Homeland Security
Science and Technology

TechNote

U.S. Department of Homeland Security
SAVER
System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions. Located within the Science & Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercial equipment and systems and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

Information provided by the SAVER Program will be shared nationally with the responder community, providing a life- and cost-saving asset to DHS, as well as federal, state, and local responders.

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, please see the SAVER Web site or contact the SAVER Program Support Office.

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SPAWAR Systems Center ATLANTIC

Night Vision – Image Intensification Technologies

Night vision devices (NVDs) use image intensification (I^2) technology to provide imaging in poorly lit situations, permitting recognition of objects and people that would normally be unrecognizable to the unaided human eye. NVDs are typically used in nighttime surveillance, search and rescue, navigation, and covert operations.

An image is produced when the I^2 technology in an NVD amplifies the available light thousands of times. This resulting image, when viewed through the eyepiece of the device, is a substantially brighter image of the environment. While NVDs use miniscule amounts of available light normally undetectable by the human eye to produce an image, they can also work in total darkness if the device is equipped with an infrared illuminator.

Technology Overview

NVDs are classified by progressive generational levels (i.e., Gen 0, Gen 1, Gen 2, etc.). Older generations (Gen 0 and Gen 1) are becoming obsolete, while Gen 2 and Gen 3 are currently the most common types of commercially available NVDs. The differences in the performance of Gen 2 and Gen 3 technologies are the amount of light amplified and the operational life of the intensifier tubes. Gen 2 tubes typically amplify available light about 20,000 times and have an operational life of approximately 2,000 to 4,000 hours, while Gen 3 tubes amplify light about 30,000 to 50,000 times and the expected operational life may exceed 10,000 hours. Enhanced generations of Gen 2 and Gen 3 tubes—Gen 2+ and Gen 3+—have a longer life expectancy or improved performance, respectively.

A key component of an NVD is the intensifier tube, which may use a green or white phosphor output screen as illustrated in Figure 1. A benefit of using a green phosphor output screen is that the human eye is more sensitive to detecting variant shades of green. However, images produced by a white phosphor output screen may be more familiar to the human eye, which naturally perceives poorly lit scenery in shades of gray. Preference for one type over the other is generally user-dependent and may vary by application.

Figure 1: Night Vision Images from a White Phosphor NVD (left) and a Green Phosphor NVD (right)

As shown in Figure 2, the intensifier tube consists of several components required to amplify the ambient light. Particles of light (photons) enter the device through the objective lens and travel through the tube where electrons are generated. The electrons are then multiplied and projected against a phosphor screen producing an image that can then be viewed by the end-user through the eyepiece of the device.

The primary distinction in Gen 2 and Gen 3 tubes is the type of materials used in the components that convert the photons into electrons and multiply the electrons.

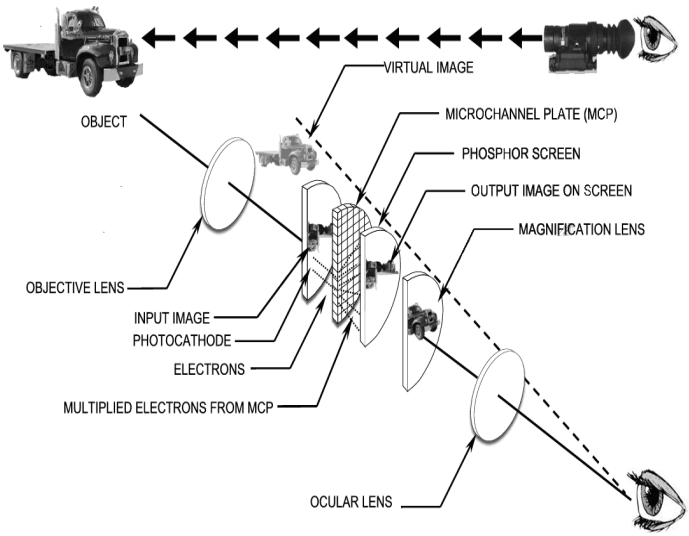

Figure 2: Gen 2 and Gen 3 Tube Components

The reliability of NVDs has improved significantly with successive generations. A major factor influencing the reliability of NVDs is protection from exposure to sources of bright light, which can permanently damage the tube. NVDs that feature automatic brightness control (ABC) or bright source protection (BSP) are less susceptible to the damaging effects of bright light. Both of these features protect the tube and also protect the eyes of the end-user from potentially harmful bright flashes of light.

Image Quality

Image quality is an important factor when determining the NVD that will best meet the needs of an agency. The quality of an image generated by an NVD is a function of many factors, including the gain of the device, the photosensitivity, the signal to noise ratio (SNR), and the resolution of both the tube and the system as a whole.

The gain, which controls the brightness of the image, contributes to the image quality by allowing the user to adjust the device for the ambient lighting conditions of the operation. Many Gen 2 and Gen 3 systems incorporate a gain adjustment.

Photosensitivity is a measure of the efficiency by which the device detects and converts photons to electrons. In general, higher photosensitivity values result in improved visual acuity.

The SNR is a ratio of the amount of light reaching the eye (signal) to the amount of static disturbances (noise) observed. A high SNR is indicative of the tube's ability to resolve objects with less noise and higher contrast under low-light conditions.

Image resolution indicates the device's ability to resolve small details and may be provided for both the tube and also for the entire NVD system. Tube resolution is measured in line pairs per millimeter (lp/mm) while system resolution is measured in cycles per milliradian. Higher resolution values correspond to sharper images by making it possible to distinguish between objects that are close together.

Additional Considerations

The price of Gen 2 and Gen 3 NVDs generally varies between $2,500 and $10,000, depending upon device configuration and features. Gen 2 and Gen 3 NVDs are available in handheld monocular, goggle, and binocular configurations and some can be helmet- and/or weapon-mounted. In addition, many NVDs can be equipped with adapters and accessories to accommodate use with equipment such as infrared illuminators, cameras, and video equipment.

The ambient lighting conditions of the environment where the NVDs are going to be used are also important to consider when making NVD procurement decisions. Less expensive then their Gen 3 successors, Gen 2 devices are generally adequate for use in urban environments where ambient light from surrounding structures, vehicles, etc., is sufficient to produce an acceptable image. However, in starlit rural areas and inside dark buildings or other environments with extremely low levels of ambient light, Gen 2+ or Gen 3 equipment may be required to achieve satisfactory image quality.

Precautions

While numerous companies produce NVDs, a smaller number of companies actually manufacture the tubes used within these devices. An agency evaluating NVDs for purchase should consider performance standards associated with the manufacturing of tubes. In addition, reconditioned tubes, while less costly, generally have a shorter operational life and lack the warranty coverage that is typically included with the purchase of new tubes and NVDs.

Additional Information

U.S. Army Research, Development and Engineering Command, Communications and Electronics Research, Development and Engineering Center, Night Vision and Electronic Sensors Directorate

- www.nvl.army.mil

Naval Surface Warfare Center

- www.crane.navy.mil/whatwedo/nightvision.asp

Handbook of Night Vision Technologies

- www.rkb.us/saver