INTERNATIONAL MILITARY CATALOG

NIGHT VISION PRODUCTS

ITT

Engineered for life

Night Vision

CLEARLY THE LEADER IN NIGHT VISION

ITT Night Vision is the leading manufacturer of night vision systems for U.S. armed and allied forces, producing more Generation (Gen) 3 night vision devices per year than all of its competitors—worldwide—combined. We have manufactured more than 65 percent of the U.S. military's Gen 3 equipment, and have delivered more than one million Gen 3 image intensifier tubes.

Our achievements are the result of more than 40 years' experience in all phases of night vision research, development, production and support. Throughout these years, ITT was a main producer of Gen 0, became a leading Gen 1 producer (of what some may remember as the "starlight" scopes), and subsequently the primary developer and a leading manufacturer of Gen 2 image tubes and systems.

With this background in technological and manufacturing expertise, ITT pioneered the development and production of the gallium arsenide (GaAs) Gen 3 image intensifier tube during the early '80s. We fully understand the complex dynamics of manufacturing night vision equipment in volume while achieving very high quality.

See our terminology list beginning on page 34 for explanations of night vision terms, such as IR Illuminator, I^2 and lp/mm.

2008

INTERNATIONAL MILITARY CATALOG

night vision products

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MONOCULAR NIGHT VISION DEVICE

Gen 3, AN/PVS-14 (F6015 Series)

AN/PVS-14

Designed for use in a variety of ground-based night operations, this monocular features a variable gain control to achieve an optimum balance in the images seen by both eyes. The dark-adapted unaided eye provides situational awareness and vision of close-range objects, while the night-vision-aided eye provides long-range vision of potential threats and targets.

NOTE: The single-battery configuration is a replacement product for the dual-battery configuration. (p/n 270609 for the F6015P and p/n 270117-2 for the F6015J)

POPULAR CONFIGURATIONS

System	Part Number	Includes
F6015JA	p/n 274769-1	F9815J variable gain tube* (1250 FOM) with standard U.S. Army head-mount
F6015PA	p/n 274769-2	F9815P variable gain tube* (1600 FOM) with standard U.S. Army head-mount
F6015JA	p/n 276907-1	F9815J variable gain tube* (1250 FOM) with Face Mask Assembly p/n 275121-2
F6015PA	p/n 276908-1	F9815P variable gain tube* (1600 FOM) with Face Mask Assembly p/n 275121-2

** see specifications on pg 25*

KEY FEATURES

- Multifunctional: hand-held as a monocular, head-mounted or helmet-mounted as a single eye goggle or weapon mounted as a night scope when used in conjunction with a red-dot sight
- High resolution, high gain and very high photoresponse in visible and near infrared
- Variable gain control for enhanced performance in changing light conditions
- Uses many components and ancillary accessories common to the AN/PVS-7 and AN/AVS-9
- Uses universally available AA batteries

system specifications

OPTICAL	
On-Axis Resolution (minimum) at optimum light level	
F6015P	1.3 cycles/milliradian
F6015J	1.2 cycles/milliradian
Magnification	1X ±0.03
System Distortion	Less than 3%
Range Focus	25 cm to infinity
Diopter Focus	+2 to -6 diopters
Exit Pupil and Eye Relief	On-axis: 14 mm @ 25 mm distance Full field: 6 mm @ 25 mm distance
Field of View	40 (±2°)
System Brightness Gain	Adjustable from 25 to more than 3,000
MECHANICAL	
Operating Temperature	-51°C to +49°C
Storage Temperature	-51°C to +85°C
Weight of Monocular with eyecup, lens cap, neck cord and battery	355 grams
Size	2.5 H x 2 W x 4.5 L (inches) 6.35 H x 5.1 W x 11.4 L (centimeters)

AN/PVS-14 STANDARD ACCESSORIES

- Head-mount assembly
- Medium and thick brow pads
- Eye cup
- Operator's manual
- Demist shield
- Sacrificial window
- Carrying case
- Shoulder strap
- Lens paper
- Head/helmet mount adapter

AN/PVS-14 OPTIONAL ACCESSORIES

Helmet Mount* (p/n A3256368)
The ruggedized helmet mount assembly provides the soldier with an easier, more comfortable mounting option when wearing the goggle. This mount allows direct attachment of the goggle to the PASGT helmet as opposed to the standard head-mount assembly.

3X Magnifier (p/n A3256391)
The 3X magnifier lens nearly triples the range of the AN/PVS-7 or AN/PVS-14 under all light conditions. Also, it can be used as a stand-alone 3X monocular during daylight operations. The lightweight magnifier (180 grams) stores easily in a protective pouch, similar in size to the current ammo pouch. The 3X magnifier provides a field of view of 11.5°.

5X Magnifier (p/n 275095)
The 5X magnifier further increases the range of the AN/PVS-7 or AN/PVS-14. It is attached and detached in exactly the same manner as the 3X. The 5X magnifier provides a field of view of 7.5° and weighs 370 grams.

Face Mask Assembly (p/n 275121-2)
The face mask assembly is designed to maximize comfort as well as stability. It accepts either the AN/PVS-7 or AN/PVS-14 systems and correctly positions them in front of the user's eyes. The face mask strap assembly can be configured with or without a chincup. Functionality includes fore/aft adjustment, line-of-sight tilt adjustment and flip-up/flip-down.

Small Arms Adapter (p/n A3256348)
Attaches the NEPVS-14 or NE6015 to a variety of small-arms weapons. Works in conjunction with the Picatinny rail.

Weapon Mount Assembly AG (p/n 271918)
Allows the PVS-14 to be attached to a variety of weapons without having to re-zero.

- **Step-up/Step-down Rings (p/n 274337)**
- **Camera Adapter Assembly (p/n 274049-1)**
- **Tethering Cord (p/n A3260933)**
- **Shuttered Eyeguard (p/n A3256345)**

** see page 9 for other helmet mount options*

NIGHT VISION GOGGLE

Gen 3, AN/PVS-7 (F5001 Series)

AN/PVS-7

ITT's AN/PVS-7 (F5001) night vision goggles enable military ground forces to conduct critical missions during the darkest nights of the year. Extremely lightweight, the AN/PVS-7 has been human engineered for long-wearing comfort.

POPULAR CONFIGURATIONS

System	Part Number	Includes
F5001J	p/n 270154-2	F9810J tube* (1250 FOM) Operator's manual
F5001P	p/n 270154-3	F9810P tube* (1600 FOM) Operator's manual

** see specifications on pg 23*

system specifications

OPTICAL	
Spectral Response	Visible to .90 μm (IR)
Field of View	40° (±2°)
Magnification	Unity
Resolution	1.15 cy/mr, minimum
Brightness Gain	3000 fL/fL, minimum
Collimation	1°±1° convergence ≤1/2° dipvergence
Diopter Adjustment	+2 to –6 diopters
Interpupillary Adjustment	55 to 71 mm
Eye Relief	15 mm
Objective Lens	EFL 26 mm, F/1.2, T/1.3
Eyepiece Lens	EFL 26 mm
Focus Range	20 cm to infinity
MECHANICAL	
Weight	680 grams maximum
Operating Temperature Range	–51°C to +49°C
Storage Temperature Range	–51°C to +85°C
ELECTRICAL	
Voltage Required	2.7 Vdc – 3.0 Vdc, battery (50 mA, maximum)
Battery Type	Two AA size 1.5-V alkaline or one 3.0-V lithium (BA-5567)

KEY FEATURES

- Hand-held or helmet-mounted/ head strap mounted for hands-free operation
- Quick-release lever to permit one-handed attachment/detachment from helmet
- Automatic high light cutoff to protect image intensifier
- "IR-on" indicator and a low-voltage indicator

- *Mounts to a variety of helmets (see page 9)*

AN/PVS-7 STANDARD ACCESSORIES

Head-mount assembly

Medium and thick brow pads

Eye cups

Demist shields

Operator's manual

Sacrificial window

Carrying case

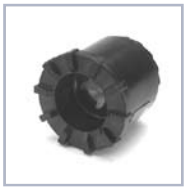
Shoulder strap

Lens paper

AN/PVS-7 OPTIONAL ACCESSORIES

Helmet Mount (p/n A3256368)

The ruggedized helmet mount assembly provides the soldier with an easier, more comfortable mounting option when wearing the goggle. This mount allows direct attachment of the goggle to the PASGT helmet as opposed to the standard head-mount assembly.



IR Spot/Flood Lens (p/n A3187441)

The IR spot/flood lens converts the standard AN/PVS-7 IR illuminator from a diffuse light source, covering much more than the goggle field of view, to a beam of light that can be focused from 20° to 50°. The beam is usable up to 50 meters.

3X Magnifier (p/n A3256391)

The 3X magnifier lens nearly triples the range of the AN/PVS-7 or AN/PVS-14 under all light conditions. Also, it can be used as a stand-alone 3X monocular during daylight operations. The lightweight magnifier (180 grams) stores easily in a protective pouch, similar in size to the current ammo pouch. The 3X magnifier provides a field of view of 11.5º.

Face Mask Assembly (p/n 275121-2)

The face mask assembly is designed to maximize comfort as well as stability. It accepts either the AN/PVS-7 or AN/PVS-14 systems and correctly positions them in front of the user's eyes. The face mask strap assembly can be configured with or without a chincup. Functionality includes fore/aft adjustment, line-of-sight tilt adjustment and flip-up/flip-down.

5X Magnifier (p/n 275095)

The 5X magnifier further increases the range of the AN/PVS-7 or AN/PVS-14. It is attached and detached in exactly the same manner as the 3X. The 5X magnifier provides a field of view of 7.5° and weighs 370 grams.

BINOCULAR NIGHT VISION GOGGLE

Gen 3, AN/PVS-23
(F5050 Series)

BINOCULAR NIGHT VISION GOGGLE

Gen 3, AN/PVS-23 (F5050 Series)

The AN/PVS-23 (F5050) binocular has aviation standard optics and high-resolution Gen 3 F9800 image intensifier tubes. It has outstanding performance because each eye receives a unique image giving greater clarity than can be obtained from single-tube devices. With a different image in each eye, it is easier to judge distances and relative motion, so the ability to perform tasks such as driving is greatly improved. The binocular includes a powerful infrared (IR) illuminator with wide or narrow beam capability. The AN/PVS-23 (F5050) can be hand-held, head-mounted or helmet-mounted. When helmet-mounted, it is powered by a rear-mounted battery pack that contains two pairs of AA batteries for extended operational endurance.

The basic AN/PVS-23 (F5050) system includes the binocular, rear-mounted battery pack, soft carrying case and accessories. To complete the system, an optional bracket and strap assembly tailored to specific helmets is required. When ordering the F5050, please specify the exact type of helmet that will be used.

POPULAR CONFIGURATIONS

System	Part Number	Includes
F5050J	p/n 270733-7	F9800J tube* (1250 FOM) Operator's manual
F5050P	p/n 270733-6	F9800P tube* (1600 FOM) Operator's manual Unmarked carrying & shipping case

see specifications on pg 21

system specifications

OPTICAL	
Scene Illumination	10-6 to 1 fc
Spectral Response	Visible to .90 μm (IR)
Field of View	40°, +1°/-2°
Magnification	Unity
Resolution	1.3 cy/mr, minimum
Brightness Gain	6,000 fL/fL, minimum
Collimation	≤1.0° convergence ≤0.3° divergence/dipvergence
Diopter Adjustment	+2 to –6 diopters
Interpupillary Adjustment	52 to 72 mm - individual knobs
Fore-and-Aft Adjustment	25 mm range
Vertical Adjustment	25 mm range
Tilt Adjustment	10°, minimum
Objective Lens	EFL 27 mm, F/1.23, T/1.35
Eyepiece Lens	EFL 27 mm
Exit Pupil/Eye Relief	On-axis: 14 mm @ 25 mm distance Full field: 6 mm @ 25 mm distance
Focus Range	41 cm to infinity
MECHANICAL	
Flip-Up/Flip-Down	Button release for flip-up and flip-down motion
Length	4.7 in. nominal
Weight	680 grams with battery
Height	3.8 in. nominal
Operating Temperature Range	–32°C to +52°C
ELECTRICAL	
Battery Type	One 1.5 Vdc AA-size alkaline internal or Two 1.5 Vdc AA-size alkaline external battery pack

ITT reserves the right to change specifications at any time.
All Generation 3 products and accessories require an export license from the U.S. Department of State.
Approved for unlimited public release per 01-S-0122

KEY FEATURES

- High-performance Gen 3 tubes
- Binocular vision for greater depth perception
- Mounts available for most types of helmets
- Integral battery for hand-held or head-mounted use
- Adjustable (spot/flood) IR illumination
- Independent eye-span adjustment
- Binocular detaches easily from mount
- Rugged construction

5050 STANDARD ACCESSORIES

Objective lens covers
Eye cups
Demist shields
Sacrificial windows
Carrying case
Shoulder strap
Lens paper
Low-profile battery pack

5050 OPTIONAL ACCESSORIES

Bracket and Strap Assembly – specific to helmet used
Head-Mount
Mount Assembly – attaches F5050 to optional head-mount or bracket strap assembly

HELMET MOUNTS FOR GROUND HELMETS

These helmet mounts are accessory mounts that can be ordered through ITT Night Vision. Standard helmet mounts included with a product are listed on the product page. Please specify type of helmet when ordering helmet mounts for night vision systems. Helmet not included.

MOUNTS FOR AN/PVS-14 (F6015) & AN/PVS-7 (F5001)

p/n A3256368
for PASGT helmet

p/n 275306-1
for ACH(MICH)/TBH/CVC helmets

ACH(MICH) helmet shown

p/n 275131-1
for RBR helmet

p/n 274603-2
for United Kingdom Mk6 helmet

p/n 275445-1
for Canadian CG634 helmet

p/n 274911-1
for Danish Army Standard helmet

p/n 272003-1
for Infantry helmet

p/n 272430-1
for South Korean K1 helmet

p/n 276756-1
for Norway helmet

MOUNTS AN/PVS-23 (F5050)

p/n 274742-1
for PASGT helmet

p/n 273270-1
for ACH(MICH)/TBH/CVC helmets

ACH(MICH) helmet shown

p/n 274742-2
for RBR helmet

MOUNTS AN/ANVS-9 (F4949)

p/n 275389-1
for PASGT helmet

p/n 274835-1
for ACH(MICH)/TBH/CVC helmets

ACH(MICH) helmet shown

AVIATION NIGHT VISION GOGGLE

AN/AVS-9 (F4949 Series)*

AVIATION NIGHT VISION GOGGLE

AN/AVS-9 (F4949 Series)*

First developed by ITT in 1992, the F4949 night vision system has evolved to address a wide range of customer requirements. It is now designated as the AN/AVS-9 by the U.S. Government. The F4949 series is the standard night flying system for the air crews of the U.S. Air Force and Navy. Over 20,000 F4949 systems are in service in 37 nations worldwide.

KEY FEATURES

- Class A, B, C and UK 645 minus-blue filters for objective lens available to suit all types of cockpit lighting, including color displays and fighter HUDs
- Helmet mount configurations designed for fixed-wing and rotary-wing applications
- 25 mm eye relief eyepieces easily accommodate eyeglasses
- Low-profile battery pack improves aviator head mobility and increases battery life

F4949 CONFIGURATIONS

Rotary-wing versions of the F4949 feature a rear-mounted, low-profile battery pack, which uses four AA alkaline batteries, allowing operation for more than 50 hours. Power is provided by a cable extending from the battery pack, over the helmet, and into a connector in the mount.

Fixed-wing versions feature a front-mounted battery pack, which uses two 1/2 AA lithium batteries that allow operation for more than 16 hours. An optional battery pack adapter enables connection of the front-mounted battery pack to the rear-mounted battery pack, providing the same operational time as the rotary-wing versions when ejection is not a consideration. An optional clip-on power source enables hand-held operation of the binocular without use of a flight helmet.

ITT's F4949 series of aviator's night vision systems is available in over 40 different configurations. The type of aircraft and type of helmet being used will determine which configuration—existing or customized—will best meet our customer's requirements.

** Please specify type of aircraft when ordering F4949.*

system specifications

OPTICAL	
Spectral Response	Visible to .90 μm (IR)
Magnification	Unity
Field of View	40° nominal (+1°, -2°)
Resolution	1.3 cy/mr, minimum (1.36 typical)
Brightness Gain	5500 fL/fL, minimum
Collimation	≤1° convergence ≤0.3° dipvergence/divergence
Interpupillary Adjustment	Independent, 51 to 72 mm total
Vertical Adjustment	25 mm to infinity
Fore-and-Aft Adjustment	27 mm, range
Tilt Adjustment	10° range
Objective Lens EFL	EFL 25 mm, F/1.23, T/1.35
Objective Lens Filters	Class A, B, C, UK 645 available
Objective Lens Focus	Range 41 cm to infinity
Eyepiece Lens	EFL 27 mm
Eyepiece Exit Pupil/Eye Relief	On-axis: 14 mm @ 25 mm distance Full-field: 6 mm @ 25 mm distance
Eyepiece Adjustment	+2.0 to -6.0 diopters
MECHANICAL	
Flip-up/Flip-down	Button release
Automatic Breakaway	11 to 15 g
Battery Type	Fixed wing: 2 ea. 1/2 AA size, lithium Rotary wing: 4 ea. AA size, alkaline
ELECTRICAL	
Weight of Binocular	550 grams
Weight of Mount	Fixed wing: 250 grams Rotary wing: 330 grams
Operating Temperature Range	-32°C to +52°C

ITT reserves the right to change specifications at any time.
All Generation 3 products and accessories require an export license from the U.S. Department of State.
Approved for unlimited public release per 07-S-2340

POPULAR F4949 (AN/AVS-9) CONFIGURATIONS

Part Number	Helmet Mount	Objective Lens	Tube
p/n 272557-1	Alpha 202	Class B	F9800J (1250 FOM)
p/n 272557-2	Alpha 202	Class B	F9800P (1600 FOM)
p/n 264359-12	HGU-55/P	Class C	F9800J (1250 FOM)
p/n 264359-13	HGU-55/P	Class C	F9800P (1600 FOM)
p/n 264359-7	SPH-4AF	Class A	F9800J (1250 FOM)
p/n 264359-11	SPH-4AF	Class A	F9800P (1600 FOM)
p/n 264359-29	SPH-4AF	Class B	F9800P (1600 FOM)

Class A – A night vision system that uses 625 nm filter. A class A night vision system is not compatible with red cockpit lights because the overlap between the spectral radiance of red light and the sensitivity of Class A night vision system.
Class B – A night vision system that uses the 665 nm filter. A class B night vision system is compatible with the color NVIS Red and therefore is compatible with properly filtered red lights and color electronic displays.
Class C – Used to improve the efficiency and see-through clarity of the HUDs that use a hologram as the reflective element in the combining glass.

F4949 STANDARD ACCESSORIES

Carrying case
Lens caps
Lens paper
Helmet modification instructions
Neck cord*
Low-profile battery pack*
Operator's manual

** rotary-wing versions*

Helmet mounts and optional accessories shown on pages 19-20

HELMET MOUNTS FOR AVIATION HELMETS

These helmet mounts are accessory mounts that can be ordered through ITT Night Vision. Standard helmet mounts included with a product are listed on the product page. Please specify type of helmet when ordering helmet mounts for night vision systems. Helmet not included.

MOUNTS FOR AN/AVS-9 (F4949)

p/n 264317-3
for HGU-55/P, HGU-66/P, HGU-68/P, HGU-85/P helmets

HGU-55/P helmet shown

p/n A3260913
for HGU-56/P helmet

p/n 3151AS150-1
for HGU-84/P helmet

p/n 271073-1
for SPH-4 AF/B helmet and SPH-5 helmet

SPH-4 AF/B helmet shown

p/n 271073-3
for ALPHA 200 Series helmet with track mount for rotary-wing application*

ALPHA rotary-wing helmet shown

p/n 271073-8
for ALPHA 200 Series helmet with rigid visor mount for rotary-wing application

** p/n 271637-1 for ALPHA 200 Series helmet with track mount for fixed-wing application*

OPTIONAL ACCESSORIES FOR AVIATION SYSTEMS

Clip-on Power Source shown attached

p/n A3260911
Clip-on Power Source

p/n 268462
Battery Pack Adapter

p/n 271765
Low-Profile Battery Pack

with mounting kit

IMAGE INTENSIFIER

Gen 3, 18 mm MX-10160 (F9800 Series)*

IMAGE INTENSIFIER GEN 3, 18 MM MX-10160

MX-10160 (F9800 Series)*

Each model in ITT's F9800 Series of Gen 3 18 mm image intensifier tubes consists of a high-efficiency gallium arsenide (GaAs) photocathode bonded to a glass input window, a microchannel plate (MCP) current amplifier and a P-43 phosphor screen deposited on an inverting fiber-optic output window.

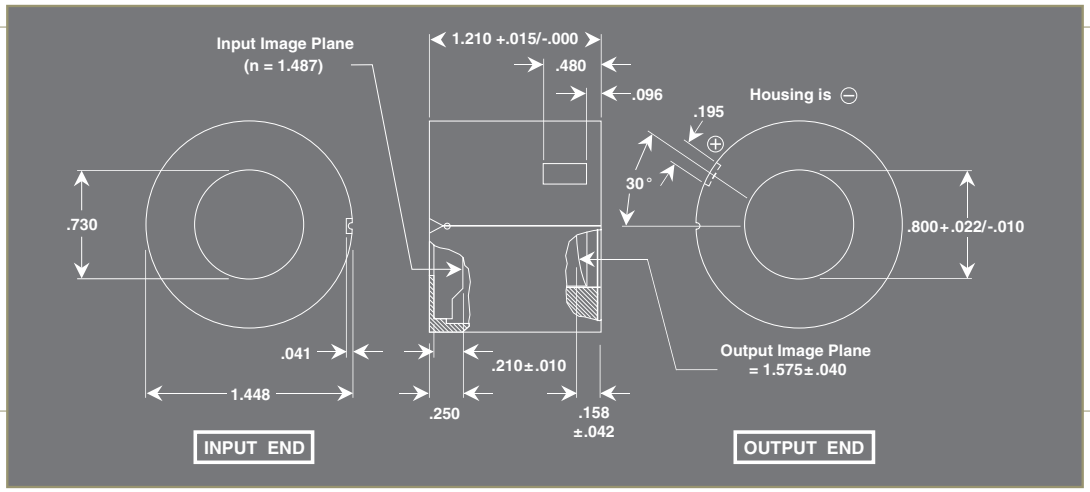
The Gen 3 photocathode is sensitive to low-radiation levels of visible and, especially, near-infrared light. It also provides very high signal-to-noise ratio (SNR) for extended detection ranges at very low-light levels. The 6-micron channel spacing in ITT's MCP provides exceptional resolution and extended detection ranges in low-light conditions. The MCP has an ion-barrier film that preserves photocathode sensitivity during operation, thereby greatly extending the life of Gen 3 tubes compared to that of Gen 2.

EXPORT MODELS: ITT offers three F9800 models for export. A Figure of Merit (FOM) is now an important consideration in determining the maximum level of tube performance allowed for export. FOM is the product of resolution, in line pairs per millimeter (lp/mm), multiplied by SNR as measured by U.S. industry standards.* Two important FOM thresholds are 1250 and 1600.

- The F9800P tube complies with 1600 FOM and meets the stringent Omnibus IV specifications.
- The F9800J tube is similar, but has a reduced SNR to comply with 1250 FOM.

** Resolution and signal-to-noise ratio calculated by other methods may not be equivalent.*

Dimensions (inches)



tube specifications

Tube Model	Performance Levels	
	F9800J (p/n 267700)	F9800P (p/n 270143)
Resolution lp/mm (Minimum)	64	64
High-Light Resolution @ 20 fc (min) lp/mm	12	12
Photocathode Sensitivity (Minimum)		
2856˚K, μA/lm	1350	1800
@ 880 nm, mA/W	65	80
Signal/Noise Ratio (Minimum)	18	21.0
FOM (Maximum)	1250	1600
EBI, x10-11 lm/cm2 (Maximum)	2.5	2.5
Luminous Gain, fL/fc		
@2X10-6 fc	40000-70000**	40000-70000**
@2X10-4 fc	10000-20000**	10000-20000**
Output Brightness, fL @ 1 and 20 fc	2.0-4.0**	2.0-4.0**
Output Brightness, Uniformity (Maximum)		
@2856°K and @880 nm	3.1	3.1
MTF (Minimum)		
@2.5 lp/mm	92%	92%
@7.5 lp/mm	80%	80%
@15.0 lp/mm	61%	61%
@25.0 lp/mm	38%	38%
Reliability, Hrs. (Minimum)	10000	10000
Maximum Spots Allowed in Each Zone	Zone	Zone
Spot Size (in.)	1 2 3	1 2 3
>.012 or Larger	0 0 0	0 0 0
>.009–.012	0 0 0	0 0 0
>.006–.009	0 1 1	0 1 1
>.003–.006	0 2 2	0 2 2

***Or per customer request*

IMAGE INTENSIFIER

Gen 3, 18 mm MX-10130 (F9810 Series)*

AN/PVS-7A

AN/PVS-7B & -7D

IMAGE INTENSIFIER GEN 3, 18 MM MX-10130

MX-10130 (F9810 Series)*

Each model in ITT's F9810 Series of Gen 3 18 mm image intensifier tubes consists of a high-efficiency gallium arsenide (GaAs) photocathode bonded to a glass input window, a microchannel plate (MCP) current amplifier and a P-43 phosphor screen deposited on a fiber-optic output window.

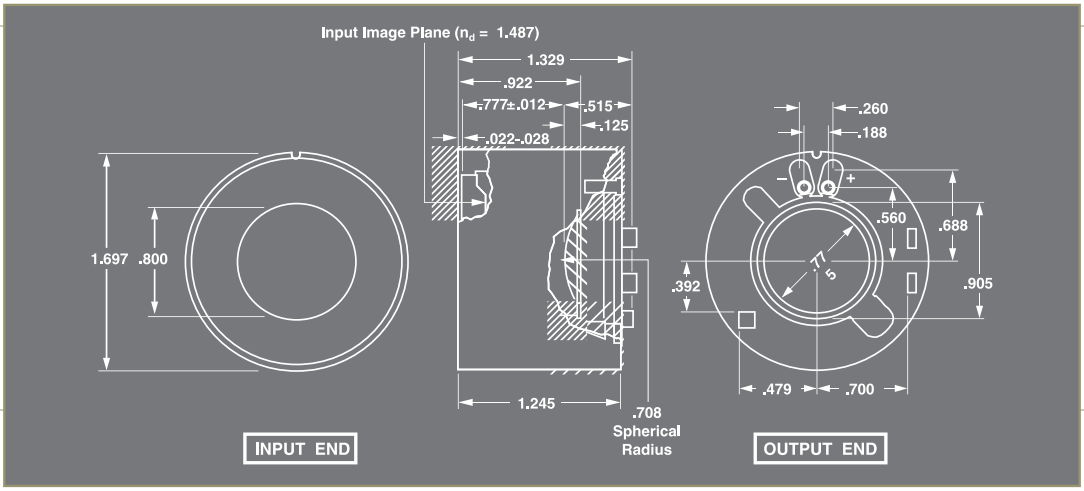
The Gen 3 photocathode is very sensitive to low-radiation levels of visible and, especially, near-infrared light. It also provides very high signal-to-noise ratio (SNR) for extended detection ranges at very low-light levels. The 6-micron channel spacing in ITT's MCP provides exceptional resolution and extended detection ranges in low-light conditions. The MCP has an ion-barrier film that preserves photocathode sensitivity during operation, thereby greatly extending the life of Gen 3 tubes compared to that of Gen 2.

EXPORT MODELS: ITT offers three F9810 models for export. A Figure of Merit (FOM) is now an important consideration in determining the maximum level of tube performance allowed for export. FOM is the product of resolution, in line pairs per millimeter (lp/mm), multiplied by SNR as measured by U.S. industry standards.* Two important FOM thresholds are 1250 and 1600.

- The F9810P tube complies with 1600 FOM and meets the stringent Omnibus V specifications.
- The F9810J tube is similar, but has a reduced SNR and resolution to comply with 1250 FOM.

** Resolution and signal-to-noise ratio calculated by other methods may not be equivalent.*

Dimensions (inches)



tube specifications

Tube Model	Performance Levels	
	F9810J (p/n 268241)	**F9810P (p/n 270166)**
Resolution lp/mm (Minimum)	57	64
High-Light Resolution @ 20 fc (min) lp/mm	12	12
Photocathode Sensitivity (Minimum)		
2856˚K, μA/lm	1350	1500
@ 830 nm, mA/W	135	155
Signal/Noise Ratio (Minimum)	18	19.2
FOM (Maximum)	1250	1600
EBI, $x10^{-11}$ lm/cm² (Maximum)	2.5	2.5
Luminous Gain, fL/fc		
@$2X10^{-6}$ fc	40000-70000**	40000-70000**
@$2X10^{-4}$ fc	10000-20000**	10000-20000**
Output Brightness, fL @ 1 and 20 fc	2.0-4.0**	2.0-4.0**
Output Brightness, Uniformity (Maximum) @2856°K and @880 nm	2.1	2.1
MTF (Minimum)		
@2.5 lp/mm	90%	92%
@7.5 lp/mm	70%	80%
@15.0 lp/mm	54%	61%
@25.0 lp/mm	30%	38%
Photocathode Diameter, mm (Minimum)	17.5	17.5
Reliability, Hrs. (Minimum)	10000	10000
Phosphor	P-43	P-43
Maximum Spots Allowed in Each Zone	Zone	Zone
Spot Size (in.)	1 2 3	1 2 3
>.015 or Larger	0 0 0	0 0 0
>.012–.015	0 0 0	0 0 0
>.009–.012	0 0 0	0 0 0
>.006–.009	0 1 2	0 1 2
>.003–.006	0 2 3	0 2 3

*** Or per customer request*

IMAGE INTENSIFIER
Gen 3, 18 mm MX-11769 (F9815 Series)*

AN/PVS-14

IMAGE INTENSIFIER GEN 3, 18 MM MX-11769

MX-11769 (F9815 Series)*

ITT's Gen 3 F9815 Series 18 mm image intensifier consists of a high-efficiency gallium arsenide (GaAs) photocathode bonded to a glass input window, a microchannel plate (MCP) current amplifier and a P-43 phosphor screen deposited on an inverting fiber-optic output window.

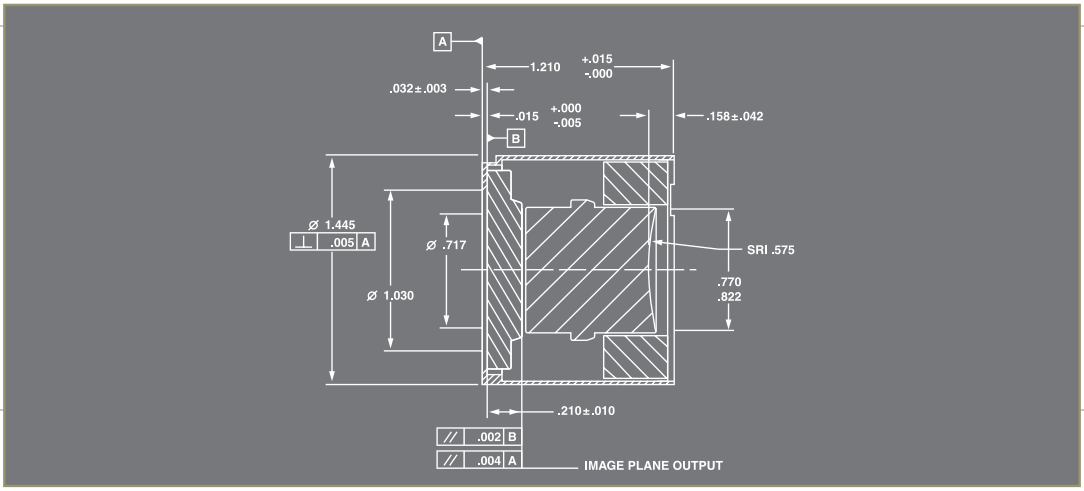
The Gen 3 photocathode is very sensitive to low-radiation levels of visible and, especially, near-infrared light. It also provides very high signal-to-noise ratio (SNR) for extended detection ranges at very low-light levels as well as variable gain to optimize performance in the AN/PVS-14. The 6-micron channel spacing in ITT's MCP provides exceptional resolution and extended detection ranges in low-light conditions. The MCP has an ion-barrier film that preserves photocathode sensitivity during operation, thereby greatly extending the life of Gen 3 tubes compared to Gen 2.

EXPORT MODELS: ITT offers three F9815 models for export. A Figure of Merit (FOM) is now an important consideration in determining the maximum performance level allowed for export. FOM is the product of resolution, in line pairs per millimeter (lp/mm), multiplied by SNR as measured by U.S. industry standards.* Two important FOM thresholds are 1250 and 1600.

- The F9815P tube complies with 1600 FOM and meets the stringent Omnibus V specifications.
- The F9815J tube is similar, but has a reduced SNR and resolution to comply with 1250 FOM.

** Resolution and signal-to-noise ratio calculated by other methods may not be equivalent.*

Dimensions (inches)



tube specifications

Tube Model	Performance Levels	
	F9815J (p/n 270120-2)	F9815P (p/n 270595-5)
Resolution lp/mm (Minimum)	57	64
High-Light Resolution @ 20 fc (min) lp/mm	12	12
Photocathode Sensitivity (Minimum)		
2856˚K, μA/lm	1350	1500
@ 830 nm, mA/W	135	155
Signal/Noise Ratio (Minimum)	18	19.2
FOM (Maximum)	1250	1600
EBI, x10-11 lm/cm2 (Maximum)	2.5	2.5
Luminous Gain, fL/fc		
@2X10-6 fc	40000-70000**	40000-70000**
@2X10-4 fc	10000-20000**	10000-20000**
Output Brightness, fL @ 1 and 20 fc	2.0-4.0**	2.0-4.0**
Output Brightness, Uniformity (Maximum) @2856°K and @880 nm	3.1	3.1
MTF (Minimum)		
@2.5 lp/mm	90%	92%
@7.5 lp/mm	70%	80%
@15.0 lp/mm	54%	61%
@25.0 lp/mm	27%	38%
Photocathode Diameter, mm (Minimum)	17.5	17.5
Reliability, Hrs. (Minimum)	10000	10000
Phosphor	P-43	P-43
Maximum Spots Allowed in Each Zone	Zone	Zone
Spot Size (in.)	1 2 3	1 2 3
>.015 or Larger	0 0 0	0 0 0
>.012–.015	0 0 0	0 0 0
>.009–.012	0 0 0	0 0 0
>.006–.009	0 1 2	0 1 2
>.003-.006	0 2 3	0 2 3

** Or per customer request

PURGE KIT FOR NIGHT VISION GOGGLES

(NSN 5855-01-442-8781) p/n 268549

KEY FEATURES

- Portable
- Quick and easy to assemble/disassemble
- Simple, hand-operated vacuum pump
- Leak detection capability
- Refillable, 20 cu. ft. nitrogen tank included
- Rugged, heavy-duty carrying case

PURGE KIT FOR NIGHT VISION GOGGLES

(NSN 5855-01-442-8781) p/n 268549

Military maintenance personnel periodically purge night vision equipment as required by Preventive Maintenance Checks & Services (PMCS). Purging evacuates air from the night vision device and backfills the system with dry nitrogen. This procedure eliminates contaminants and moisture that can degrade optical performance. ITT's portable and efficient purge kit simplifies nitrogen-purging for a wide range of night vision goggles.

OPERATION: Our purge kit operates via an easy-to-operate manual vacuum pump, which requires no electricity. Weighing only 32 lbs., the purge kit contains all the equipment needed to purge night vision devices. Straightforward, detailed instructions enable fast and effective purging both at the maintenance facility and in the field.

A purge-valve torque-limiting screwdriver (p/n 269857) and screwdriver bit (p/n 269862), which is specified for purging AN/AVS-6 and AN/AVS-9 (F4949) systems, are included with the ITT Specialized Tool Set (p/n 269776). This Specialized Tool Set is an optional accessory. Also included with the kit is a refillable 20 cu. ft. dry nitrogen tank, equipped with a high-quality regulator.

PURGE ADAPTERS: Purge adapters are not included; however, they may be ordered separately to meet specific needs for the following types of night vision equipment: AN/AVS-6, AN/AVS-9 (F4949) and AN/PVS-5, p/n 269390-1; AN/PVS-7 & AN/PVS-14, p/n 269390-2; KITE & SOPELEM NVGs, p/n 269390-3; and F7001, p/n 269390-5.

In addition to those listed above, other special types of purge adapters can be supplied, depending upon the customer's requirement/specification.

This purge kit can be used on the following night vision goggles:
All AN/AVS-6 variants, AN/AVS-9 (F4949), AN/PVS-5, AN/PVS-14, all AN/PVS-7 variants, F7001
Approved for unlimited public release per 01-S-0095

SPECIALIZED TOOL SET FOR AN/PVS-14/F6015

Monocular Night Vision Device (MNVD) p/n 273483

KEY FEATURES

- Portable
- Hex driver for removal/replacement of upper and lower housings
- Eyepiece lock-ring torque driver
- Objective lock-ring hex wrench
- Tube-retainer torque driver
- Close-focus lock-ring wrench
- Hex wrench for ON/OFF/IR
- Switch knob set-screw

SPECIALIZED TOOL SET FOR AN/PVS-14/F6015

(MNVD) p/n 273483

As a full-service supplier, ITT offers this portable, efficient tool set designed to provide the night vision goggle (NVG) maintainer with the tools necessary to disassemble and reassemble monocular night vision devices.

OPERATION: Military maintenance personnel are periodically required to perform Preventative Maintenance Checks and Services (PMCS) on night vision equipment. This tool set will simplify the disassembly and reassembly of the AN/PVS-14 and F6015 MNVDs both in maintenance facilities and in the field. The torque drivers in this tool set are factory calibrated to the torque values proven by ITT goggle manufacturing processes to provide the best lock-ring and tube-retainer ring tightness without overstressing. These tools are identical to those used by ITT on the factory floor to produce the MNVDs supplied to the U.S. Government.

Approved for unlimited public release per 07-S-2298

SPECIALIZED TOOL SET FOR AN/AVS-6/AN/AVS-9

Monocular Night Vision Device (MNVD) (NSN 5855-01-443-6806) p/n 269776

KEY FEATURES

- Portable
- Objective set-screw torque driver
- Eyepiece lock-ring torque driver
- Objective lock-ring torque driver
- Tube retainer torque driver
- Purge-valve torque driver
- Wrench 1/4 inch, modified
- Spanner wrench
- Custom fit carrying case

SPECIALIZED TOOL SET FOR AN/AVS-6

(MNVD) (NSN 5855-01-443-6806) p/n 269776

ITT's portable and efficient tool set is designed to provide the night vision goggle (NVG) maintainer with the tools necessary to disassemble and reassemble ANVIS-type night vision goggles. This tool set will simplify the disassembly and reassembly of the AN/AVS-6 and AN/AVS-9 night vision goggles both in maintenance facilities and in the field.

OPERATION: The torque drivers in this tool set are factory calibrated to the torque values proven by ITT goggle manufacturing processes to provide the best lock-ring, purge-valve, set-screw, and tube retainer ring tightness without overstressing. These tools are identical to those used by ITT on the factory floor to produce the goggles supplied to the U.S. Government.

NIGHT VISION DEVICE INFINITY FOCUS SYSTEM

p/n 273909 (ANV-20/20)

NIGHT VISION DEVICE INFINITY FOCUS SYSTEM

p/n 273909 (ANV-20/20)

The ANV-20/20 night vision device (NVD) optical alignment system is compact, portable and designed to provide the user with an accurate means of performing infinity focus and mechanical alignment. The system provides a means to check interpupillary distance (IPD) spacing, adjust the goggle mount for proper tilt and eye relief and adjust the focus of each eyepiece and objective-lens assembly.

The system presents a resolution pattern at correct infinity focus to both NVD channels at once. This allows proper adjustment of all goggle parameters to be performed quickly. The resolution pattern is directly correlated to the Snellen Eye Chart, providing a visual acuity range of 20/70 to 20/20. The test set checks the ability of the NVD to perform under a variety of light level conditions by providing an eight-step gray scale pattern that checks the dynamic range of the NVD. Each step doubles in density as it progresses from 1 (clear) to 8 (black).

KEY FEATURES

- Can be used with all versions of the AN/AVS-6 and AN/AVS-9 NVDs
- Provides an accurate target at correct infinity focus for proper adjustment of all NVD parameters
- Collimator optics simultaneously serve both sides of the NVD
- Projects a high resolution reticle image at correct infinity focus
- Allows best focus check in both high-light and low-light (simulated starlight) conditions
- Designed, packaged and tested to MIL-T-28800
- Uses four D-cell batteries housed in watertight compartments
- Battery life for more than 1,500 goggle adjustments
- Water-resistant (when the ruggedized case is closed)
- Offered in either MIL-Spec or non-MIL-Spec enclosure

system specifications

OPTICAL	
Light Source	LED, continuously monitored
Focal Settings	100 meters (minimum), Infinity (maximum)
Reticle Resolution	0.49 to 1.72 line pairs per milliradian
Reticle Luminance	Approximately 1/4 moon (normal), starlight (low)
Source Accuracy	±5% at normal mode
Left/Right Collimation	<0.5° error
System MTF	>75%
MECHANICAL	
Case Size (with cover)	13 H x 10.5 W x 9.6 L (inches) 33 H x 26.6 W x 24.4 L (centimeters)
Case Size (without cover)	13 H x 10.5 W x 6.26 L (inches) 33 H x 26.6 W x 15.9 L (centimeters)
Test Set Weight (with batteries)	26 pounds / 11.79 kg (MIL-spec) 23 pounds / 10.43 kg (non-MIL-spec)
ELECTRICAL	
Power Source	Four D-size batteries
Battery Life (normal mode)	1,500 cycles (minimum), 3-minute cycle
Battery Replacement Limit	<1.05 V
Ambient Light Sensor	Silicone photodiode
Ambient Light Level Limit	< 0.1 fc

ANV-126A NIGHT VISION DEVICE TEST SET

KEY FEATURES

- Versatile
- Portable
- Calibrated
- Variable light levels
- System self-test
- Simple to use
- Quantifiable information

ANV-126A NIGHT VISION DEVICE TEST SET

The ANV-126A provides the capability to perform a full range of critical tests on night vision devices (NVDs). It evaluates resolution, gain, distortion and spot defects under any nighttime light levels. The ANV-126A also accurately measures electrical parameters, including device current draw, battery voltage and low-battery indicator.

The system is designed for use with all levels of service and repair. At the operational level, it verifies an NVD's basic functions prior to use. At the maintenance and depot levels, the ANV-126A troubleshoots, supports repair activities and performs final tests on NVDs. The unit is calibrated to NIST standards and is qualified to the environmental requirement of MIL-T-28800D.

system specifications

Light Source Range	Continuously variable from 5.0 x 10-6 to 1.5 x 10-3 fL equivalent luminance
Light Sources	Internal light sources are monitored by calibrated silicon photodiode detectors IR LED (810 nm peak) for goggle test levels Visible LED (560 nm peak) for gain probe self-test
Gain Probe	15° circular field of view 15 mm eye relief Mechanically adaptable to most NVD eyepieces
Digital Readouts	Easy-to-read, green LED display Four-digit display of gain, test levels and NVD output Three-digit display of goggle current Three-digit display of goggle battery voltage
Test-Set Focal Length	Set to infinity
Resolution Target	Uses elements of 1951 Air Force Bar Target Resolution Ranges: 4.0 to 57.0 lp/mm, 0.107 to 1.530 lp/mrad
Spot Defect Test	Evaluates quality zones 1 and 2 Reference gauge for 0.003, 0.006, 0.009, 0.012 and 0.015 inch defects displayed directly in the NVD's field of view
Power for Goggle	Regulated 2.70 Vdc supplied to goggles Test set simultaneously monitors and displays NVD current with 0.1 mA resolution
Goggle Battery Test	60 mA resistive load applied to battery under test at 3.0 volts 0.01 volt resolution
Diopter Scope	Graduated -6 to +2 diopter scale
Collimation Bridge	Rugged bridge contains two beam-combining prisms for evaluation of goggle optical alignment Allows left-to-right, right-to-left checking
Test Set Power	Operates on internal battery or AC line voltage
Test Set Battery	Rechargeable, fully sealed, lead acid battery 20-hour operational cycle 4-8 hour recharge cycle
AC Line Operation	90-260 Vac, 50-400 Hz
Dimensions	Case: 16 x 15 x 16 (inches); 40.6 x 38.1 x 40.6 (centimeters) Operational (less lid): 16 x 9 x 16 (inches); 40.6 x 22.86 x 40.6 (centimeters)
Weight	49 pounds / 22.23 kg (with rechargeable battery) 42 pounds / 19.05 kg (without battery)

ITT reserves the right to change specifications at any time.
All Generation 3 products and accessories require an export license from the U.S. Department of State.
Approved for unlimited public release per 04-S-0071

Test Set	Part Number	Includes
ANV-126A-001 Digital NVD	p/n 276636-1	Includes test set, disposable module lift and replace tool, AC line cord, AN/AVS-6/9 power adapter, new foam lid accessory insert, user replacement instructions.

FUTURE BATTLEFIELD TECHNOLOGY

MINI-BINOCULAR (F2525)

- Smaller and lighter I^2 binocular
- Binocular vision for greater depth perception
- Provides variable gain in both eyes
- Rugged construction
- Lower profile reduces center of gravity/increases comfort level for soldiers
- Increases field of view
- Versatile mounting interface

ENHANCED NIGHT VISION GOGGLE (ENVG)

ENVG is the first night vision goggle to provide fusion (via optical overlay) of image intensified (I^2) and infrared (IR) imagery. It will give the following benefits to the soldier:

- Easy to use controls similar to proven AN/PVS-14
- Greater situational awareness
- Expanded viewing capability from highlight conditions to total darkness (no light) and through battlefield obscurants. Increases capability for urban operations
- Non-exit pupil forming eyepiece allows a clear image even as helmet shifts during vigorous physical movements

ENHANCED NIGHT VISION GOGGLE-DIGITAL (ENVG-D)

- Digital image fusion and image processing
- Digital interconnectivity:
  - Export of fused imagery to battlefield network
  - Import/display of information from battlefield network
- Increased awareness and target detection using image enhancement
- Enhanced field of view

MCP CMOS SENSOR

- Vacuum integration of direct view I^2 components with a new electron sensing CMOS imager
- Superior direct video output with reduced size and weight
- Decrease in size and weight for MCP CMOS compared to I^2 CMOS
- Improved contrast through higher Modulation Transfer Function (MTF), a measurement of the ability of an optical system to reproduce (transfer) various levels of detail from the object to the image, as shown by the degree of contrast (modulation) in the image.

UNDERSTANDING NIGHT VISION TECHNOLOGY

Image intensifier tube technology has evolved over the past 50 years through a series of "generations." In order to differentiate night vision products and determine which is best for your application, you should understand the generations.

Each generation (Gen) has been defined by specific technology advancements. To date, there have been four generations of image intensifier devices produced: Gen 0 through Gen 3.

Gen 0—The earliest (1950s) night vision products were based on image conversion rather than intensification. They required a source of invisible infrared (IR) light mounted on or near the device to illuminate the target area.

Gen 1—The "starlight scopes" of the 1960s (Vietnam era) had three image intensifier tubes connected in a series. These systems were heavy and bulky. The Gen 1 image was clear at the center but distorted around the edges. (Low-cost Gen 1 imports are often mislabeled as a higher generation.)

Gen 2—The microchannel plate (MCP) electron multiplier prompted Gen 2 development in the 1970s. The "gain" provided by the MCP eliminated the need for back-to-back tubes—thereby improving size and image quality. It also enabled development of hand-held and helmet-mounted goggles.

Gen 3—Two major advancements characterized development of Gen 3 in the late 1970s and early 1980s: the gallium arsenide (GaAs) photocathode and the ion-barrier film on the MCP. The GaAs photocathode enabled detection of objects at greater distances under much darker conditions. The ion-barrier film increased the operational life of the tube from 2,000 hours (Gen 2) to 10,000 hours (Gen 3).

When discussing night vision technology, you also may hear the term "Omnibus" or "OMNI." The U.S. Army procures night vision devices through multi-year/multi-product contracts referred to as "Omnibus"—abbreviated as "OMNI." For each successive OMNI contract, ITT has provided Gen 3 devices with increasingly higher performance. Therefore, Gen 3 devices may be further defined as OMNI I, II, etc.

NIGHT VISION TERMINOLOGY

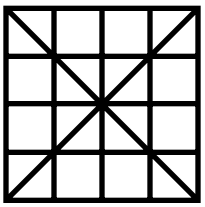
Automatic Brightness Control (ABC) An electronic feature that automatically reduces voltages to the microchannel plate to keep the image intensifier's brightness within optimal limits and protect the tube. The effect of this can be seen when rapidly changing from low-light to high-light conditions; the image gets brighter and then, after a momentary delay, suddenly dims to a constant level.

Black Spots These are cosmetic blemishes in the image intensifier or can be dirt or debris between the lenses. Black spots that are in the image intensifier do not affect the performance or reliability of a night vision device and are inherent in the manufacturing processes.

Blooming Momentary loss of the night vision image due to intensifier tube overloading by a bright light source. When such a bright light source comes into the night vision device's view, the entire night vision scene becomes much brighter, "whiting out" objects within the field of view. Blooming is common in Generation 0 and 1 devices.

Bright-Source Protection (BSP) An electronic function that reduces the voltage to the photocathode when the night vision device is exposed to bright light sources such as room lights or car lights. BSP protects the image tube from damage and enhances its life; however, it also has the effect of lowering resolution when functioning.

Diopter The unit of measure used to define eye correction or the refractive power of a lens. Usually, adjustments to an optical eyepiece accommodate for differences in individual eyesight. Most ITT systems provide a +2 to -6 diopter range.



Normal

Distortion There are two types of distortion found in night vision systems. One type is caused by the design of the optics, or image intensifier tube, and is classical optical distortion. The other type is associated with manufacturing flaws in the fiber optics used in the image intensifier tube.

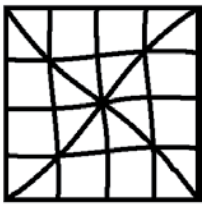
Classical Optical Distortion Classical optical distortion occurs when the design of the optics or image intensifier tube causes straight lines at the edge of the field of view to curve inward or outward. This curving of straight lines at the edge will cause a square grid pattern to start to look like a pincushion or barrel. This distortion is the same for all systems with the same model number. Good optical design normally makes this distortion so low that the typical user will not see the curving of the lines.

Fiber Optics Manufacturing Distortions Two types of fiber optic distortions are most significant to night vision devices: S-distortion and shear distortion.

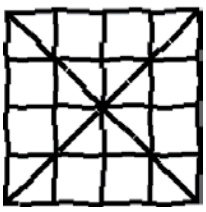
S-Distortion Results from the twisting operation in manufacturing fiber-optic inverters. Usually S-distortion is very small and is difficult to detect with the unaided eye.

Shear Distortion Can occur in any image tube that uses fiber-optic bundles for the phosphor screen. It appears as a cleavage or dislocation in a straight line viewed in the image area, as though the line were "sheared."

Types of Distortion



"S"



Shear

Equivalent Background Illumination (EBI) This is the amount of light you see through a night vision device when an image tube is turned on but no light is on the photocathode. EBI is affected by temperature; the warmer the night vision device, the brighter the background illumination. EBI is measured in lumens per square centimeter (lm/cm^2). The lower the value the better. The EBI level determines the lowest light level at which an image can be detected. Below this light level, objects will be masked by the EBI.

Emission Point A steady or fluctuating pinpoint of bright light in the image area that does not go away when all light is blocked from the objective lens. The position of an emission point within the field of view will not move. If an emission point disappears or is only faintly visible when viewing under brighter nighttime conditions, it is not indicative of a problem. If the emission point remains bright under all lighting conditions, the system needs to be repaired. Do not confuse an emission point with a point light source in the scene being viewed.

Eye Relief The distance a person's eyes must be from the last element of an eyepiece in order to achieve the optimal image area.

Figure of Merit (FOM) Image intensification tube specification used to qualify exportability. Calculated on resolution (line pairs per millimeter) x signal-to-noise.

Fixed-Pattern Noise (FPN) A faint hexagonal (honeycomb) pattern throughout the image area that most often occurs under high-light conditions. This pattern is inherent in the structure of the microchannel plate and can be seen in virtually all Gen 2 and Gen 3 systems if the light level is high enough.

Footlambert (fL) A unit of brightness equal to one footcandle at a distance of one foot.

Gain Also called brightness gain or luminance gain. This is the number of times a night vision device amplifies light input. It is usually measured as tube gain and system gain. Tube gain is measured as the light output (in fL) divided by the light input (in fc). This figure is usually expressed in values of tens of thousands. If tube gain is pushed too high, the tube will be "noisier" and the signal-to-noise ratio may go down. U.S. military Gen 3 image tubes operate at gains of between 40,000 and 70,000. On the other hand, system gain is measured as the light output (fL) divided by the light input (also fL) and is what the user actually sees. System gain is usually seen in the thousands. U.S. military systems operate at 2,000 to 3,000. In any night vision system, the tube gain is reduced by the system's lenses and is affected by the quality of the optics or any filters. Therefore, system gain is a more important measurement to the user.

Gallium Arsenide (GaAs) The semiconductor material used in manufacturing the Gen 3 photocathode. GaAs photocathodes have a very high photosensitivity in the spectral region of about 450 to 950 nanometers (visible and near-infrared region).

Generations Two technologies are referenced as night vision: image intensification and thermal imaging (see definitions). Because of cost and the fact that image intensifier scenes are easier to interpret than thermal (thermal images show targets as black or white—depending upon temperature—making it more difficult to recognize objects), the most widely-used night vision aid in law enforcement is image intensification (I^2) equipment. Developments in the I^2 technology are categorized in terms of "generations." To date, there have been four generations of I^2 devices, identified as Gen 0, Gen 1, Gen 2, and Gen 3. Developmental laboratory work is ongoing, and the U.S. military may designate the resulting effort as Gen 4. However, no definition for Gen 4 presently exists.

Generation 0 The first night vision aids (also called Generation Zero or 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.

Generation 1 The "starlight scopes" developed during the early 1960s for use in Vietnam were the first Generation (Gen 1) image intensifier devices. In Gen 1 night vision units, three image intensifiers were connected in a series, making the units longer and heavier than future night vision units would be. Gen 1 equipment produced an image that was clear in the center of the field of view but suffered from large optical distortion around the periphery. Gen 1 equipment was also subject to "blooming." Most low-cost imported night vision units use Gen 1 technology, though often under the guise of a higher "generation."

Generation 2 The development of the microchannel plate, or MCP, in the late 1960s brought on the second generation (Gen 2) in I^2 night vision. The MCP accelerated and multiplied electrons which provided the gain previously supplied by coupling three image intensifiers together (Gen 1). The introduction of the MCP significantly reduced size and weight for image intensifier tubes, enabling design of smaller night vision goggles and hand-held devices. The MCP also provided much more robust operation when bright lights entered the field of view. The Gen 2 tubes used the same tri-alkali photocathode as the Gen 1 devices. This generation was implemented to reflect the change in how the light was amplified (MCP versus three-stage coupling).

Generation 3 Third-generation (Gen 3) image intensifiers were developed in the mid-1970s and became available during the early 1980s. Gen 3 introduced two major technological improvements: the gallium arsenide (GaAs) photocathode and the ion barrier coating to the microchannel plate. The GaAs photocathode increases the tube's sensitivity to 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. Application of a metal-oxide ion barrier to the MCP increases the life of the image tube. The operational life of Gen 3 tubes is in excess of 10,000 hours, compared to that of Gen 2 tubes which is about 2,000 to 4,000 hours. This generation was implemented to reflect the change in the photocathode (tri-alkali replaced with GaAs).

I^2 (Image Intensification) Collects and intensifies the available light in the visible and near-infrared spectrum. Offers a clear, distinguishable image under low-light conditions.

IR (Infrared) Area outside the visible spectrum that cannot be seen by the human eye (between 700 nanometers and 1 millimeter). The visible spectrum is between 400 and 700 nanometers.

IR Illuminator Provides a light source (invisible to the unaided human eye) for the night vision system to amplify. Operates at approximately 880 nanometers.

lp/mm (Line Pairs per Millimeter) Unit used to measure image intensifier resolution. Usually determined from a 1951 U.S. Air Force Resolving Power Test Target. The target is a series of different-sized patterns composed of three horizontal and three vertical lines. A user must be able to distinguish all the horizontal and vertical lines and the spaces between them.

Lumen A measure of the perceived power of light. The lumen can be thought of casually as a measure of the total "amount" of visible light emitted.

mA/W (Milliamps per Watt) The measure of electrical current (mA) produced by a photocathode when exposed to a specified wavelength of light at a given radiant power (watt).

MCP (Microchannel Plate) A metal-coated glass disk that multiplies the electrons produced by the photocathode. An MCP is found only in Gen 2 and Gen 3 systems. MCPs eliminate the distortion characteristic of Gen 0 and Gen 1 systems. The number of holes (channels) in an MCP is a major factor in determining resolution. ITT's MCPs have 10.6 million holes or channels compared to the previous standard of 3.14 million.

Modulation Transfer Function (MTF) A measurement of the ability of an optical system to reproduce (transfer) various levels of detail from the object to the image, as shown by the degree of contrast (modulation) in the image.

Near-Infrared The shortest wavelengths of the infrared region, nominally 750 to 2,500 nanometers. Also see IR (infrared).

Photocathode The input surface of an image intensifier tube that absorbs light energy (photons) and in turn releases electrical energy (electrons) in the form of an image. The type of material used is a distinguishing characteristic of the different generations.

Photocathode Sensitivity Photocathode sensitivity is a measure of how well the image intensifier tube converts light into an electronic signal so it can be amplified. The units of photocathode sensitivity are micro-amps/lumen (μA/lm). A lumen is a scientific unit that measures light at wavelengths the human eye sees (violet through red). Since image intensifier tubes see light that the eye does not, it is important to know the spectral (color) content of the light used in testing photocathode sensitivity. Photocathode sensitivity is measured using a light source with a color spectrum similar to a theoretical black body operating at 2856°K (2856 degrees Kelvin). This light source was chosen because it has a color spectrum similar to the color of a night sky illuminated only by stars. Photocathode sensitivity measured with a different color spectrum light source will yield different readings.

Resolution The ability of an image intensifier or night vision system to distinguish between objects close together. Image intensifier tube resolution is measured in line pairs per millimeter (lp/mm) while system resolution is measured in cycles per milliradian. For any particular night vision system, the tube resolution will remain constant while the system resolution can be affected by altering the objective or eyepiece optics and by adding magnification filters or relay lenses. Often the resolution in the same night vision device is very different when measured at the center of the image and at the periphery of the image. This is especially important for devices selected for photography or video where the resolution of the entire image is important.

Scintillation A faint, random, sparkling effect throughout the image area. Scintillation, sometimes called "video noise," is a normal characteristic of microchannel plate image intensifiers and is more pronounced under low-light conditions. Do not confuse scintillation with emission points.

Signal-to-Noise Ratio (SNR) SNR is a ratio of the magnitude of the signal to the magnitude of the noise. If the noise in the scene (see "scintillation" definition) is as bright and as large as the intensified image, you cannot see the image. SNR changes with light level because the noise remains constant but the signal increases (higher light levels). The higher the SNR ratio, the darker the scene can be and the device still performs. The effect of SNR ratio in I^2 devices is similar to that of a television far away from the TV station. At long distances from the station, the TV picture becomes noisy, and the "snow" blocks the picture.

Spectrum The range of electromagnetic energy from cosmic rays to extra-low frequency.

Thermal Imaging Senses radiation and temperature differentiation from the 7.5 to 13.5 micron range and creates a thermal picture (image of emitted heat energy). Better for detection than recognition.

μA/lm (Microamps per Lumen) The measure of electrical current (μA) produced by a photocathode when it is exposed to a measured amount of light (lumens).

NIGHT VISION EVALUATION

Characteristics of night vision equipment fall into four major categories. Understanding these categories helps significantly in the evaluation of night vision equipment.

Performance The very need for night vision capability focuses on performance as the most important factor: Using night vision, can you see a clear image in the dark yet not see the same image with your unaided eye? Most night vision equipment available today will provide an adequate image under higher night-light conditions such as a full moon. Evaluate the following parameters to determine how well a system will perform when you need to see under truly dark conditions such as starlight.

Active Versus Passive High-performing night vision systems enable use in very low-light situations. No-light or extreme low-light situations (under dense foliage, in a cave or warehouse without windows) require additional illumination for optimal performance of the night vision device. IR illumination adds the needed light from the spectrum that is not visible to the unaided human eye. However, when IR illumination is in use (active), it can be seen by other night vision devices. You should select night vision equipment that will operate adequately without additional illumination (passive) in all but the most extreme conditions. Users also should use caution when operating the IR illumination in covert situations.

Resolution Usually this is measured as tube resolution (lp/mm) or system resolution – in cycles per milliradian (cy/mr). The more significant measurement is system resolution because this is what is visible to the user. Most systems produce an optimal resolution at some point between very high-light and very low-light conditions. As long as resolution is measured the same way using the same magnification and the same conditions (i.e., per U.S. military specs), then the higher the value, the better the ability to present a sharp picture. However, be aware that many devices will produce an image that is sharp in the center of the viewing area, but less sharp (or less defined) toward the periphery. Inability to obtain a clear, uniformly sharp image throughout the viewing area may be due to older technology (Gen 0, Gen 1 tube) or to the system's optics.

Human Factors Issues such as weight, size, safe equipment and the ease of operation should be considered when selecting night vision equipment. Remember that the ease of operation should be determined under dark conditions where the user cannot see the device being used. What may appear to be an acceptable level of operating ease under room lights may not be "user friendly" when it is dark. Long-term use should also be considered when evaluating weight. What may seem an acceptable weight when using a device for a short time may not be so when viewing for long periods of time. Additionally, consider such functions as the power switch. Must the user continually hold down the switch? Even one finger exerting light pressure for a long time can produce fatigue. Must the user repeatedly press the switch to recharge the image tube? Such devices usually produce an initially bright image, which gradually fades (reducing the ability to see), then the device shuts off unless the switch is repressed. This characteristic could cause loss of image (vision) at a crucial moment.

Suitability to Its Application Within this category, characteristics such as field of view (FOV), magnification, versatility, weather resistance and image distortion affect the ability of a night vision device to perform as needed.

Distortion Gen 0 and Gen 1 image tubes produce a certain amount of geometric distortion in the image. In Gen 2 and Gen 3 systems, geometric distortion is eliminated although it is possible to encounter some perceptible S- and shear distortion. The degree of any distortion and its interference with the application should be considered. When the application involves photography, video work, or weaponsights, the distortion and peripheral resolution are critical. (See description of "distortion," pg 34).

Magnification and Field of View (FOV) Regarding magnification and FOV, users should consider the distance and the overall area of the scene being observed or target being searched. For most surveillance or search applications, the higher the magnification or narrower the FOV, the more frequently you must scan an area to avoid missing important objects or events. Usually a 1:1 lens with a 40° FOV provides optimal performance. For long-range observation or weaponsight applications, the amount of magnification needed will vary. However, be sure to consider the other performance characteristics of the device. As the magnification increases, FOV decreases and the F number increases, all reducing the amount of light captured. Consequently, you will need an image tube with excellent performance at very low-light levels and/or high-performance lenses. Another factor involves the versatility of a device if it is used in situations that may require different magnification. How easily and quickly can the magnification be changed? Is it necessary to open the system to install the optics? In some cases, this may be inescapable, and the susceptibility of internal components to damage should be considered.

Weather Resistance The ability of a night vision system to operate under adverse environmental conditions is another important factor. Any system built to U.S. military specs for environmental factors will perform suitably under almost any condition encountered. The major concern is internal fogging which destroys the ability to see an image; hence, the ability to resist humidity and moisture is vital.

Overall Cost of Ownership Evaluation factors that impact the actual cost of acquiring a night vision capability are image tube life (referred to as "reliability"), warranty coverage, repair availability, service support and overall workmanship as an indicator of quality. When evaluating night vision equipment, the initial acquisition cost does not equate to the cost of ownership. How often must the tube be replaced? What is the likelihood for repairs? Are batteries available? What happens with exposure to bright lights? All image intensifier tubes will "wear out" over time due to gases generated within the tube that migrate to the photocathode and slowly destroy it. Because of this, characteristics such as reliability, a bright-source protection (BSP) circuit and the presence or absence of an ion-barrier film on the microchannel plate are important. U.S. military specs describe procedures for determining tube reliability.

An important factor that can influence reliability is the voltage used to produce gain. If an image tube is "driven" hard to produce high gain, it will accelerate the production of gases and more quickly destroy the ability to convert light into electrons.

Finally, a user should know whether the night vision device incorporates automatic protection for the image intensifier when it is exposed to high-light conditions or bright-light sources. Image tubes manufactured by ITT have a BSP circuit built into the image intensifier. This circuit automatically reduces the voltage to the photocathode when the system is exposed to bright-light sources. The BSP feature protects the image tube and enhances its life. When in doubt, consult the warranty; does the warranty exclude exposure to high-light or bright lights?

Note: Generation classification – Some night vision product advertising has presented confusing or misleading information, describing Russian equipment as Gen 1, Gen 2 and Gen 3, when, in fact, by worldwide classification it is Gen 0, Gen 1 and Gen 2, respectively, subject to "blooming." Most low-cost imported night vision units use Gen 1 technology, though often under the guise of a higher "generation."

WARRANTY STATEMENT

One-year warranty on intensifier tube and all system parts.

The system is warranted by ITT Night Vision to conform to design and manufacturing requirements, to remain free from defects in materials and workmanship, and to conform to performance specifications. *This warranty does not cover any product which has been subject to misuse, neglect, accident, installation or maintenance in violation of the instructions in the Operator's or Maintenance Manuals.*

The warranty expiration date is printed on the label affixed to the end item. If a warranty defect is detected, the product (either the end item or the image intensifier) is returned directly to the manufacturer for warranty service.

In the event of any malfunction or defect, ITT Night Vision will repair or replace the product, at its option, free of charge within the warranty period.

Enclosed with each ITT Night Vision product are specific warranty information and operating instructions.

To obtain warranty service on original equipment, purchaser/owner must contact his/her dealer.

p/n refers to an ITT Night Vision part number. Please use this number when ordering.

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01-S-0095, 01-S-0101, 01-S-0106, 01-S-0122, 02-S-2376, 03-S-0415,
04-S-0071, 04-S-0494, 04-S-0495, 07-S-2298, 07-S-2300, 07-S-2301,
07-S-2318, 07-S-2319, 07-S-2340, 07-S-2346

EXPORT RESTRICTIONS

All ITT Night Vision products in this catalog are subject to the following United States Export rules and regulations:

All Generation 3 products require an export license from the U.S. Department of State, Directorate of Defense Trade Controls, in accordance with International Traffic in Arms (ITAR), Title 22, CFR 120-130.

ITT Night Vision provides products and services of exceptionally high quality and performance to its customers. We guarantee that our systems offer the following:

Generation 3 Intensifier Tubes

- High-performing intensifier tubes with image sharpness and clarity in low-light situations
- Exceptional resolution in the total viewing area
- Proven 10,000-hour image tube reliability
- Cadmium-free phosphor
- High temperature performance

To Contact Us

ITT Night Vision
7635 Plantation Road
Roanoke, VA, USA 24019

Telephone: 800-448-8678
Fax: 540-366-9015
URL: www.nightvision.com
E-mail: nvsales@itt.com

ITT Night Vision

7635 Plantation Road Roanoke, VA, USA 24019

540-563-0371 800-448-8678 Fax: 540-364-4979

URL: www.nightvision.com E-mail: nvsales@itt.com

CONTACT INFORMATION

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