

# How Night Vision Works

## HOW STARLIGHT TECHNOLOGY WORKS

All Starlight technology Night Vision Devices consist of several main parts: an objective lens, an eyepiece, a power supply and an image intensifier tube (Photocathode Tube).

Night vision devices gather existing ambient light (starlight, moonlight or infra-red light) through the front lens. This light, which is made up of photons goes into a photocathode tube that changes the photons to electrons.

The electrons are then amplified to a much greater number through an electrical and chemical process. The electrons are then hurled against a phosphorus screen that changes the amplified electrons back into visible light that you see through the eyepiece. The image will now be a clear green- hued amplified re-creation of the scene you were observing.

- |                        |                               |
|------------------------|-------------------------------|
| 1 - FRONT LENS         | 4 - HIGH VOLTAGE POWER SUPPLY |
| 2 - PHOTOCATHODE       | 5 - PHOSPHORUS SCREEN         |
| 3 - MICROCHANNEL PLATE | 6 - EYEPIECE                  |

## NIGHT VISION DEVICES GENERATIONS

A Night Vision Device can be either a 1st, 2nd, 3rd or 4th generation unit. What this stands for is what type of image intensifier tube is used for that particular device; the image intensifier tube is the heart and soul of an NVD.

**1st generation** is currently the most popular type of night vision in the world. Utilizing the basic principles described earlier, a 1st generation unit will amplify the existing light several thousand times letting you clearly see in the dark. These units provide a bright and sharp image at a low cost, which is perfect, whether you are boating, observing wildlife, or providing security for your home. You may notice the following when you are looking through a 1st Gen. unit.

- A slight high-pitched whine when the unit is on.
- The image you see may be slightly blurry around the edges. This is known as Geometric Distortion.
- When you turn a 1st Gen. unit off it may glow green for some time.
- These are inherent characteristics of a 1st Gen. unit and are normal.

**2nd generation** is primarily used by law enforcement or for professional applications. This is because the cost of a 2nd Gen. unit is approximately \$500.00 to \$1000.00 more than a 1st Gen. The main difference between a 1st and a 2nd generation unit is the addition of a micro-channel plate, commonly referred to as a MCP. The MCP works as an electron amplifier and is placed directly behind the photocathode. The MCP consists of millions of short parallel glass tubes. When the electrons pass through these short tubes, thousands more electrons are released. This extra process allows 2nd generation units to amplify the light many more times than 1st generation giving you a brighter and sharper image.

**2nd Gen. IIT** ATNs standard 2nd generation tubes are high quality with exceptional brightness and resolution. Each tube has a micro channel plate, multi-alkaline photocathode with built-in power supply.

2nd Gen. IIT Features:

- Photo Cathode type: Multi-Alkali
- Resolution from 40 to 45 lp/mm
- Signal-to-Noise Ratio from 12 to 20
- 5,000+ hour tube life

**CGT IIT.** The CGT type of Image Intensifier tubes are engineered for significantly enhanced performance over current 2nd generation IITs. The CGT IIT is a Multi-Alkali compact 18mm format MCP Image Intensifier. Highlights of the CGT specifications are typical SNR of 16-22 and resolution of 45-54 lp/mm. CGT IITs are sensitive in a wide spectral band and thus provide good contrast in all scene circumstances.

CGT IIT Features:

- Photo Cathode type: Multi-Alkali
- Resolution from 45 to 54 lp/mm
- Signal-to-Noise Ratio from 16 to 22
- 10,000-hour tube life

**HPT IIT** HPT tubes are an upgrade of the CGT Generation tube. They are a Multi-Alkali compact 18mm format MCP Image Intensifier. The HPT tube increases sensitivity, resolution, Signal-to-Noise Ratio (SNR), and the Modulation Transfer Function (MTF). These improvements produce an exceptional image clarity and

brightness. Most HPT specifications typically are equivalent to standard 3rd generation. Highlights of the HPT specifications are the typical SNR of 22 and resolution of 64 lp/mm.

**HPT IIT Features:**

- Photo Cathode type: Multi-Alkali
- Resolution from 55 to 72 lp/mm
- Signal-to-Noise Ratio from 16 to 24
- 10,000-hour tube life

**3rd generation** By adding a sensitive chemical, gallium arsenide to the photocathode a brighter and sharper image has been achieved over 2nd generation units. An ion barrier film was also added to increase tube life. 3rd Gen. provides the user with good to excellent low light performance.

**3rd Gen. Standard IIT** Our standard 3rd generation image intensifier tubes are of the highest quality. They have a micro channel plate, GaAs photocathode, and a completely self-contained integral high-voltage power supply. These 3rd Generation tubes provide a combined increase in resolution, signal to noise and photosensitivity over tubes with a multi-alkali photocathode. Generation 3 is the standard for the USA military.

**3rd Gen. Standard IIT Features:**

- Photo Cathode type: Gallium Arsenide
- Resolution 64 lp/mm
- Signal-to-Noise Ratio 22 Typical
- 10,000-hour tube life

**3A Gen. Premium select IIT** Our 3A Gen. Premium select IITs are the highest quality of our generation 3 IITs. These IITs are hand picked to provide the highest quality and specifications available in our 3rd Gen. line. They have a micro channel plate, GaAs photocathode, and a completely self-contained integral high-voltage power supply.

**3A Gen. Premium select IIT Features:**

- Photo Cathode type: Thin Film GaAs
- Resolution from 64 to 72 lp/mm
- Signal-to-Noise Ratio 26 Typical
- 10,000-hour tube life

**3P Gen. ITT Pinnacle™** ATN Night Vision units with the 3P designation use ITT Pinnacle™ Image Intensifier tubes. The industry leading ITT Pinnacle™ image tubes utilize a gated power supply providing truly outstanding performance in high-light or light-polluted areas, such as urban environments. The Pinnacle™ tube with gated power supply minimizes any "halo" effects. "Halo" is often associated with using night vision devices in an urban area where random street lights are often an issue with early Generation Night Vision devices. Night Vision units with Pinnacle™ tubes have a resolution of 64-72lp/mm and a typical signal to noise ratio of 26. All Night Vision devices utilizing Pinnacle™ Image Intensifier tubes come with ITT data record sheet. Units with Pinnacle™ tubes are not available for export. A signed export compliance and end use statement is required prior to shipping of these units.

\*Pinnacle is a registered trademark of ITT Night Vision

**3P Gen. ITT Pinnacle™ IIT Features:**

- Photo Cathode type: Gallium Arsenide
- Resolution from 64 to 72 lp/mm
- Signal-to-Noise Ratio: 25-30
- 10,000-hour tube life

**4th generation** Gated/Filmless technology represents the biggest technological breakthrough in image intensification of the past 10 years. By removing the ion barrier film and "Gating" the system Gen 4 demonstrates substantial increases in target detection range and resolution, particularly at extremely low light levels.

The use of film less technology and auto-gated power supply in 4th generation image intensifiers result in:

- Up to 100% improvement in photo response.
- Superb performance in extremely low light level (better S/N and EB1).
- At least triple high light level resolution (a minimum of 36 lp/mm compared to 12 lp/mm).

**4th GEN. GATED/FILMLESS IIT** ATNs Autogated / Filmless inverting image intensifier tubes improve night operational effectiveness for users of night vision goggles and other night vision devices. The filmless micro channel plate provides a higher signal-to-noise ratio than standard 3rd Gen. IITs, resulting in better image quality under low-light conditions. An Autogated power supply further improves image resolution under high light conditions and a reduced halo effect that minimizes interference from bright light sources. The reduced Halo maximizes the effectiveness of the Night Vision device in dynamic lighting conditions such as those experienced, for example, in night operations in urban areas.

**4th Gen. IIT Features:**

- Photo Cathode type: Filmless GaAs
- Resolution from 64 to 72 lp/mm
- Signal-to-Noise Ratio from 25 to 30
- Autogated power Supply
- 10,000-hour tube life

With significant improvement in contrast level and in performance under all light conditions, 4th generation represents the top of the line performance in the night vision market.



**GENERATION 1**



**GENERATION 2**



**GENERATION 3**



**GENERATION 4**

**2nd Gen + (2I) IIT** ATNs standard 2nd generation tubes are high quality with exceptional brightness and resolution. Each tube has a micro channel plate, multi-alkaline photocathode with built-in power supply.

**2I IIT Features:**

- Photo Cathode type: Multi-Alkali
- Resolution from 40 to 45 lp/mm
- Signal-to-Noise Ratio from 14 to 18
- 5,000+ hour tube life

**2nd Gen + (2IA) IIT** ATNs 2nd generation + (2IA) tubes are high quality with exceptional brightness and resolution. Each tube has a micro channel plate, multi-alkaline photocathode with built-in power supply. The 2IA tubes are hand picked for additional performance with less cosmetics over the standard 2I IITs.

**2IA IIT Features:**

- Photo Cathode type: Multi-Alkali
- Resolution from 40 to 50 lp/mm
- Signal-to-Noise Ratio from 14 to 20
- 5,000+ hour tube life

**CGTI IIT** The CGTI type of Image Intensifier are engineered for significantly enhanced performance over current 2nd generation IITs. The CGTI IIT is a Multi-Alkali compact 18mm format MCP Image Intensifier. Highlights of the CGTI specifications are the typical SNR of 15-22 and a resolution of 45-54 lp/mm. CGTI IITs are sensitive in a wide spectral band and thus provide good contrast in all scene circumstances

**CGTI IIT Features:**

- Photo Cathode type: Multi-Alkali
- Resolution from 45 to 54 lp/mm
- Signal-to-Noise Ratio from 15 to 22
- 10,000-hour tube life

**HPTI FOM 1250 IIT** HPTI tubes are an upgrade of the CGT Generation tube. They are a Multi-Alkali compact 18mm format MCP Image Intensifier. The HPTI tube increases sensitivity, resolution, Signal-to-Noise Ratio (SNR), and the Modulation Transfer Function (MTF). These improvements produce an exceptional image clarity and brightness. Most HPTI specifications typically are equivalent or exceed standard 3rd generation. Highlights of the HPTI specifications are the typical SNR of 18-24 and resolution of 51-64 lp/mm. These tubes are designed to give optimal performance while being in compliance with the FOM 1250 requirement. State Department export license required.

**HPTI IIT Features:**

- Photo Cathode type: Multi-Alkali
- Resolution from 51 to 64 lp/mm
- Signal-to-Noise Ratio from 18 to 24
- 10,000-hour tube life

**3rd Gen FOM 1250 (3I) IIT** Our 3I FOM 1250 Tubes (3I) are designed to support international sales of 3rd generation equipment to friendly countries. They have a micro channel plate, GaAs photocathode, and a completely self-contained integral highvoltage power supply. These 3rd Generation tubes provide a combined increase in resolution, signal to noise and photosensitivity over tubes with a multi-alkali photocathode. Generation 3 is the standard for the USA military. These tubes are designed to give optimal performance while being in compliance with the FOM 1250 requirement. State Department export license required.

**3I IIT Features:**

- Photo Cathode type: Gallium Arsenide
- FOM: <1250
- Resolution 51-64 lp/mm
- Signal-to-Noise Ratio 18 to 24
- 10,000-hour tube life

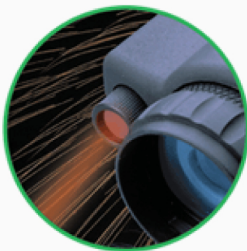
**3rd Gen FOM 1600 (3N) IIT** Our 3N FOM 1600 Tubes (3N) are designed to support international sales of 3rd generation equipment to NATO countries. They have a micro channel plate, GaAs photocathode, and a completely self-contained integral highvoltage power supply. These 3rd Generation tubes provide a combined increase in resolution, signal to noise and photosensitivity over tubes with a multi-alkali photocathode. Generation 3 is the standard for the USA military. These tubes are designed to give optimal performance while being in compliance with the FOM 1600 requirement. State Department export license required.

**3N IIT Features:**

- Photo Cathode type: Gallium Arsenide
- FOM: <1600
- Resolution 64 lp/mm typical
- Signal-to-Noise Ratio 22 Typical



## INFRARED ILLUMINATORS



All Starlight scopes need some light to amplify. This means that if you were in complete darkness you could not see. Due to this we have a built in infra-red illuminator (IRI) on all of our scopes. Basically what an IRI does is throw out a beam of infra-red light that is near invisible to the naked eye but your NVD can see it. This allows you to use your scope even in total darkness. The IRI works like a flashlight and the distance you can see with it will be limited. We do use the most powerful eye-safe illuminator on the market. This allows our IRI to extend out to 100 yards. However, because of the power at a short distance the IRI may cover only 40-60% of the viewing area.



## HOW FAR YOU CAN SEE

There are many different variables that can affect the distance you can see with a Night Vision device. First, what are you trying to see? Are you looking for another boat on the water or are you looking for a rabbit in the woods? The larger the object the easier it is to see. Plus, are you trying to see details (what we call recognition range) or are you just trying to see if something is there? Maybe you will just see the movement, but won't be able to determine 100% who or what it is. This is called "detection range". A second variable is lighting conditions. The more ambient light you have (starlight, moonlight, and infrared light) the better and further you will be able to see. You can always see further on a night where the moon and stars are out, then if it is cloudy and overcast. We typically state that you can tell the difference between a male and a female or a dog and a deer at about 75 to 100 yards. However, if you were looking across an open field and there was a half moon out you could see a barn or a house 500 yards away.

**Remember, that the purpose of an NVD is to see in the dark not necessarily at a long distance like a binocular.**

## ATN WPT™ REPRESENTS A NEW STANDARD FOR NIGHT VISION



In ATN's continuing effort to supply our clients with cutting edge Night Vision solutions we are proud to introduce a new line of select units based on ATN White Phosphor Technology® (WPT™).

Studies show that nighttime scenes appear remarkably more natural in black and white versus the usual green. B&W provides clearer information about contrast, shapes and shadows. ATN's White Phosphor Technology® provides users with this natural B&W night vision image.

Operators that tested units that use ATN WPT™ reported a significantly better degree of detail, overall contrast, full moon similarity and range of shades. WPT™ provides more discriminating shades of intensity between white and black than between green and black resulting in better contrast and depth perception than when compared to green phosphor NVG's.

The majority of the WPT™ performance characteristics are on par or better than the latest Gallium Arsenide based image intensifier tubes. WPT™ specifications include typical resolution of 68lp/mm (with some over 74lp/mm) and Signal-to-Noise figures as high as 25.

7 out of 10 users name WPT™ as a "Night Vision Preference" when compared with common green night vision, especially in an urban environment. "No lab testing needed on WPT™ – the depth perception is phenomenal and noticeably better than what I used in the past." – SOF Operator K.

WPT™ is available now in limited quantities in a wide variety of systems such as ATN PVS14/6015 tactical monocular, ATN NVM-14 multifunctional pocket-scope/goggle, ATN Marsx4 and ATN Marsx6 medium to long range weapon sights and on the FIITS-14 where WPT™ is

optically fused with thermal imaging.

Designed for Special Ops WPT™ is not a toy. If your life depends on your gear and you want to improve your operational effectiveness you should check it out.

**White phosphor technology® (WPT™) from ATN — GREEN IS SO LAST YEAR!**



## WPT™ TUBE SPECIFICATIONS

<b>Photo Cathode type:</b>	<b>Multi-Alkali</b>
<b>Image output:</b>	<b>Black &amp; White image output</b>
<b>Resolution:</b>	<b>60-74lp/mm ( 68 Typical )</b>
<b>Signal-to-Noise Ratio:</b>	<b>18-26 ( 22 Typical )</b>
<b>Tube life:</b>	<b>10,000 hour</b>



**STANDARD  
NIGHT VISION VIEW**



**VIEW THROUGH WPT™  
DEVICE**