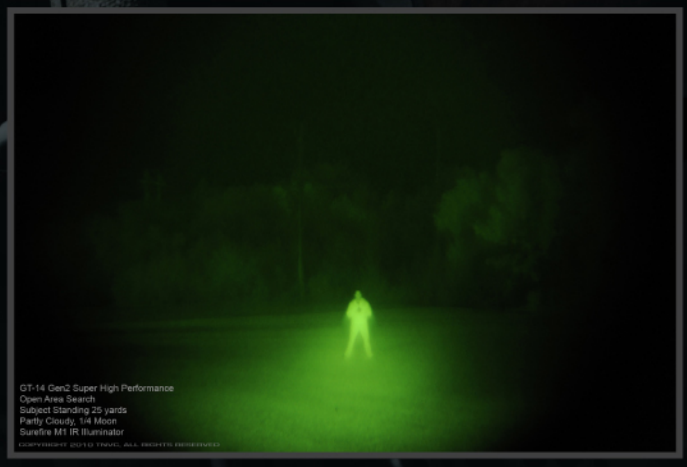
Gen2 Super High Performance



The Gen2 SHP image intensifier produces a decent image that gives the user a view of the subject, but there is no way to identify the presence of a weapon. The far tree line is visible, but like the subject, details are not as crisp as the Gen3 tubes.

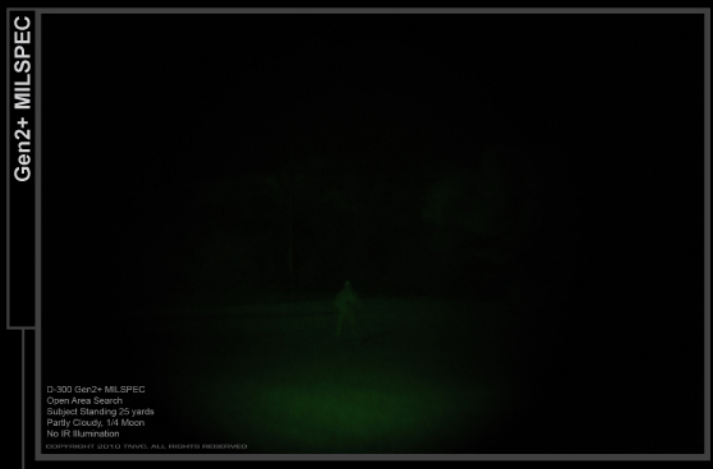


Activating the internal IR Illuminator does not do much for the image in this environment.

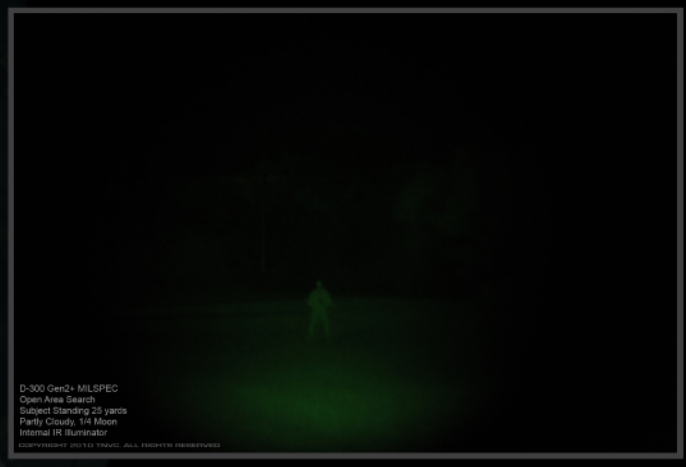


The Addition of the Surefire M1 highlights the subject against the background, but does not help with identifying the weapon. In this case, the illuminator is more useful in picking up the subject.

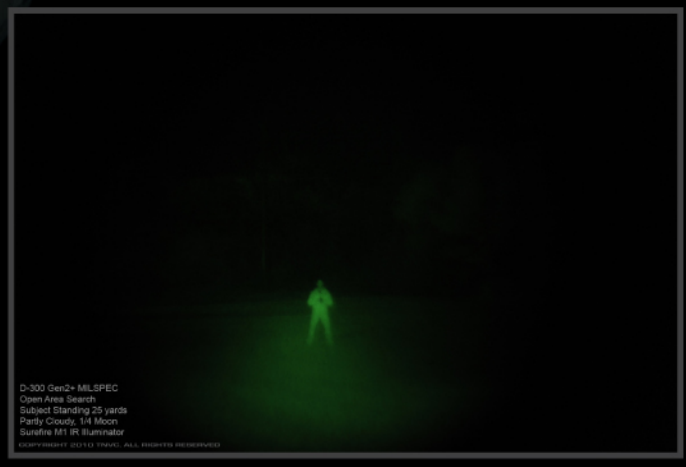
Gen2+ MILSPEC



With no ambient light available, the Gen2 SHP tube still produces a useable image at 25 yards. The resolution is noticeably less than the Gen3 units, but the subject can be easily acquired in the image. Though, when comparing the image to Gen3 units, the Gen2 SHP is obviously darker because of the lesser amount of light able to be gathered. Edge-to-edge clarity is also observed in that the outer zone of the image is noticeably fuzzier and less defined than the Gen3 units. The contrast is also significantly reduced with less definition in the subject and the far tree line. The subject can be seen standing. It is difficult to tell hand placement. The dark swatch in front of the subject's chest could be a camera or other dark object; or it could be a weapon. The lack of definition/contrast would hamper an officer's ability to identify a possible threat from this distance.

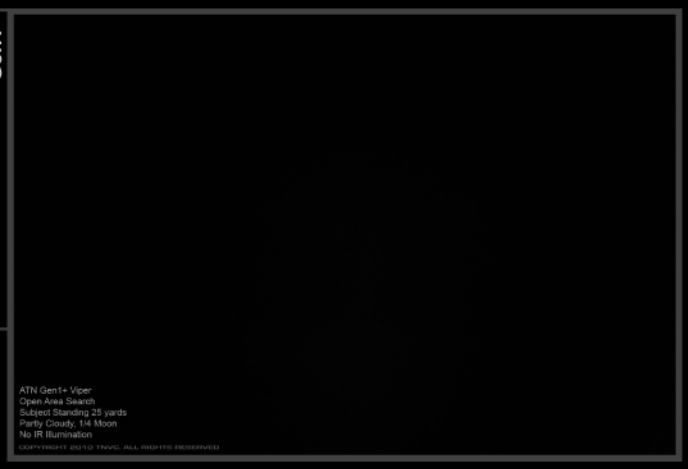


Turning on the internal IR illuminator adds no noticeable benefit to the image.

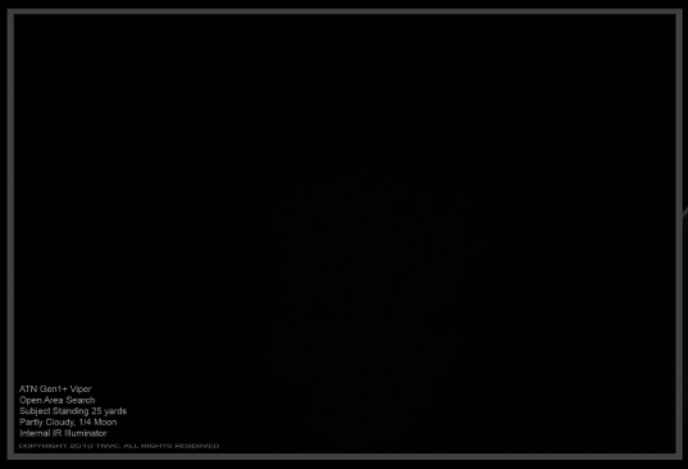


The external IR illuminator helps to "ping" the subject, drastically contrasting him against the background environment. At the same time, it can be seen that the surrounding environment is perceived darker because the image intensifier is working to resolve the illuminated portion of the image. The subject washes out.

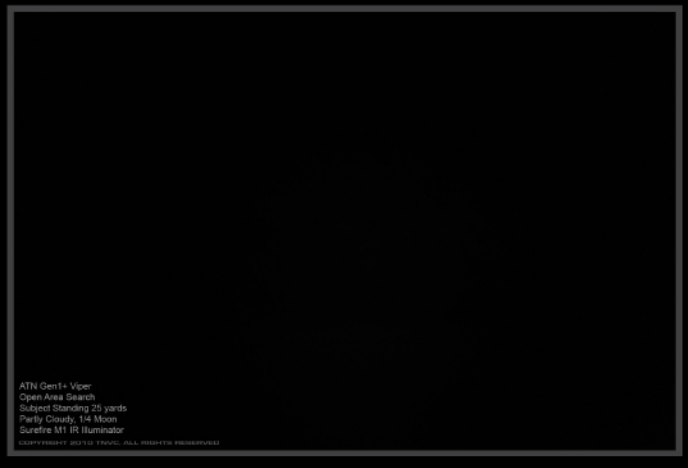
Gen1+



The Gen1 tube fails completely to deliver any image whatsoever. Even under good ambient light conditions, the subject at 25 yards is completely shrouded in darkness. This would leave a law enforcement professional blind of all intents and purposes, even at close distance.



The built-in IR illuminator did not add any value to the image. It is still completely dark with no details discernable.



Not even the additional illumination from the Surefire M1 can provide enough light for the Gen1 tube.