



INTRODUCTION TO VARO
NIGHT VISION PRODUCTS

Prepared By

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1. INTRODUCTION

Varo, Inc., Texas Division, is pleased to take this opportunity to submit a proposal for the implementation of our Model 9823E Hyper-Miniscope which will greatly improve night fighting capability.

For more than a decade, Varo has been a major supplier of night vision equipment to the United States Military Forces, having already supplied more than \$100 million worth under their contracts. Attached for reference is a listing of some of the major programs that Varo has been involved in. Varo is unique in that we are the only Company that manufactures the complete night vision system. This includes the semiconductor devices, which are manufactured by Varo Semiconductor, Inc., that are used in the miniature power supplies manufactured by Biometrics Instrument Corp., a subsidiary of Varo, Inc. The power supply is an integral part of the image intensifier tube manufactured by Varo Electron Devices, Inc. These image tubes are the heart of all night vision systems manufactured by the Texas Division of Varo, Inc. Varo even has its own glass grinding and polishing facility along with a very modern machine shop.

This total capability greatly decreases the cost to the customer in that only one company is required to make a profit. It increases the quality in that all phases of



manufacture are closely controlled by the management of Varo and all components are specifically made for their end use in the night vision devices.

2. HISTORY

As far back as World War I the need to see in the dark was considered to be a necessity by the U. S. Military. At that time the equipment simply was not available and the technical knowledge necessary to build such equipment had not been developed.

During World War II such devices as the carbon arc searchlight and the magnesium flares were put into use, but they were just not the solution to the problem of fighting at night that had plagued the military leaders for decades.

The invention of radar solved some of the more complex situations such as air and sea penetration, but the soldier was still just a part time fighter.

During the period of the Korean conflict the invention of infrared illuminators was a major breakthrough in night fighting. By using these infrared techniques, the American soldier was able to light up the enemy with an infrared beam that could not have been seen with the naked eye. By using the night vision weapon sight known



as the "Sniper Scope", he could fire very accurately within close ranges. (Varo produced 4,500 of these early model sights for the U. S. Army).

This active night vision system worked very effectively until the opposing forces discovered what was being used. When this was discovered, they were able to counter these systems by using a very simple infrared converter viewer. Then the infrared sight became a device that would accurately pin point you to the enemy rather than give you the advantage of darkness.

In 1960, the U. S. Military realized the absolute necessity to develop a passive night vision capability. A capability that could neither be detected nor countered. In that year they established the Night Vision Laboratories at Fort Belvoir, Virginia. It was under contracts funded by the Night Vision Laboratories that Varo and several other companies undertook to develop an image intensifier tube that would take the limited light that is available at night, either from the moon, stars or the air glow through an overcast sky, and amplify it sufficiently so as to enable an image to be seen by the human eye. More than \$200 million were spent before a useful image tube was made. One that could be manufactured on a production basis at a cost that would enable it to be procured in sufficient quantity to put it into the hands of the infantry soldier.



Since that time Varo has manufactured and delivered more than 30,000 of these image intensifier tubes to the United States Army. With these devices in their inventory, the soldiers, tanks and weapons were no longer part time men and equipment but were ready to engage in combat at any time, day or night, using equipment that cannot be detected by the enemy.

When the U. S. Army began development of the image intensifier tube, they also recognized the importance of developing the optical systems so they would be ready when tubes were available. At that time there had been no previous requirement for optically fast lenses, consequently, none existed in the industry. Up until this time the only night vision sight was the infrared "Sniper Scope" which utilized an infrared light source to illuminate the target area. Since the new equipment was to be passive, requiring no supplemental illuminator, the optics had to be much more efficient in order to gather what little light was available.

It should be pointed out that the major consideration when designing optics for a daytime gunsight is range versus desired field-of-view. A wider field-of-view requires a proportionately shorter focal length objective with a resulting loss in power or range. For night vision sights, another problem had to be contended with.



This problem was the efficiency, or T-number, of the objective lens. Since the technology in the field of lens design for night vision sights had not progressed too far at this time, it was understandable that the lens for the AN/PVS-2 and AN/TVS-2 were not as efficient as was desired. The T-number was a relatively slow 2.2. Almost ten years later, Varo received a contract from the U. S. Army to develop new night vision sights for the individual handheld weapons and the crew served weapons. Using the very latest in state-of-the-art design techniques, Varo was successful in designing new lenses that were almost twice as efficient as those used on the older type sights. These lenses were so far superior to anything else available that Varo has been successful in selling them to other countries for their night vision sights. Three different companies in Germany have purchased both the small lens for the individual handheld weapon sight and the larger lens for crew served weapon sights.

3. EQUIPMENT DESCRIPTION

Varo's Model 9823E Hyper-Miniscopes, with its many available accessories, is the most versatile night vision weapon sight on the market. As previously mentioned, this sight takes advantage of almost 15 years of development effort by the U. S. Army in night vision warfare. Specifically, it utilizes optics that represent



state-of-the-art in design. These optics were developed by Varo for the Second Generation Night Vision Weapon Sights which have just recently completed service test by the U. S. Army. Varo's Hyper-Miniscopes utilize these optics along with the 18mm 3-stage image intensifier which is also manufactured by Varo and has proven its reliability over several years of use in many varied applications.

Although there are many other manufacturers of night vision equipment, Varo is one of the few who manufacture the complete sight including the image intensifier tube and its power supply, the optics, and most of the more complicated machine parts. The more important advantages offered by Varo's Hyper-Miniscopes over other manufacturer's equipment are outlined below:

Boresight Accuracy - The boresight accuracy of this sight is 1/4 mil. No other night vision sight can guarantee this type of accuracy.

Illuminated Reticle - The illuminated reticle for the Hyper-Miniscopes is projected onto the image tube. Since it is illuminated, it provides a sharp contrast against a dark background such as a hillside or trees. The blackline type reticle, such as used in the AN/PVS-2 and in most other night



vision sights, is very difficult to see against a dark background.

Superior Optics - As already mentioned, the optics offer state-of-the-art in focal length, f-number, T-number, and Modulation Transfer Function (MTF).

4. EQUIPMENT APPLICATION

Varo's Model 9823E was designed for use in many varied applications including surveillance and crew served weapons.

Varo's Hyper-Miniscopes is unique in that most of the many available weapon adapter brackets have already been tested and approved by the U. S. Army during engineering and service test of the Second Generation Night Vision Weapon Sights.

Discussed below are just a few of the many applications for the Hyper-Miniscopes that would greatly enhance night fighting capability.

Tank Warfare - Varo's Model 9823E Hyper-Miniscopes, with the larger objective lens, can be easily attached to the turret mounted .50 cal. machine gun to provide passive night vision capability. The tank commander would use this sight to maintain surveillance over his area of responsibility and,



if the need should arise, he could also use this sight to direct fire of the main gun or use it for accurate aimed fire of the .50 cal. machine gun. The weapon adapter bracket for attaching the Hyper-Miniscopes to the machine gun has been tested and approved by the U. S. Army.

Surveillance - To maintain surveillance of a specified area of responsibility, Model 9823E is used to provide the greatest range possible. For situations requiring observation for long durations with minimal operator fatigue, the sight should be tripod mounted. To further reduce possible operator fatigue, this sight can be supplied with a large biocular eyepiece to permit viewing with both eyes.

Anti-Tank Warfare - There are a number of anti-tank weapons on which the Hyper-Miniscopes has been successfully tested. Weapon adapter brackets are available for the following:

- M67 - 90mm Recoilless Rifle
- M72A1 Rocket Launcher
- 84mm RCL Carl-Gustaf M2 (Swedish made)
- M20 - 3.5 in. Rocket Launcher
- M40 - 106mm Recoilless Rifle

Infantry Weapons - There are numerous other weapons on which the Hyper-Miniscopes has been successfully



tested. These are listed below:

M60 - 7.62mm Machine Gun

M79 - 40mm Grenade Launcher

M16 w/XM203 - M16 w/40mm Grenade Launcher attached

M2 - .50 cal. Machine Gun

5. CONTRACTS FOR NIGHT VISION EQUIPMENT

The following pages contain listings of U. S. Government Contracts for various items of night vision equipment.



**NIGHT VISION
CONTRACTUAL PROGRAMS CONDUCTED
BY VARO FOR U. S. GOVERNMENT AGENCIES**

EQUIPMENT	QUANTITY	CONTRACT NUMBER	GOVERNMENT AGENCY	DATES
<u>1 ST GENERATION CREWSERVED WEAPON SIGHT, TVS-2 ()</u>				
THESE CONTRACTS PROVIDED FOR THE MANUFACTURE OF A PASSIVE NIGHT VISION SIGHT THAT PERMITS OPERATION OF MISCELLANEOUS CREWSERVED WEAPONS UNDER NIGHTTIME CONDITIONS. THE WEAPON SIGHT MOUNTS DIRECTLY TO THE WEAPON.	1500	DAAB07-67-C-0629	U.S.A. ECOM FT. MONMOUTH, N.J.	1967 - 1968
	450	DAAB07-67-C-0203	U.S.A. ECOM FT. MONMOUTH, N.J.	1965 - 1967
	1500	DA-28-043-AMC-02390(E)	U.S.A. ECOM FT. MONMOUTH, N.J.	" "
	425	DA-28-195-AMC-00107(T)	U.S.A. ECOM FT. MONMOUTH, N.J.	" "
 <u>METASCOPE, AN/PAS-6</u>				
THESE CONTRACTS PROVIDED FOR PRODUCTION OF THE HANDHELD VIEWER WITH AN ATTACHABLE SOURCE OF IR ILLUMINATION.	1182	DAAB07-72-C-0017	U.S.A. ECOM FT. MONMOUTH, N. J.	1971 - 1972
	7000	DAAB07-69-C-0340	U.S.A. ECOM FT. MONMOUTH, N. J.	1969 - 1970
	10000	DAAB07-67-C-0617	U.S.A. ECOM FT. MONMOUTH, N. J.	1967 - 1968
	5000	DA-23-195-AMC-00153(T)	U.S.A. ECOM FT. MONMOUTH, N. J.	1966
	5000	DA-11-184-AMC-710(T)	U.S.A. EPO CHICAGO, ILL.	1965 /
 <u>2.2 KW SEARCHLIGHT, AN/VSS-()</u>				
THESE CONTRACTS PROVIDE FOR FABRICATION OF 2.2 KW XENON SEARCHLIGHTS FOR MOUNTING ON HELICOPTERS, JEEPS, TANKS, PERSONNEL CARRIERS, AND OTHER VEHICLES. CAPABLE OF MULTI-MODE OPERATION, INCLUDING VISIBLE AND IR WIDE AND NARROW BEAM, AND BLACKOUT AND OVERDRIVE MODES OF OPERATION.	273	DAAB07-71-C-0057	U.S.A. ECOM FT. MONMOUTH, N.J.	1970 - 1971
	750	DAAB07-68-C-0055	U.S.A. ECOM FT. MONMOUTH, N.J.	1967
	500	DAAB07-67-C-0606	U.S.A. ECOM FT. MONMOUTH, N.J.	1967
	1500	DA-28-043-AMC-02288(E)	U.S.A. ECOM FT. MONMOUTH, N.J.	1966
	1800	DA-11-184-AMC-636(T)	U.S.A. EPO CHICAGO, ILL.	1964
	1500	DA-11-184-AMC-66(T)	U.S.A. EPO CHICAGO, ILL.	1964
 <u>1 ST GENERATION STARLIGHT SCOPE AN/PVS-2 ()</u>				
THESE CONTRACTS PROVIDED FOR PRODUCTION OF A SMALL LIGHTWEIGHT PASSIVE NIGHT VISION DEVICE FOR TARGET ACQUISITION AND SURVEILLANCE UNDER AMBIENT LIGHT CONDITIONS AS LOW AS 10 ⁻⁵ FOOTCANDLES.	2952	DAAB07-69-C-0258	U.S.A. ECOM FT. MONMOUTH, N.J.	1969
	2500	DA-28-043-AMC-02598(E)	U.S.A. ECOM FT. MONMOUTH, N.J.	1966



EQUIPMENT	QUANTITY	CONTRACT NUMBER	GOVERNMENT AGENCY	DATES
<u>1 KW SEARCHLIGHT, AN/VSS-3 ()</u>				
THESE CONTRACTS PROVIDED FOR DESIGN AND PRODUCTION OF THE XENON IR-VIS SEARCHLIGHT. ALSO INCLUDED PRODUCT REDESIGN AND IMPROVEMENT. SPECIAL CONSIDERATION DURING DESIGN WAS GIVEN TO BEAM CHARACTERISTICS AND ANGULAR VISUAL SECURITY. INCLUDED MOUNTS FOR BOTH THE M-551 VEHICLE AND M-60 TANK.	114	DAAK02-69-C-0757	U.S.A. MERDC FT. BELVOIR, VA.	1969 - 1972
	322	DAAB07-73-C-0147	ECOM FT. MONMOUTH, N.J.	1973 - 1974
	1112	DAAB07-74-C-0534	ECOM FT. MONMOUTH, N.J.	1974 - P.
	470	DAAB07-75-C-0784	ECOM FT. MONMOUTH, N.J.	1974 - P.
	770	DAAB07-76-C-0823	U.S.A. ECOM FT. MONMOUTH, N.J.	1975 - P.
<u>SEALED BEAM TURRET INTEGRATED XENON ILLUMINATOR</u> - THIS CONTRACT PROVIDED FOR THE DESIGN OF AN OPTIMAL PERFORMANCE TANK SEARCHLIGHT. INCLUDED IN THE REQUIREMENTS ARE: SELF CONTAINED COOLING SYSTEM, VEHICLE INTERFACE, ELECTRONIC POINTING SERVO SYSTEM, IR FILTER, ENVIRONMENTAL PROTECTION, SMALL ARMS FIRE PROTECTION AND RELIABILITY.	2	DAAK02-74-C-0222	USAMERDC FT. BELVOIR, VA.	1974
<u>1 KW PULSED SEARCHLIGHT</u> - THIS CONTRACT PROVIDED FOR TWO AN/VSS-3A SEARCHLIGHTS MODIFIED FOR PULSE OPERATION. THE REPETITION RATE CALLED FOR IS FROM 3 PULSES PER SECOND TO 18 PULSES PER SECOND WITH A PULSE WIDTH OF 15 MS. THIS EQUIPMENT WAS FOR USE WITH PROJECT MASSTER AT FORT HOOD, TEXAS.	2	DAAK02-74-C-0210	USAMERDC FT. BELVOIR, VA.	1974
<u>2ND GENERATION CREWSERVED AN/TVS-5 ()</u>				
THESE CONTRACTS PROVIDED FOR DESIGN, DEVELOPMENT, FABRICATION, AND TESTING OF AN ENGINEERING DEVELOPMENT MODEL OF THE SECOND GENERATION CREWSERVED WEAPON SIGHT. INCLUDES DESIGN OF A MICRO-CHANNEL INVERTER, NEW OPTICAL ELEMENTS, AND POWER SUPPLY.	35	DAAK02-69-C-0801	U.S.A. MERDC FT. BELVOIR, VA.	1969 - 1972
	81	DAAB07-75-C-0875	U.S.A. ECOM FT. MONMOUTH, N.J.	1975
<u>2ND GENERATION STARLIGHT SCOPE, AN/PVS-4 ()</u>				
THESE CONTRACTS PROVIDED FOR DESIGN, DEVELOPMENT, FABRICATION AND TESTING OF AN ENGINEERING DEVELOPMENT MODEL OF THE SECOND GENERATION STARLIGHT SCOPES. INCLUDES DESIGN OF A MICRO-CHANNEL INVERTER, NEW OPTICAL ELEMENTS, AND POWER SUPPLY.	30	DAAK02-69-C-0781	U.S.A. MERDC FT. BELVOIR, VA.	1969 - 1972
	101	DAAB07-75-C-0875	U.S.A. MERDC FT. BELVOIR, VA.	1975



EQUIPMENT	QUANTITY	CONTRACT NUMBER	GOVERNMENT AGENCY	DATES
<u>XM44E1 PERISCOPE</u> THIS CONTRACT PROVIDED FOR THE MANUFACTURE OF A DUAL MODE FIRE CONTROL AND SURVEILLANCE SYSTEM INCORPORATING TWO SEPARATE OPTICAL PATHS, ONE FOR DAYTIME OPERATIONS, AND THE OTHER, THROUGH A PASSIVE NIGHT VISION SYSTEM IS USED UNDER NIGHT-TIME AMBIENT LIGHT CONDITIONS. THE XM-44 PERISCOPE IS INSTALLED IN THE M-60 TANK.	1273	DA-28-043-AMC-3410(W)	U.S. ARMY FRANKFORD ARSENAL PHILADELPHIA, PA.	1966 - 1969
<u>25MM - 3 STAGE INTENSIFIER ASSEMBLY WITH ABC</u> THIS CONTRACT CALLS FOR THE INCORPORATION OF THE AUTOMATIC BRIGHTNESS CONTROL FEATURE INTO THE STANDARD U.S. ARMY IMAGE INTENSIFIER ASSEMBLY AND POWER SUPPLY. THIS ABC FEATURE IS PARTICULARLY ADVANTAGEOUS IN VARIOUS TYPES OF FIRE CONTROL SYSTEMS WHEN THE TARGET IS VIEWED DURING FIRING THE WEAPON.	1503 WITH 100% OPTION	DAAB07-72-C-0232	U.S.A. ECOM FT. MONMOUTH, N.J.	MARCH 1973 TO APRIL 1974
<u>40MM - 3 STAGE INTENSIFIER ASSEMBLY WITH ABC</u> THIS CONTRACT CALLS FOR THE INCORPORATION OF THE AUTOMATIC BRIGHTNESS CONTROL FEATURE INTO THE STANDARD U.S. ARMY IMAGE INTENSIFIER ASSEMBLY AND POWER SUPPLY. THIS ABC FEATURE IS PARTICULARLY ADVANTAGEOUS IN VARIOUS TYPES OF FIRE CONTROL SYSTEMS WHEN THE TARGET IS VIEWED DURING FIRING OF THE WEAPON.	915 WITH 100% OPTION	DAAB07-72-C-0187	U.S.A. ECOM FT. MONMOUTH, N.J.	JUNE 1973 TO JAN. 1975
<u>HYPER - MINISCOPE, MODEL 9823E</u> THIS CONTRACT PROVIDES THE NAVY WITH THE LATEST AND MOST VERSATILE FIRST GENERATION PASSIVE NIGHT VISION SIGHT FOR TARGET ACQUISITION AND SURVEILLANCE.	CLASSI- FIED	N61756-76 M-5546	U.S. NAVAL AIR PT. MAGU, CA.	1976



VARO, INC.
NIGHT VISION EQUIPMENT

GENERAL DESCRIPTION
OF EQUIPMENT, WITH
DATA SHEETS

APPENDIX A



ABOUT VARO

For nearly three decades, Varo has been engaged in the engineering and manufacture of high technology electronic, electro-mechanical, and electro-optical products and systems for military, governmental, and commercial applications.

The first product line was devoted to electronic power conversion devices. Research in this area resulted in the introduction of the world's first airborne static inverter.

Much of the company's expertise is a result of its hardware development for military and space applications. This has given Varo the reputation for high standards of reliability, quality, and performance in all product areas and applications.

The Varo headquarters, main engineering, and manufacturing facilities are located in a modern complex at Garland, Texas. Marketing operations are international in scope through a network of sales offices and manufacturers' representatives throughout the free world.

The specialized production of night vision equipment is carried out at three separate plants in Garland. The high voltage power supplies are manufactured by Biometrics Instrument Corp. (a Varo subsidiary), image intensifiers and image converter tubes are produced by Varo Electron Devices, Inc., and overall systems engineering and electro-optical assembly is performed by the Texas Division of Varo.

NIGHT VISION DEVICES

Equipment and systems for night vision are divided into two basic types: active and passive.

Active devices are composed of a high-intensity illumination source using either white or infrared lenses or filters. With an infrared light, an appropriate viewing device must be used.

Passive devices require no illuminator. They operate instead by using ambient light (starlight, moon, natural skylight, etc.) which is amplified electronically 30 to 50 thousand times.



Active devices are used in fixed, mobile, transportable, and airborne applications.

Passive devices have found widespread acceptance in surveillance and weapons sighting applications where security demands minimum detection of the user. Since no accompanying light source is required (as is true in active systems), detection by infrared viewers is impossible.

Varo manufactures a complete line of both types of devices which are in active use by military, governmental, and commercial agencies.

HYPER-MINISCOPIES

The new series of Hyper-Miniscopes night vision viewers combine the latest technological advances in passive second generation optics with the high resolution first generation 18mm image intensifier tube to provide the most accurate individual weaponsights available anywhere. The superb accuracy of the Hyper-Miniscopes results from its unique internal reticle projector which eliminated the need for external mechanical adjustment. The projected reticle is fully adjustable to compensate for scene brightness and target contrast. Performance and accuracy have been proved over many hours of live firing. The reticle is especially effective under very dark conditions when a fixed blackline reticle could not be distinguished. Reticle patterns are available for each type weapon.

One model of the Hyper-Miniscopes attaches directly to the AR15/M16 rifle. It can also be used with other weapons using simple, lightweight, low-cost mounting brackets. Another model of the Hyper-Miniscopes attaches directly to all crew-served weapons with mounting brackets.

The Hyper-Miniscopes are lightweight and are battery operated. Since they do not require visible or infrared illumination, the Hyper-Miniscopes can be used without danger of detection.

Readily interchangeable optics are available for many applications. Please refer to the specific data sheet for exact specifications.



Each Hyper-Miniscopes is shipped complete in a protective metal case with a manual, batteries, and a boresight filter for zeroing during daylight hours. It can also be supplied with a biocular eyepiece and a camera adaptor.

1 KW SEARCHLIGHT

The lightweight 1 KW Xenon Searchlight is a dependable illumination source intended primarily for use on Military ground vehicles. It provides an intense beam of visible or infrared light variable from 1° to 7° in width.

The 1 KW can be mounted on any vehicle having a power supply capability of 28 volts DC at 60 amperes. It may also be operated conveniently from any position within the vehicle through the use of a remote control panel. Other advantages of this system include its portability and the ease with which it may be adapted for airborne or perimeter illumination with different mounts and cables.

Varo is the world's largest producer of Xenon Searchlights.

METASCOPE

The Metascope is the smallest, yet the most versatile night vision system produced by Varo. It features an attachable infrared light source permitting night map reading without detection. It offers increased vision in photographic darkrooms and can be used to observe infrared light-emitting diodes and infrared laser beams. It also is highly effective to locate and pinpoint distant infrared light sources. It has excellent performance characteristics during night activities. For example, when used with the 1 KW Searchlight, it can detect a man at a distance of 350 meters.

SECOND-GENERATION CREWSERVED WEAPONSIGHT

Lightweight and versatile, the Varo Second-Generation Crewserved Weaponsight is easily adapted to a number of different weapons or may be tripod-mounted for night reconnaissance. This



passive night vision sight uses a 25mm intensifier tube with automatic gain control circuitry which maintains image brightness during periods of changing light levels after sunset. Muzzle-flash protection also is provided to prevent circuit and image overloading. An adjustable, internally projected reticle allows the sight to be boresighted to various weapons without having to move the sight. An optional 235mm objective is available on special order.

NOCTRON IV

The NOCTRON IV[®] hand-held night vision viewer is a result of the technology which produced the U. S. Army's famous Starlight Scope.

When used with video tape and photographic equipment, it can provide permanent visual records under cover of darkness and with a substantial element of safety.

The NOCTRON IV[®] offers maximum performance and versatility at low cost, interchangeability of hundreds of available photographic lenses from zoom to telephoto using a standard "C" mount lens system, and Automatic Brightness Control that compensates for changing ambient light levels.

Standard equipment includes a three-stage 18mm image tube with Automatic Brightness Control, 12.7 x adjustable monocular eyepiece, 75mm "C" mount lens, batteries and a custom fitted high impact plastic case. The eyeshield and eyepiece assembly is easily removed for attaching optical and photographic accessories.

Optional equipment includes a biocular eyepiece which permits viewing by more than one person, and adapters for 35mm SLR cameras, 16mm movie cameras and TV cameras.

Recent commercial and consumer utilization of the NOCTRON IV[®] reported to Varo has included public law enforcement and industrial security, boating and yachting, and naturalist study of nocturnal animal life. One unit is even being used by a naturalist to detect reptiles on roads at night. Farmers and stockmen also are using the NOCTRON IV[®] to protect against fence cutting and cattle rustling.



PAVE-SPOT/PAVE-NAIL

A prime example of the success of advanced technology at Varo is the company's participation in the U. S. Air Force Pave-Spot/Pave-Nail Programs. These programs, incorporating one of the most advanced concepts in weapon delivery since World War II, provide for the pinpoint delivery of laser-directed munitions or "smart" bombs.

Under the U. S. Air Force contract, Varo developed and delivered systems combining an electro-optical viewing and tracking periscope with a laser beam. Installed in a forward air control aircraft, the device allowed targets to be detected, identified, and marked by a laser spot, even under starlight conditions. Attack aircraft carry munitions which can "home" in on the spot with an extreme degree of accuracy. Although combat results are classified, a dramatic improvement in both day and night weapons delivery was noted.

IMAGE INTENSIFIERS

Varo Electron Devices, Inc., is one of the largest suppliers of image intensifiers in the world. Varo manufactures as standard production items 18mm, 25mm, and 40mm diode-type image intensifier modules in single-, two-, and three-stage configurations.

Three-Stage assemblies are normally furnished completely packaged with high-voltage power supply and housing. Varo image intensifiers are available with Automatic Brightness Control (ABC) which automatically adjusts unit gain to ambient light.

Varo Electron Devices can provide optional features such as low distortion, as well as variable magnification (zoom) intensifiers with input/output useful diameters of 80/40, 80/25, 60/18, and 40/18 (millimeters). These zoom tubes are gateable when used with the appropriate power supply.

Varo has designed and developed 18mm and 25mm channel amplifier intensifiers.

For the commercial and industrial market, Varo Electron Devices manufactures special purpose intensifiers which are



now operating in medical X-ray systems, X-ray baggage inspection, low light level television, security systems, spectrophotometer instruments, and astronomical equipment.

VARO NIGHT VISION HIGH-VOLTAGE POWER SUPPLIES

The power supplies shown in our data sheet were developed by Varo's Biometrics Instrument Corporation subsidiary to provide the high DC voltages required for image intensifier tubes. They are available with positive or negative outputs in configurations to fit one-, two-, or three-stage image intensifier tubes.

Zoom power supplies have been developed and manufactured by Varo in many configurations from rectangular to circular wrap-around packages for many different applications such as: Zoom Image Intensifier Systems, SIT Low Light Level T.V. System, and many other unique imaging and display systems. Varo can supply many different types of special purpose high voltage power supplies, including floating gate configurations.

Special customer applications can be accommodated by our engineering staff. Just let us know your system application, and we'll give you the answers.



NATO STOCK NO. 5855-21-871-4120 AN/PVS-502

HYPER-MINISCOPE model 9823

The new Model 9823 Hyper-Miniscopes combines the latest developments in second generation night vision optics with the high resolution first generation 18mm image intensifier to provide the most accurate individual night vision weaponsight available anywhere.

The superb accuracy of the Hyper-Miniscopes results from its unique internal reticle projector. The projected reticle is fully adjustable to compensate for scene brightness and target contrast and it is especially effective under very dark conditions when a fixed blackline reticle would disappear. This reticle system is more accurate than adjustable mounts. The Hyper-Miniscopes is attached directly to the M16 rifle and can be used with other weapons using simple, lightweight, low cost adaptors.

The Model 9823 is lightweight (1.75 Kg) and is battery operated. Since it does not require visible or infrared illumination, the Hyper-Miniscopes can be used without danger of detection.

Readily interchangeable ballistic reticles and adaptors are available for the following applications: M14 Rifle, FN Rifle, G3 Rifle, M60 Machine Gun, M16 Rifle, M67 Recoilless Rifle, Winchester Model 70 Rifle, Remington Model 700

Rifle, and the M79 Grenade Launcher.

Each Hyper-Miniscopes is shipped complete with a protective metal case, batteries, and a bore-sight filter for zeroing during daylight hours. It can also be supplied with either biocular eyepiece or camera adaptor.

SPECIFICATIONS

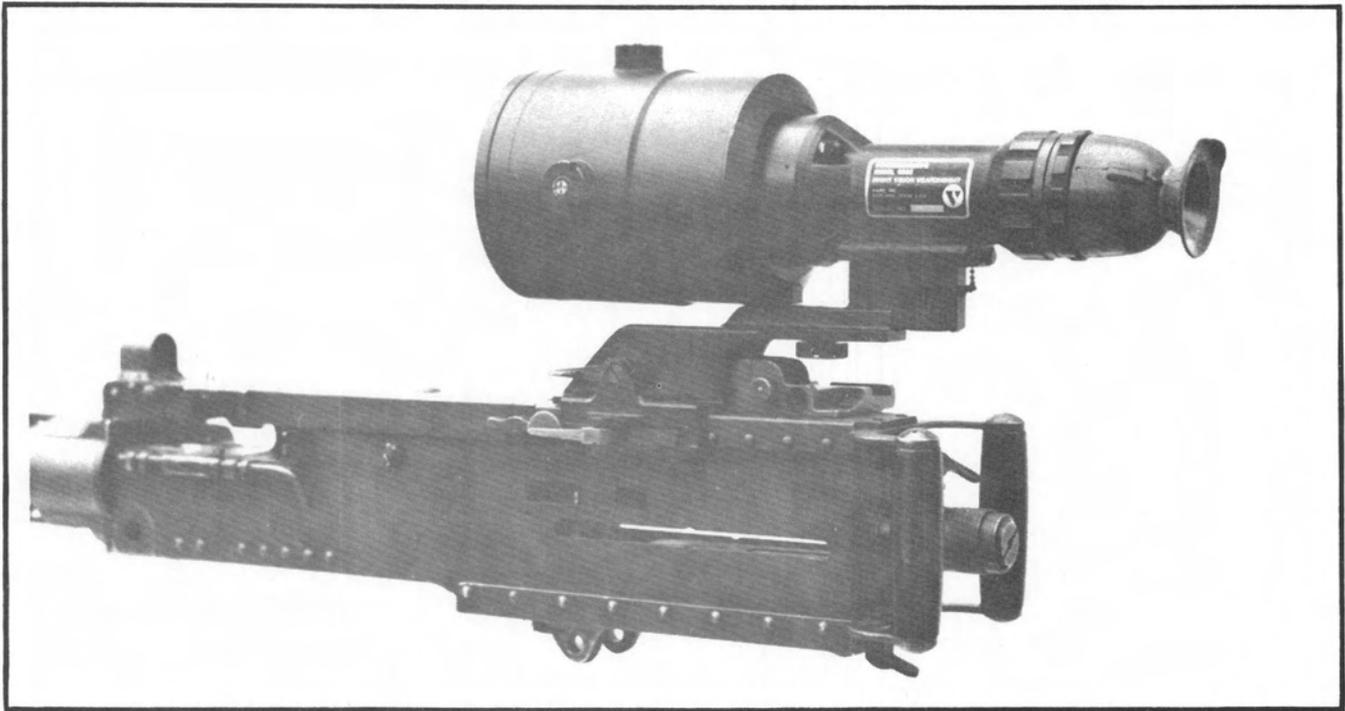
OPTICAL	
Magnification	3.5X
Field of View	10°50'
System Resolution 100% Contrast Target (Lp/mr)	
@ 3×10^{-3} FT-L	2.7
@ 3×10^{-5} FT-L	1.5
Objective Focal Length	95mm
Objective f/No.	1.2
Objective T/No.	1.72
Focus Range	10m to Infinity
Eyepiece Focal Length	25mm
Eyepiece Diopter Adjustment	-4 to +2
Image Format	18mm
Reticle Accuracy	$\frac{1}{4}$ Mil
Reticle Adjustment	$\frac{1}{4}$ Mil increments

MECHANICAL	
Length	37cm
Diameter	8.65cm
Weight	1.75Kg

ELECTRICAL	
Power Source	Mallory RM401 (4 reqd)
Operating Duration @ 20° C	48 hrs
Image Intensifier Per	MIL-I-55553

ENVIRONMENTAL	
Operating Temperature	-54°C to +52°C
Storage Temperature	-54°C to +68°C
Humidity (operating)	98% @ +31°C
Immersion (water depth)	To 1 meter





HYPER-MINISCOPE model 9823E

The new Model 9823E Hyper-Miniscopes combines the latest developments in second generation night vision optics with the high resolution first generation 18mm image intensifier to provide the most accurate crew-served night vision weaponsight available anywhere.

The superb accuracy of the Hyper-Miniscopes results from its unique internal reticle projector. The projected reticle is fully adjustable to compensate for scene brightness and target contrast and it is especially effective under very dark conditions when a fixed blackline reticle would disappear. This reticle system is more accurate than adjustable mounts. The Hyper-Miniscopes is attached directly to all crew-served weapons with simple, lightweight, low cost mounting adaptors.

The Model 9823E is lightweight (3.95 Kg) and is battery operated. Since it does not require visible or infrared illumination, the Hyper-Miniscopes can be used without danger of detection.

Readily interchangeable ballistic reticles and adaptors are available for the following applications: M2 Cal. 50 Machine Gun, M85 Cal. 50 Machine Gun, M139 20mm Gun, and M40 106mm Recoilless Rifle.

Each Hyper-Miniscopes is shipped complete with a protective metal case, batteries, and a boresight filter for zeroing during daylight hours. It can also be supplied with either biocular eyepiece or camera adaptor.

SPECIFICATIONS

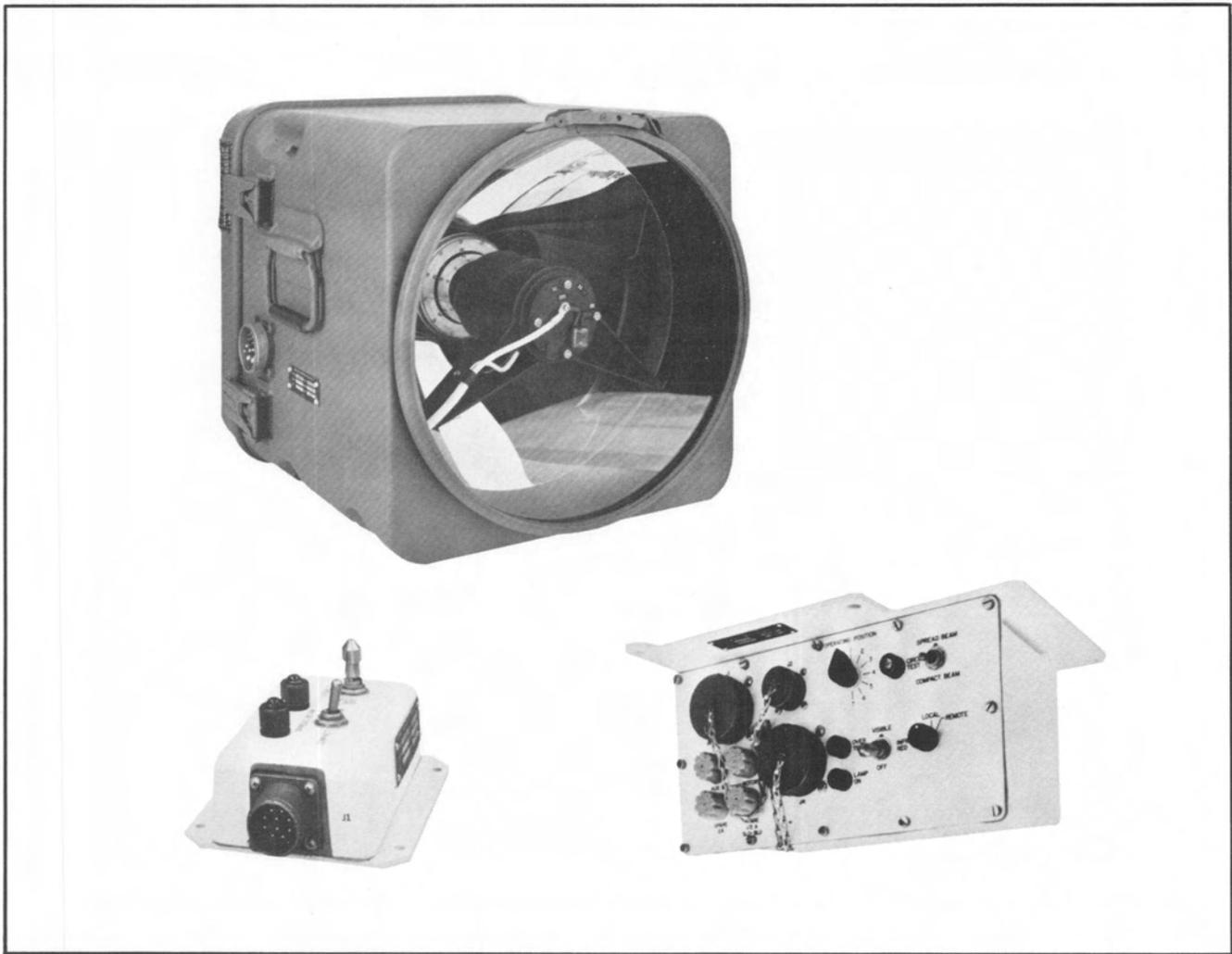
OPTICAL	
Magnification	5.7X
Field of View	6°30'
System Resolution 100% Contrast Target (Lp/mr)	
@ 3X10 ⁻³ FT-L	4.4
@ 3X10 ⁻⁵ FT-L	3.1
Objective Focal Length	155mm
Objective f/No.	1.2
Objective T/No.	1.72
Focus Range	25m to Infinity
Eyepiece Focal Length	25mm
Eyepiece Diopter Adjustment	-4 to +2
Image Format	18mm
Reticle Accuracy	¼ Mil
Reticle Adjustment	¼ Mil increments

MECHANICAL	
Length	46cm
Diameter	15cm
Weight	3.95Kg

ELECTRICAL	
Power Source	Mallory RM401 (4 reqd)
Operating Duration @ 20°C	48 hrs
Image Intensifier Per	MIL-I-55553

ENVIRONMENTAL	
Operating Temperature	-54°C to +52°C
Storage Temperature	-54°C to +68°C
Humidity (operating)	98% @ +31°C
Immersion (water depth)	To 1 meter





1 kw SEARCHLIGHT ,AN/VSS-3(A) model 9962A

The 1 KW Searchlight is a dependable source of white or infrared illumination intended primarily for use on Military ground vehicles.

The 1 KW provides an intense beam of visible or infrared light continuously variable from 1° to 7° in width.

The 1 KW can be adapted for mounting on any military vehicle capable of providing the required 28 volts dc at 60 amperes and may be operated conveniently from any position within the vehicle through the use of a remote control panel.

Other advantages of this system include its portability and the ease with which it may be adapted for airborne or perimeter illumination with different mounts and cables, and the extreme simplicity of maintenance designed into the system.

SPECIFICATIONS

MECHANICAL

Size	
Height	15"
Width	15"
Length	18"
Weight	70 lbs
Type of Mounting	fixed, three point

POWER REQUIREMENTS

Voltage	28 volts dc
Current	60 amps

ENVIRONMENTAL

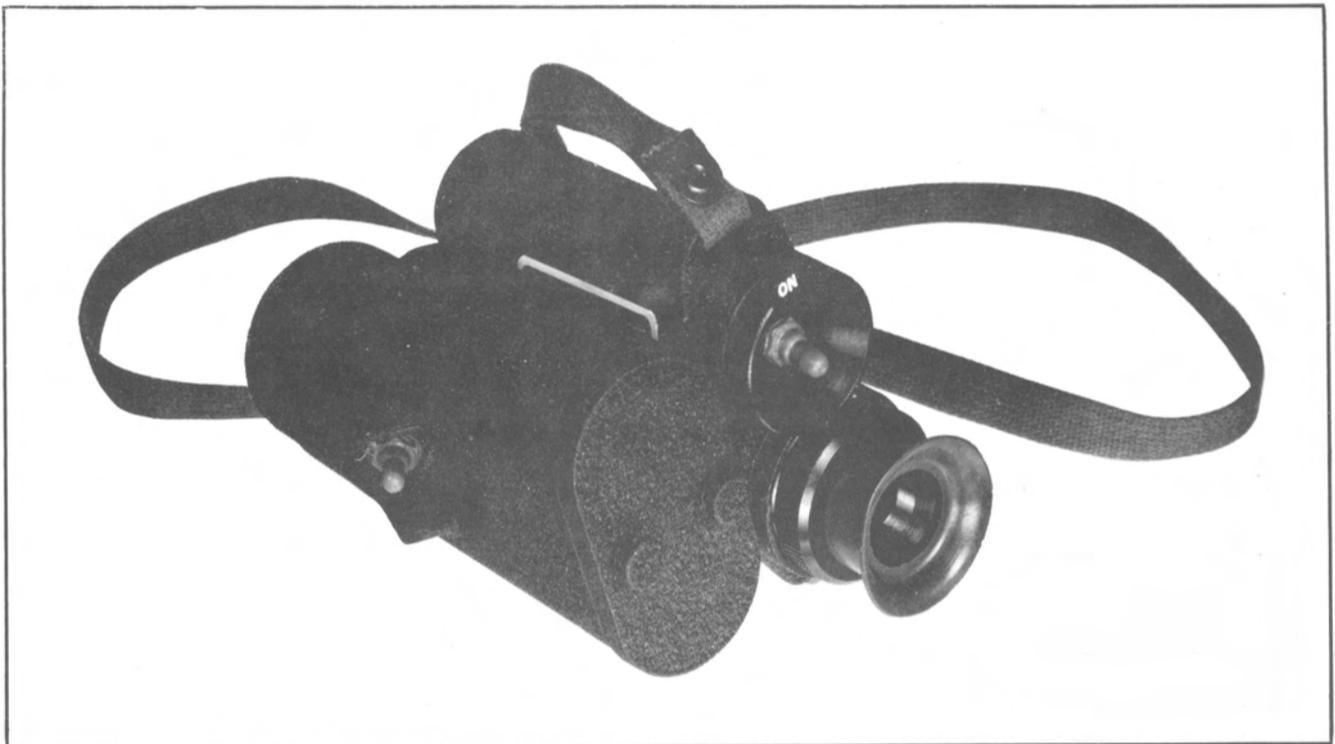
	operating	non-operating
Temperature	-65°F to +115°F	-80°F to +155°F
Humidity	98% @ 115°F	immersion to 1 meter for 1 hr to 40,000 ft
Altitude	to 10,000 ft	

PERFORMANCE

Beamwidth	1° to 7° (variable)
Candlepower	60 million (min.)
Range	

Approximate Size of Target	SEARCHLIGHT IN INFRARED MODE		SEARCHLIGHT IN VISIBLE MODE
	6 x Binoculars	Crew Served Weaponsight	With Naked Eye
Man	800m	1000m	1000 m
Jeep	1050m	1400m	1200 m
Tank	1400m	1800m	1600 m





METASCOPE

The smallest night vision system produced by Varo, the Metascope is an active handheld viewer with an attachable source of infrared illumination designed to permit the field soldier to read maps and perform similar tasks without breaking visual security. Without the IR light source attached, the Metascope is a highly effective instrument for the detection of enemy infrared light sources.

The Metascope offers increased vision in photographic darkrooms to observe film and equipment processes. It can be used to observe infrared light emitting diode (LED) and infrared laser beams. It features lightweight well balanced, wide angle monocular vision, a focus range of 1 foot to infinity, and a precision ground eyepiece and objective lens.

One of the most significant features of the Metascope is its greater clarity and field of view with less distortion than a conventional infrared viewers.

The Metascope does not have the magnifying power of other infrared viewers. However, it has been built by the thousands and has been proven to be reliable and economical where magnifying power is not a critical requirement.

SPECIFICATIONS

OPTICAL

Magnification	1.1x
Field of View	30°
F Number	1.4
Resolution	3.75 min of arc
Focus Range	1 ft to inf (fixed)
Diopter Range	±4

MECHANICAL

Size	
Length	6"
Width	4 1/4"
Height	4 1/2"
Weight	2 lbs 12 ozs w/light source
Type of Mounting	handheld

ELECTRICAL

Power Source	
Sight	1.34 vdc mercury battery (RM-1)
Light	2" d" cells
Operating Duration ¹	
Viewer	24 hours
Light Source	6 hours

ENVIRONMENTAL

	operating	non-operating
Temperature	-40°f to +125°f	-65°f to +140°f
Humidity	98%	98%
Altitude	to 10,000 ft	to 40,000 ft

TUBE

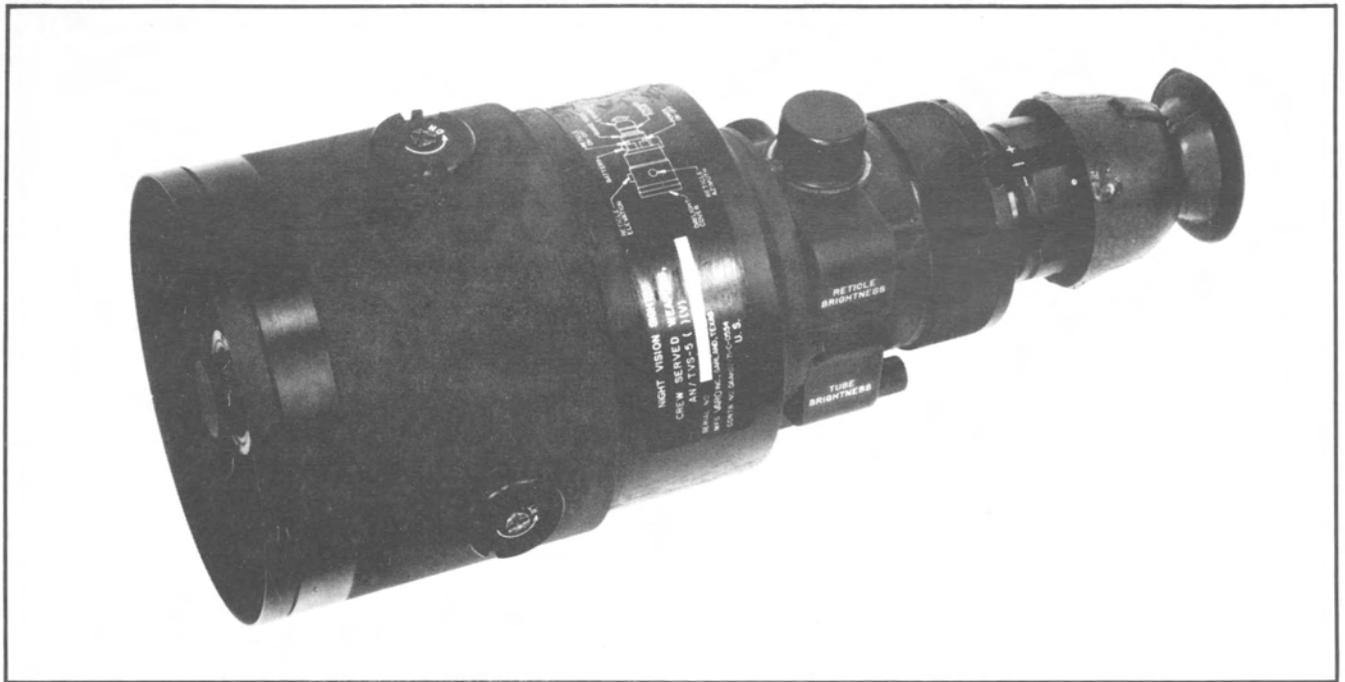
Type	6929
Ultimate Resolution	50 lp/mm
Photocathode Response	S-1

PERFORMANCE

Target Size ²	Infrared Searchlight Power		
	600w	1 kw	2.2 kw
Man	300m	350m	400m
Jeep	400m	450m	500m
Tank	500m	575m	650m

1. Under Average Conditions
2. Target Contrast 30%





2nd GENERATION CREWSERVED WEAPONSIGHT, AN/TVS-5

The Second Generation Crewserved Weaponsight is a light weight passive night vision sight using a 25MM micro-channel plate inverter intensifier tube. The sight is easily attached to a number of different weapons or may be tripod mounted for night reconnaissance.

An adjustable internally projected reticle and interchangeable reticle patterns allow the sight to be bore-sighted to the various weapons without having to move the sight.

Image tube gain and reticle brightness are manually adjustable to compensate for different levels of ambient lighting.

Automatic Gain Control circuitry is employed to automatically maintain the viewed scene illumination constant during periods of changing light level conditions such as the period from sunset to full darkness. This allows the operator of the sight to use the sight without having to readjust the tube gain control every few minutes during this period.

The tube features muzzle-flash protection which prevents the tube from being damaged by high intensity short duration flashes of light. The flash protection circuit is designed to recover in time for the observer to see the round hit the target.

SPECIFICATIONS

OPTICAL	
Magnification	6.2x
Field of View	9°
Focus Range	25m to infinity
Objective	
Focal Length	155 mm
T Number	1.6
MTF	70% @ 40 lp/mm
Eyepiece	
Focal Length	25mm
Eye Relief	34mm
Diopter Range	+4 -5

MECHANICAL

Length	31cm
Width	16cm
Height	17cm
Weight	3kg

ELECTRICAL

Power	25ma @ 2.65 VDC
Battery Life	12 hrs

ENVIRONMENTAL

	operating	non-operating
Temperature	-65°f to +115°f	-65°f to +155°f
Humidity	98%	98%
Altitude	to 10,000 ft	to 40,000 ft

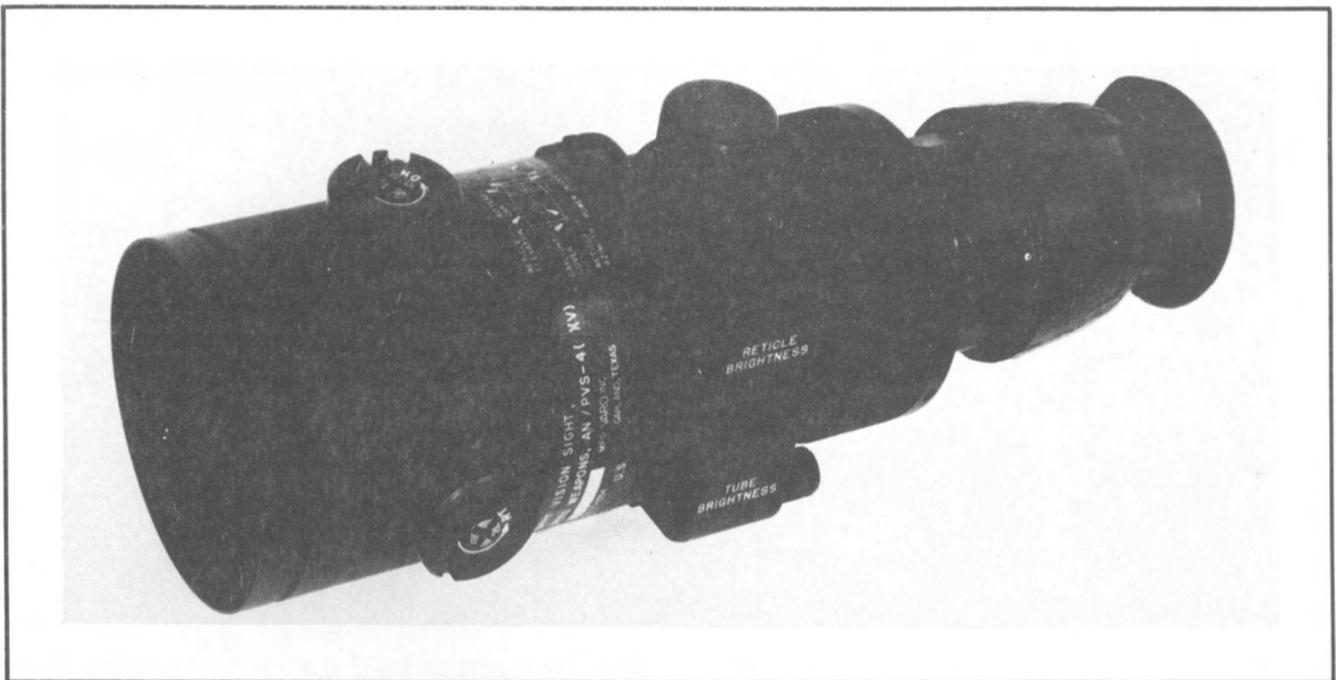
IMAGE TUBE

Type	25mm microchannel inverter
Resolution	30 lp/mm
Photocathode Response	S-20R

SYSTEM RESOLUTION

100% Contrast	
.001 lux	2.5 lp/mr
.1 lux	4.2 lp/mr
30% Contrast	
.001 lux	1.9 lp/mr
.1 lux	3.5 lp/mr





2nd GENERATION STARLIGHT SCOPE, AN/PVS-4

The Second Generation Starlight Scope is a light weight passive night vision sight using a 25mm micro-channel plate inverter intensifier tube. The sight is easily attached to a number of different weapons or may be hand held for night reconnaissance.

An adjustable internally projected reticle and interchangeable reticle patterns allow the sight to be bore-sighted to the various weapons without having to move the sight.

Image tube gain and reticle brightness are manually adjustable to compensate for different levels of ambient lighting.

Automatic Gain Control circuitry is employed to automatically maintain the viewed scene illumination constant during periods of changing light level conditions such as the period from sunset to full darkness. This allows the operator of the sight to use the sight without having to readjust the tube gain control every few minutes during this period.

The tube features muzzle-flash protection which prevents the tube from being damaged by high intensity short duration flashes of light. The flash protection circuit is designed to recover in time for the observer to see the round hit the target.

SPECIFICATIONS

OPTICAL	
Magnification	3.7x
Field of View	14° 30'
Focus Range	25m to infinity
Objective	
Focal Length	95mm
T Number	1.6
MTF	70% @ 40 lp/mm
Eyepiece	
Focal Length	25mm
Eye Relief	34mm
Diopter Range	+4 -5

MECHANICAL	
Length	24cm
Width	12cm
Height	12cm
Weight	1.7kg
Mounting	vee-block bracket

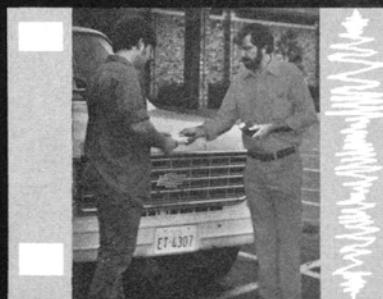
ELECTRICAL	
Power	25 ma @ 2.65 VDC
Battery Life	12 hrs

ENVIRONMENTAL		
	operating	non-operating
Temperature	-65°f to +115°f	-65°f to +155°f
Humidity	98%	98%
Altitude	to 10,000 ft	to 40,000 ft

IMAGE TUBE	
Type	25mm microchannel inverter
Resolution	30 lp/mm
Photocathode Response	S-20R

SYSTEM RESOLUTION	
100% Contrast	
.001 lux	1.6 lp/mr
.1 lux	2.6 lp/mr
30% Contrast	
.001 lux	1.2 lp/mr
.1 lux	2.2 lp/mr





NOCTRON IV[®]
...THE NIGHTSTALKER

NOCTRON IV® ...THE NIGHTSTALKER

The highest percentage of *crimes against persons* and property is perpetrated under the cover of *darkness*.

Police surveillance teams all over the world are now depending on NOCTRON IV to penetrate the darkness barrier, and virtually turn night into day!

NOCTRON IV is simple to operate. Any officer can be briefed on its operations in a matter of minutes.

In those "one chance to get it" situations, NOCTRON IV can be depended on to produce crisp, *identifiable* photographs capable of obtaining convictions. One notable defense attorney (former Assistant District Attorney) stated; "If faced with only the testimony from arresting officers, there is a chance the defense can create reasonable doubt. However, when faced with photographic evidence obtained through the NOCTRON IV . . . I'll cop a plea."

Benefits to the police or security force equipped with NOCTRON IV:



Simplicity . . . NOCTRON IV can be operated by anyone; no special skills required.



Safety . . . NOCTRON IV can ferret out and locate armed suspects in dark alleys, buildings or streets. Reduces the risk of accidental firing on un-armed suspects, innocent bystanders, or fellow officers.



NOCTRON IV is lightweight. It weighs about the same as a loaded .357 magnum side-arm.

NOCTRON
by GIVIN



Durability . . . NOCTRON IV can take the punishment of night-to-night constant use.

NOCTRON IV® IS PRODUCED BY VARO, INCORPORATED, THE PIONEER IN NIGHT VISION DEVICES. MORE VARO NIGHT VISION EQUIPMENT IS IN USE BY THE POLICE AND THE MILITARY THAN ANY OTHER KIND!



NOCTRON IV® can make NIGHTSTALKERS of any police tactical or surveillance team, GIVING THEM EYES THAT SEE IN THE DARK! Full line of accessories.

THE BASIC NOCTRON IV NIGHT VISION VIEWER

Standard equipment includes basic viewer with automatic brightness control, 12 power monocular eyepiece with ± 4 diopters adjustment, 75mm f/1.9 "C" mount lens, batteries, and custom fitted high impact plastic case.

- A. 135mm Telephoto lens. Extends distance from subject to surveillance team by roughly double that of standard lens. Highest Quality Optics.
- B. 75mm f/1.4 produces brighter image, clearer picture than standard lens.
- C. 18-90mm Zoom Lens. Adds versatility to night viewer. Operator can locate subject easily on low magnification, then zoom in to get a closeup of the action.



A



B



C

- D. Virtually any lens requirement can be met with the universal lens adapters. Operator can select from stock of commercially available lenses to fit the assignment.



D



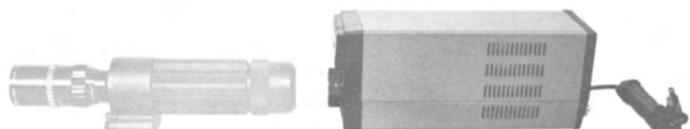
- 1. 4X Biocular eyepiece. Permits operator to view subject with both eyes, or by two operators simultaneously. Greater eye comfort for extended surveillance assignments.
- 2. Single lens reflex camera adapter. Allows wide variety of camera equipment to be coupled to NOCTRON IV. Full image area of film is covered. No cutoffs or blanking out. Full frame square format picture results. Constant observation with use of camera's through-the-lens viewing. (Specify camera type when ordering).



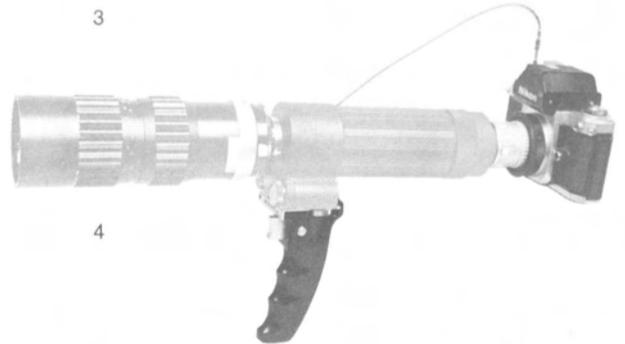
1



2

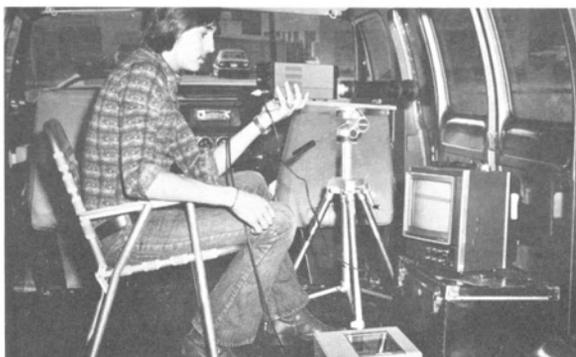


3



4

- 3. Motion Picture/Video Camera Adapter. Couples the NOCTRON IV to any standard 16mm Movie Camera, or to a wide variety of TV cameras. Excellent for Videotaping!
- 4. Pistol grip handle. Excellent when using longer focal length lens, or with camera attached. Trigger can be remotely to shutter release of camera.



Complete systems. Customized systems are available through the single source of your Varo Representative. Varo engineers will be happy to recommend the equipment for your particular surveillance needs. A call to any of the offices listed on the next page will get the system you need on its way.

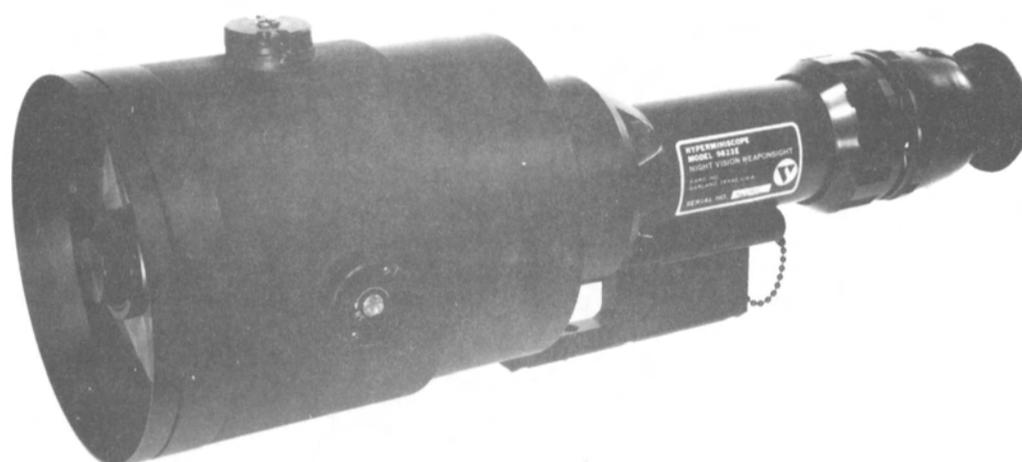


OPERATION & MAINTENANCE
MANUAL

VARO HYPER-MINISCOPE
MODELS 9823 AND 9823E

APPENDIX B

CM010/1 (3-76)



**OPERATION & MAINTENANCE
MANUAL**

**VARO
HYPER-MINISCOPE**

model 9823 and 9823E

Manufactured
by



OPERATION & MAINTENANCE MANUAL

for

VARO HYPER-MINISCOPE MODEL 9823

(NATO DESIGNATION: NIGHT VISION

SIGHT, IMAGE INTENSIFIER,

SU-5007/PVS-502.

NSN 5855-21-871-4120)

and

VARO HYPER-MINISCOPE MODEL 9823E

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CHAPTER 1 – DESCRIPTION

1.1 General

The Hyper-Miniscopes, figures 1.1 and 1.2, is a portable, battery-operated, electro-optical instrument for observation and aimed fire of weapons at night. It amplifies reflected light such as moonlight, starlight or skyglow so that the viewed scene becomes clearly visible to the operator. Since it does not require visible or infrared light, it can be used without danger of detection. The major components of the Hyper-Miniscopes are: (a) objective lens assembly, (b) image intensifier, (c) main housing, and (d) eyepiece (figure 1.3).

This manual is applicable to both the Model 9823 (individual served weapon) and Model 9823E (crew served weapon) sights. The sights are identical in construction except for the size of the objective lens. Tables 1.1 and 1.2 give the characteristic data of both sights.

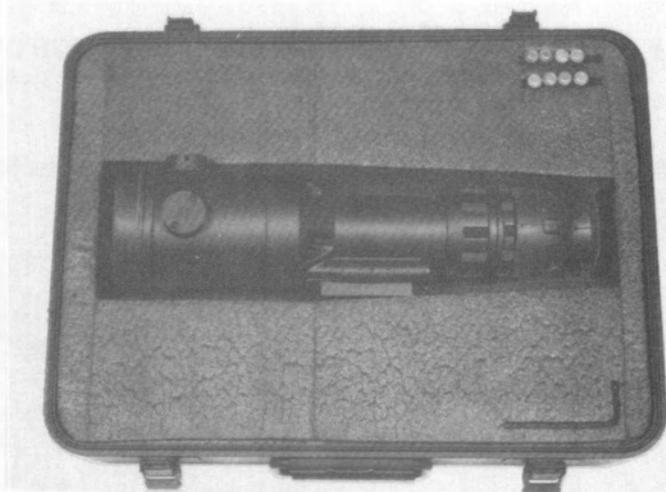


FIGURE 1.1 HYPER-MINISCOPE MODEL 9823 (NIGHT VISION SIGHT, INDIVIDUAL SERVED WEAPONS)

TYPICAL APPLICATIONS: M14 Rifle, M16 Rifle, FN Rifle, G3 Rifle, M60 Machine Gun, M67 Recoilless Rifle, M79 Grenade Launcher

SPECIFICATIONS, MODEL 9823, 95MM OBJECTIVE

<p>OPTICAL</p> <p>MAGNIFICATION 3.5X</p> <p>FIELD OF VIEW 10°-50'</p> <p>SYSTEM RESOLUTION: 100% CONTRAST</p> <p>TARGET LINE PAIRS PER MILLIRADIAN</p> <p> @ 3×10^{-3} FT.L 2.7</p> <p> @ 3×10^{-5} FT.L 1.5</p> <p>RETICLE ADJUSTMENT $\frac{1}{4}$ mil</p> <p>OBJECTIVE f/No. 1.2</p> <p>MECHANICAL</p> <p>LENGTH 37cm</p> <p>DIAMETER 8.65cm</p> <p>WEIGHT 1.75kg</p>	<p>ELECTRICAL</p> <p>POWER SOURCE MALLORY RM401 (4 REQ'D) OR EQUIVALENT</p> <p>OPERATING DURATION @ 20°C 48hr</p> <p>IMAGE INTENSIFIER PER MIL-I-55553</p> <p>ENVIRONMENTAL</p> <p>TEMPERATURE</p> <p> OPERATING -54°C to +52°C</p> <p> NON-OPERATING -54°C to +68°C</p> <p> HUMIDITY (OPERATING) 98% @ +31°C</p> <p>IMMERSION (WATER DEPTH) to 1 meter</p>
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TABLE 1.1 CHARACTERISTICS, HYPER-MINISCOPE MODEL 9823

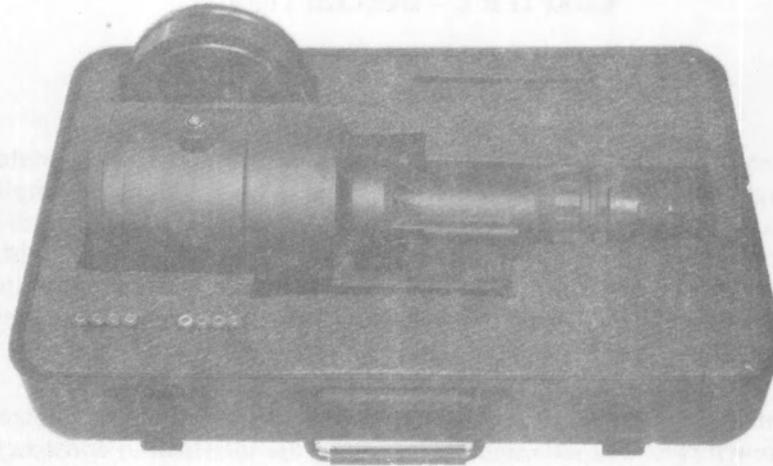


FIGURE 1.2 HYPER-MINISCOPE MODEL 9823E, NIGHT VISION WEAPONSIGHT, CREW SERVED WEAPONS)

TYPICAL APPLICATIONS: M2 and M85 Machine Guns, M40 Recoilless Rifle, M139 Gun, Tripod Mount

SPECIFICATIONS, MODEL 9823E, 155MM OBJECTIVE

OPTICAL			ELECTRICAL	
MAGNIFICATION	5.7X		POWER SOURCE	MALLORY RM401 (4 REQUIRED) OR EQUIVALENT
FIELD-OF-VIEW	6°30'		OPERATING DURATION @ 20°C	48 HOURS
SYSTEM RESOLUTION, 100% CONTRAST			IMAGE INTENSIFIER PER	MIL-I-55553
TARGET LINE PAIRS PER MILLIRADIAN				
@ 3×10^{-3} FT L	4.4		ENVIRONMENTAL	
@ 3×10^{-5} FT L	3.1		TEMPERATURE	
RETICLE ADJUSTMENT	¼mil		OPERATING	-54°C to +52°C
OBJECTIVE f/No.	1.2		NON-OPERATING	-54°C to +68°C
MECHANICAL			HUMIDITY (OPERATING)	98% @ +31°C
LENGTH	46Cm		IMMERSION (WATER DEPTH)	to 1 meter
DIAMETER	15Cm			
WEIGHT	3.95Kg			

TABLE 1.2 CHARACTERISTICS, HYPER-MINISCOPE MODEL 9823E

1.2 Objective Lens Assembly

The objective lens assembly is a sealed unit containing five lenses and two mirrors that mounts to the front of the main housing assembly. A reticle projector is contained within the objective lens assembly. The azimuth and elevation controls for the reticle are located on the outside of the objective lens assembly. The reticle projector superimposes a ballistic pattern upon the image of the viewed scene. The pattern is optically shifted to zero the sight to a weapon.

1.3 Image Intensifier

CAUTION

Do not expose the image intensifier for prolonged periods to light levels above that of the maximum brightness of the projected reticle.

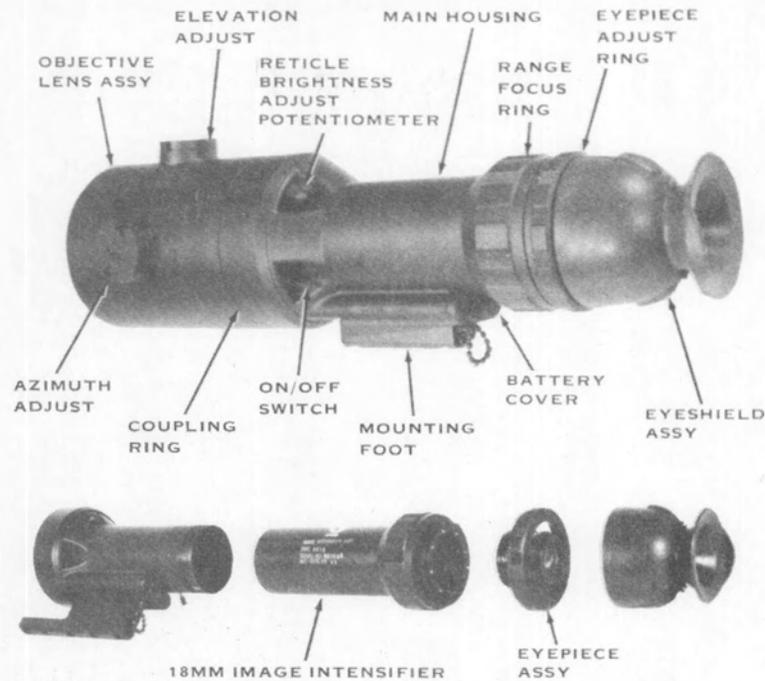


FIGURE 1.3 HYPER-MINISCOPE COMPONENTS

The image intensifier assembly is a sealed unit containing the image tube and power supply required for its operation. The image intensifier screws onto the eyepiece assembly and slides into the main housing assembly when the eyepiece assembly is installed.

1.4 Main Housing

The main housing assembly is a tubular case to which the eyepiece and objective lens assemblies are secured. The sight and reticle controls are on the main housing assembly and the image intensifier assembly is contained within it. All weapon mounting brackets attach to this housing.

1.5 Eyepiece Assembly

The eyepiece assembly is a sealed unit containing four lenses that attaches to the rear of the image intensifier. A rubber eyeshield is attached to the eyepiece assembly to prevent illuminating the user's face and to protect the user's eye from recoil when a weapon is fired. The eyeshield contains two rubber flaps that close when the user's eye is removed from the scope to prevent light leakage.

The eyepiece is adjustable so the sight can be used without eyeglasses. The eyepiece and image intensifier are attached to the main housing by the range focus ring.

1.6 Boresight Filter

The dark filter glass supplied with the sight serves two functions. It provides protection for the objective lens when the sight is not in use and permits the sight to be operated under daylight conditions. The filter reduces the light input to the sight to a level comparable to full moonlight.

CHAPTER 2 – PRELIMINARY PROCEDURES

2.1 General

These procedures should be followed upon receipt or issue of the equipment, and repeated periodically to ensure proper operation. Check the sight against figures 1.1 or 1.2 for completeness of the sight and accessories.

2.2 Electrical Checkout

Remove battery cover and install four batteries oriented as shown in the engraved pictures on the housing (figure 2.1). Cover the objective lens by attaching the boresight filter, push the switch up and listen for a characteristic high pitch tone. Look into the eyepiece and turn the reticle control clockwise until the reticle is visible.



FIGURE 2.1 BATTERY INSTALLATION

2.3 Optical Checkout

This procedure may be performed in darkness, or in daylight with the boresight filter attached to the objective. First, depress the eyeguard and adjust the eyepiece ring until the reticle appears sharp. Next, rotate the focus ring until a distant (one kilometer) object or star is in sharp focus. Then rotate the focus ring counterclockwise to focus on a nearby object. As an aid in determining if the Hyper-Miniscopes is performing properly, a resolution target is inserted into the manual. Remove the resolution chart and place it on a wall or other flat surface at a viewing distance of 10 meters. Reduce the light to a level approximately equivalent to moonlight. Mount the Hyper-Miniscopes on a tripod or other suitable rigid fixture and focus on target. The Model 9823 (95 mm) Hyper-Miniscopes should be able to resolve both the horizontal and vertical lines of (-3, 1). The model 9823E (155 mm) Hyper-Miniscopes should be able to resolve (-2, 1).

2.4 Storage

Turn the unit off, rotate the reticle control fully counterclockwise, remove the batteries, and store the batteries separately in the case. Remove all dirt and moisture, then place the boresight cover over the objective lens and place unit in the case.

CHAPTER 3 – OPERATING INSTRUCTIONS

3.1 Preliminary

Check the sight for proper operation per Chapter 2.

3.2 Installation

Attach the sight to the weapon adapter bracket as shown in figures 6.2, 6.3, or 6.4. Tighten the thumbscrew to fully depress the spring washer.

3.3 Operation

The preliminary steps are identical to paragraphs 2.2 and 2.3.

- a. Install batteries. Observe polarity.

NOTE

At temperatures below 0°C, use Mallory battery no. 9R81 for maximum life.

- b. Turn the sight on by pushing the switch upwards.

NOTE

Eyeglasses should be removed. They are not required with this sight.

- c. Place eye against eyeshield to open flaps.
- d. Turn reticle control clockwise until reticle is visible.
- e. Adjust eyepiece ring for best image of reticle pattern.

NOTE

Each operator may require a different eyepiece setting. The eyepiece setting is NOT affected by adjustment of the range focus.

- f. Rotate the range focus ring for the sharpest image of the scene.

NOTE

Turn the focus ring clockwise as viewed from the eyepiece end to focus on distant objects.

3.4 Boresighting

The reticle projector is a ball-mounted optical device within the objective lens. The two cross-slotted actuators are turned with a coin, cartridge rim or similar object to adjust the position of the reticle (figure 3.1). The following procedures should be followed:

- a. Select a target at the proper range (100 meters for small caliber weapons).
- b. Place the weapon in a stable position with sandbags, or on a mount.
- c. Look through the sight and align the center reticle dot with the target. Use the daylight sight if possible as a guide for coarse boresight setting.
- d. Sight the weapon and fire several rounds to obtain a shot group.
- e. Move the reticle to coincide with the center of the shot group.

NOTE

Each click of the reticle actuators moves the aiming point one quarter mil (25mm per 100 meters range).

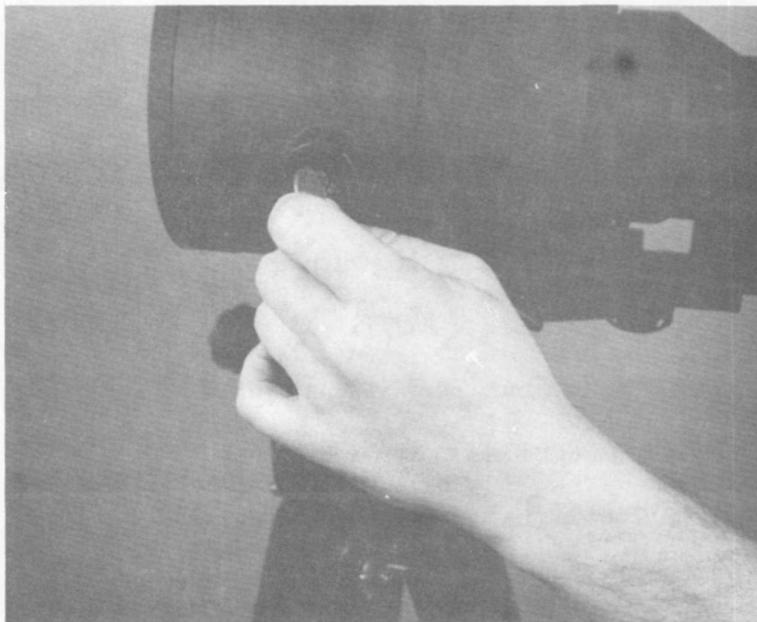


FIGURE 3.1 RETICLE ADJUSTMENT

CHAPTER 4 – MAINTENANCE

4.1 Introduction

CAUTION

The eyepiece, objective, and image intensifier assemblies are sealed units that must not be opened except under laboratory conditions.

This section contains instructions on the field maintenance of the Varo Hyper-Minisphere. Discussions are limited to preventive maintenance and those repair procedures which can be accomplished with the use of tools normally available under field conditions.

4.2 Preventive Maintenance

Preventive maintenance on the Hyper-Minisphere should be performed weekly and before each use. The following table presents the preventive maintenance checks and services for the Hyper-Minisphere:

Item to be Inspected	Procedure	References
Hyper-Minisphere	a. Check for completeness, including spares. b. Check for dirt and moisture on external surfaces and parts.	Figure 1.1 or 1.2
Carrying Case	Check for dirt, moisture, and mildew. Service as required.	Paragraph 4.3
Controls	While making the operating checks, see that the mechanical action of each knob, switch, and control is smooth and free of external or internal binding.	Report to higher category of maintenance if repairs are required.
ON/OFF Control	Place in ON position. Look for characteristic green glow.	Paragraph 2.2
Eyepiece Ring	Adjust for sharp reticle image.	Paragraph 2.3
Range Focus Ring	Adjust for sharp image.	Paragraph 2.3
Reticle Intensity	Rotate control and check that the reticle intensity can be controlled.	Paragraph 2.2
Azimuth Adjustment Knob	Rotate azimuth adjustment knob, and see that reticle is adjustable.	Report to higher category of maintenance if repairs are required.

NOTE

If the sight is zeroed to a particular weapon, count the number of clicks, and return the knob to its original position.

Elevation Adjustment	Rotate elevation adjustment knob, and see that reticle assembly is adjustable. See note above.	Report to higher category of maintenance if repairs are required.
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4.3 Cleaning

a. **Glass Surfaces.** Clean the glass surfaces of the Hyper-Miniscopes by removing any loose dirt with a lens brush and then cleaning the glass with a lens tissue. The tissue may be saturated with water to remove stubborn dirt. Care must be exercised to ensure that lens is not scratched. Dry lens.

b. **Metal Surfaces.** Clean the exposed metal surfaces with a lint free cloth. The cloth may be dampened with water if necessary. Be sure surfaces are thoroughly dried.

4.4 Troubleshooting

The following chart is to be used for performance of troubleshooting on the Hyper-Miniscopes. The symptoms in the troubleshooting chart are those which may be observed while performing the preventive maintenance checks and services as well as symptoms of trouble that may occur during normal operation.

Item	Trouble Symptom	Probable Trouble	Checks & Corrective Action
1	Very dim or no visible image.	a. ON/OFF control turned OFF.	a. Turn on.
		b. Boresight cover attached.	b. Remove cover.
		c. Weak batteries.	c. Replace batteries (para. 4.6).
		d. Open or loose wire.	d. Check wiring (para. 4.5).
2	Blurred image.	a. Sight out of focus.	a. Adjust focus (para. 2.3).
		b. Lenses are dirty.	b. Clean (para. 4.3).
3	Reticle pattern missing or low in intensity.	a. Batteries weak.	b. Replace batteries (para. 4.6).
		b. Reticle lamp burned out.	c. Replace reticle lamp (para. 4.7).
		c. Open or loose wire.	d. Check wiring (para. 4.5).

4.5 Voltage and Resistance Checks

Occasionally a wire may be broken within the sight. Repairs can be accomplished through checking resistances and voltages within the housing. Refer to the schematic (figure 4.1a) for wiring information for serial numbers 1 through 105. Refer to figure 4.1b for all later serial numbers.

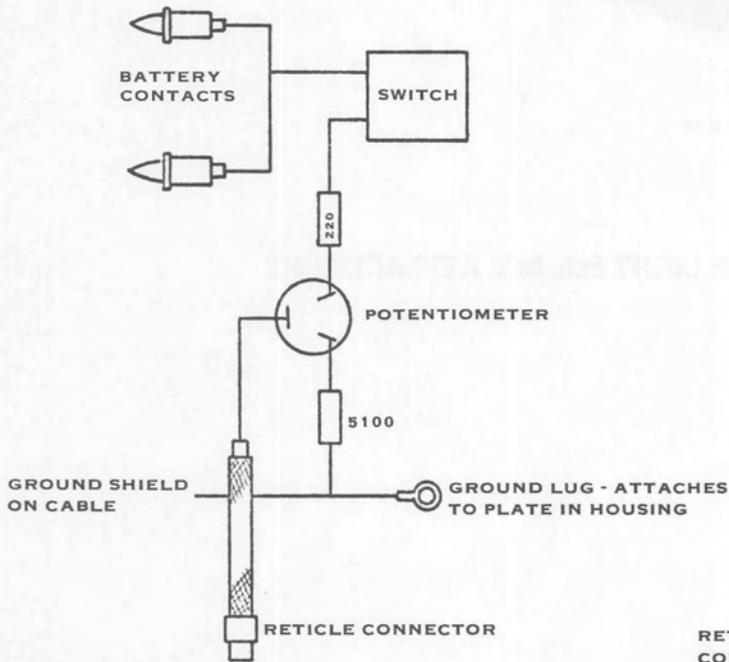


FIGURE 4.1a. SCHEMATIC FOR SERIAL NUMBERS 1-105

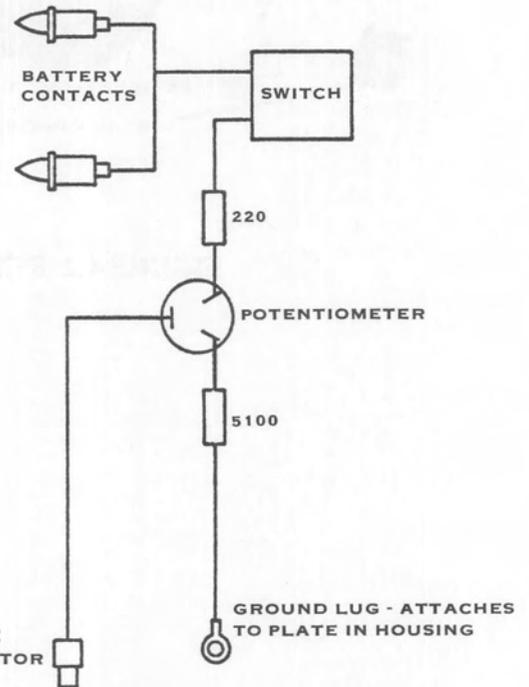


FIGURE 4.1b. SCHEMATIC FOR SERIAL NUMBERS 106 AND ABOVE

4.6 Battery Replacement

To replace the batteries, unscrew the battery cover and remove the old batteries. Insert fresh batteries, observing the polarity marked on the side of the battery housing and fasten the battery cover.

4.7 Reticle Light Source Replacement

NOTE

Do not overtighten the reticle projector cap, as the sealing ring makes it extremely difficult to remove an overtight cap.

To replace the reticle light source, remove the reticle projector cap (figure 4.2) and unscrew the light source assembly protruding from the center of the lens. This assembly, if found to be defective, should be discarded and replaced by a new one.



FIGURE 4.2 RETICLE LIGHT SOURCE REPLACEMENT

CHAPTER 5 – REPLACEMENT PROCEDURES

CAUTION

These procedures require special tools and should be performed in a dry, dust-free laboratory. Except where noted, the procedures are reversed for reassembly.

5.1 Eyeguard

Squeeze lightly on the spindling ring and rotate counterclockwise.

CAUTION

Do not operate the sight while the tube window is exposed. It becomes electrostatically charged and will collect dust particles from the air.

5.2 Eyepiece

Loosen the stop screw and remove (figure 5.1). Rotate the eyepiece counterclockwise to remove. See figure 5.2 for stop screw location.



FIGURE 5.1 REMOVAL OF EYEPIECE STOPSCREW

5.3 Image Intensifier (NATO Stock No. 5855-21-871-4118)

Remove the focus ring stop screw and rotate the focus ring counterclockwise until the ring can be pulled straight out. Loosen the clamp behind the focus ring and remove both the clamp and ring.

To replace the image intensifier, reverse this procedure with the following precautions. The clamp ring must be **tightly** clamped and the focus ring must turn without axial play.

To reinsert the image intensifier, push it gently until the guide pins meet the face of the tube. Rotate the tube to align the pins with the holes in the tube. The tube will move 3 millimeters upon alignment. Rotate the focus ring to complete assembly. See figure 5.3 for focus stop screw location.

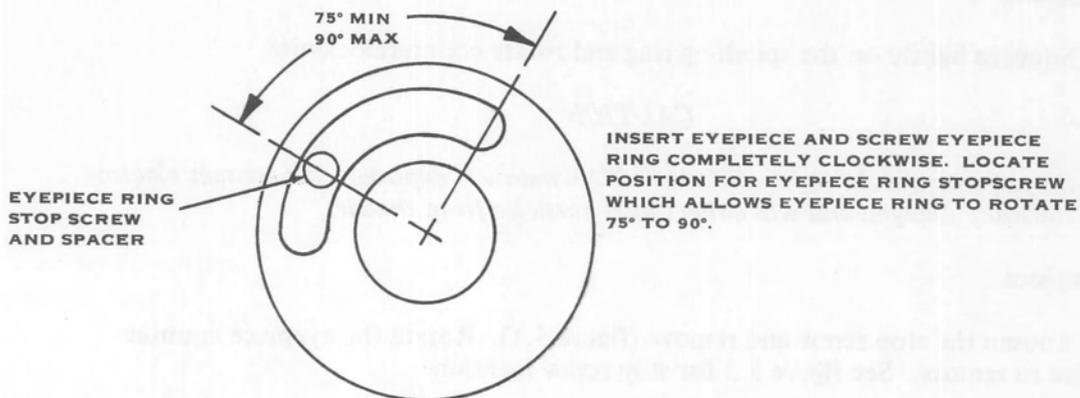


FIGURE 5.2 LOCATION OF EYEPIECE RING STOP SCREW

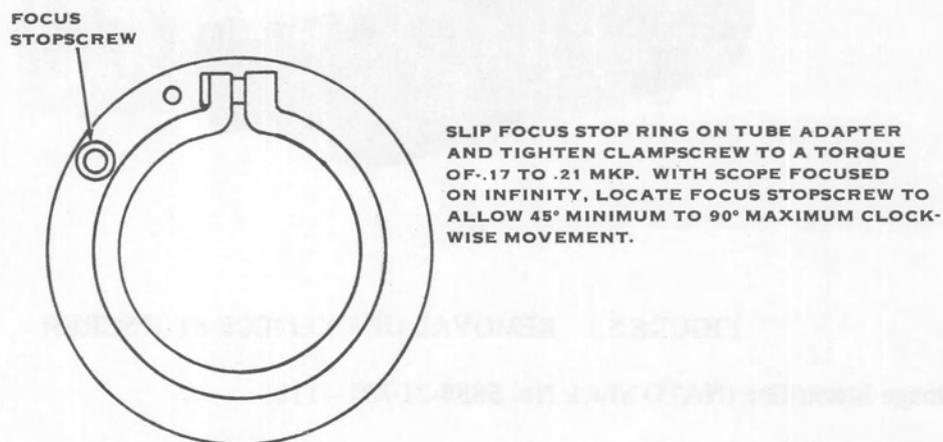


FIGURE 5.3 LOCATION OF FOCUS STOP SCREW

5.4 Objective Lens

Rotate the objective coupling ring and pull the objective away from the main housing.

NOTE

The 155mm objective is also attached to the mounting foot with a screw which must be removed.

On earlier models, serial number 1 through 105, the electrical contact between the battery housing and the objective lens consists of a flexible connector that must be disconnected to remove the objective lens. To disconnect, gently twist and pull the reticle connector. To reassemble, first mate the connector, gently twisting and pushing until it snaps together. See figure 5.4. On later models this flexible connector has been replaced with a male plug-in connector fixed to the battery housing. On these models, the objective may be removed by first disconnecting the coupling ring and then pulling it away from the battery housing. To reassemble, first align and plug the electrical connectors together and tighten the coupling ring.

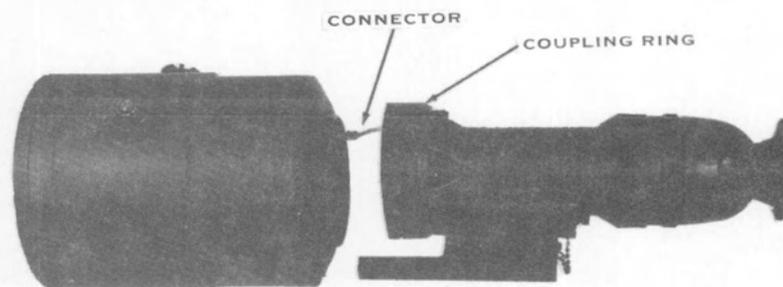


FIGURE 5.4 REMOVAL OF OBJECTIVE LENS

CHAPTER 6 – ACCESSORIES

The accessories available for the Hyper-Miniscopes are divided into three general classes:

- a. Ballistic reticles for the weapons listed in the specifications.
- b. Mounting brackets for the listed weapons. Others are manufactured to special customer specifications.
- c. Special optical accessories as desired by the customer.

6.1 Ballistic Reticles

The Hyper-Miniscopes are designed to use interchangeable reticles to match the ballistics of various weapons. These reticles have range marks expressed in hundreds of meters.

NOTE

Most of the reticles are designed specifically for either the 95mm (individual) or 155mm (crew served) objective lens and they are shown in figure 6.1.

To replace the reticle, remove the reticle lamp per paragraph 4.7 and pull the reticle out (figure 4.2). Replace with the proper reticle, aligning the guide pins in the slot in the projector. Replace the lamp and cover and check for operation and alignment per Paragraph 2.2.

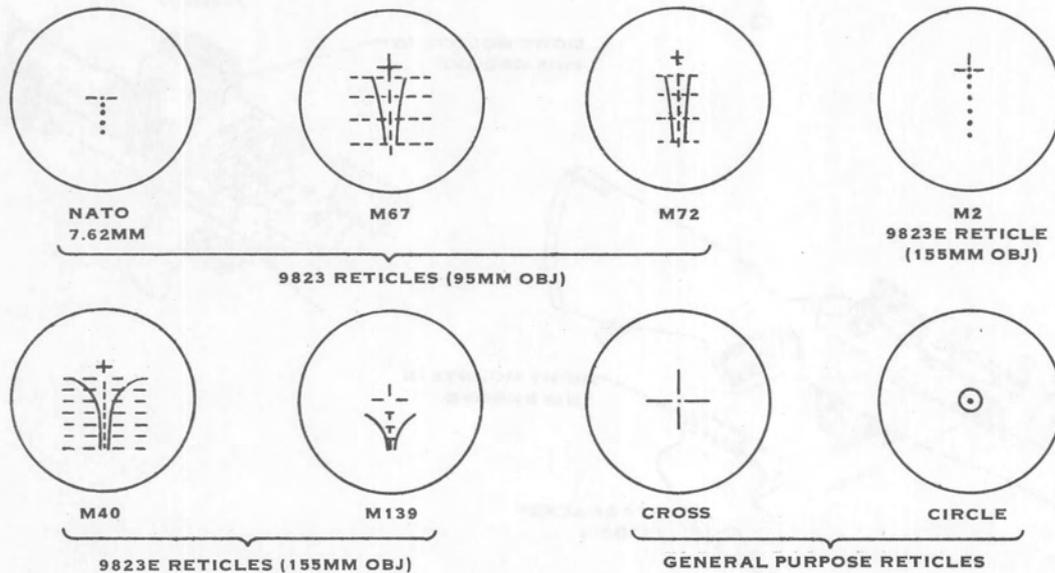


FIGURE 6.1 BALLISTIC RETICLES

6.2 Mounting Brackets

The Hyper-Miniscopes mount is attached to the handle of the M16 rifle with a thumbscrew as shown in Figure 6.2. The mounting brackets for various other weapons are shown in figures 6.3, 6.4, and 6.5. Each bracket attaches to the weapon as shown and the sight attaches exactly as to the M16. In each case, the thumbscrew must be tightened to fully flatten the spring washer for secure mounting.

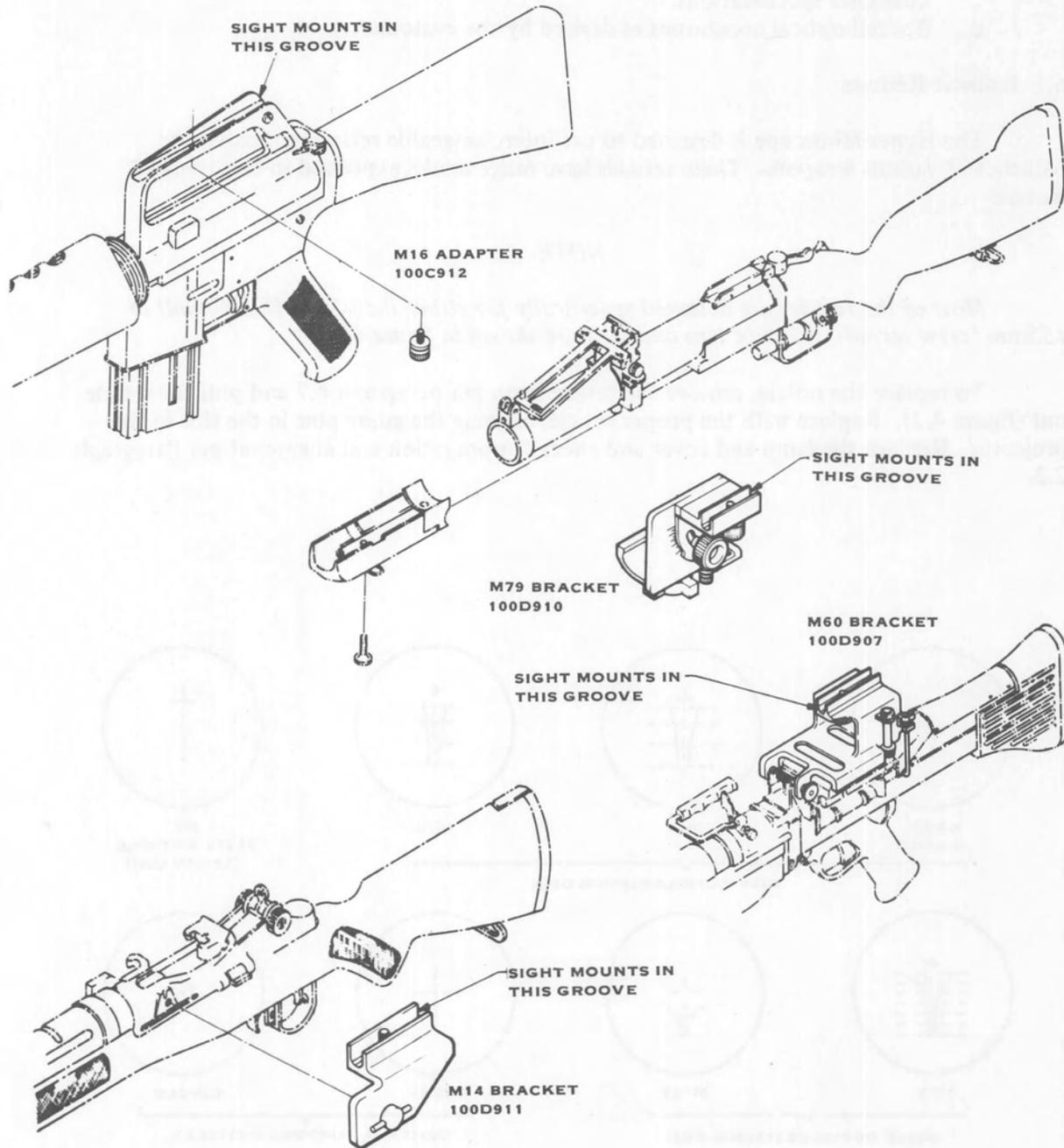


FIGURE 6.2 9823 ADAPTER BRACKETS

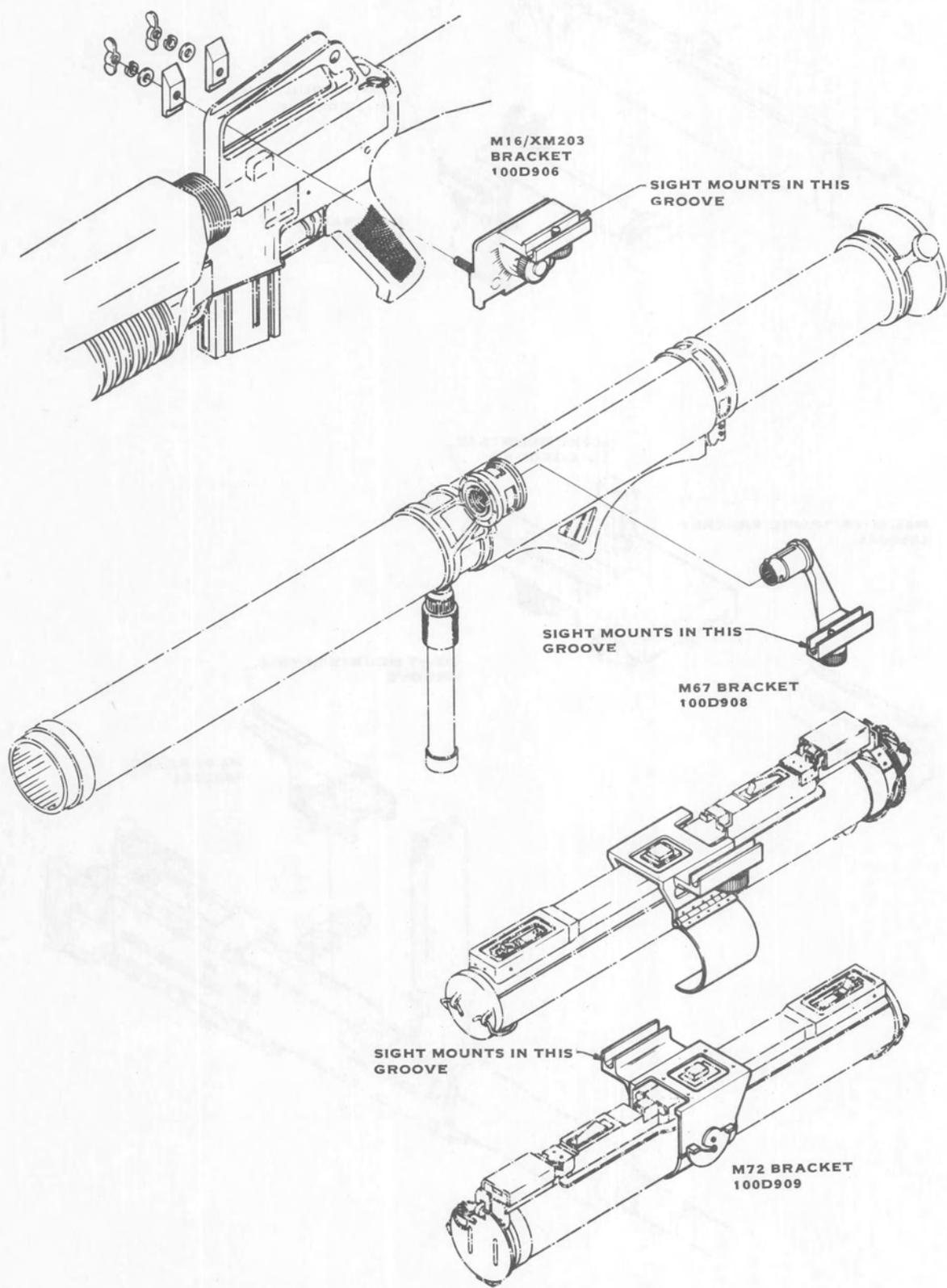


FIGURE 6.3 9823 ADAPTER BRACKETS

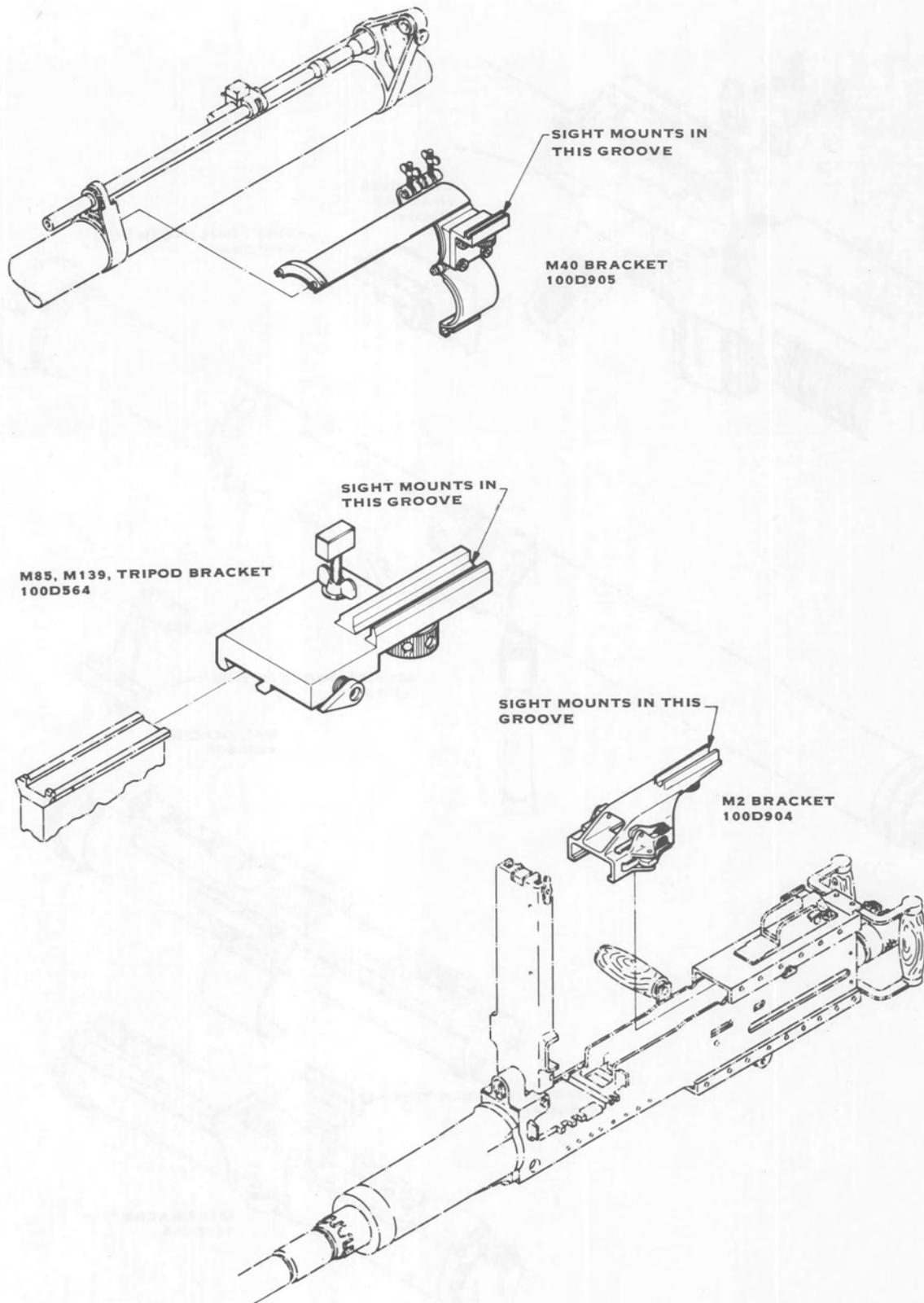


FIGURE 6.4 9823E ADAPTER BRACKETS



FIGURE 6.5 HYPER-MINISCOPE ON M16

6.3 Optical Accessories

a. **Boresight Filter.** The boresight filter is a rubber-mounted dark filter glass which slips over the front of the objective lens. It reduces the light entering the sight and permits operation during daylight hours for boresighting and checkout.

b. **Right Angle Adapter.** This optical adapter is required for using the sight on the M40 Recoilless Rifle. To install the right angle adapter, remove the standard eyepiece in accordance with para. 5.2 and attach it to the right angle adapter. Attach the threaded coupling ring to the scope and install the adapter as shown in figures 6.6 and 6.7.

c. **Camera Lens.** Remove the eyepiece (para. 5.2) and attach the relay lens assembly to the scope body. Adapters for most 35mm SLR cameras are available.

d. **Salt Spray Cover.** This cover is intended for use at sea to protect the objective lens. It slips over the front of the objective lens barrel.

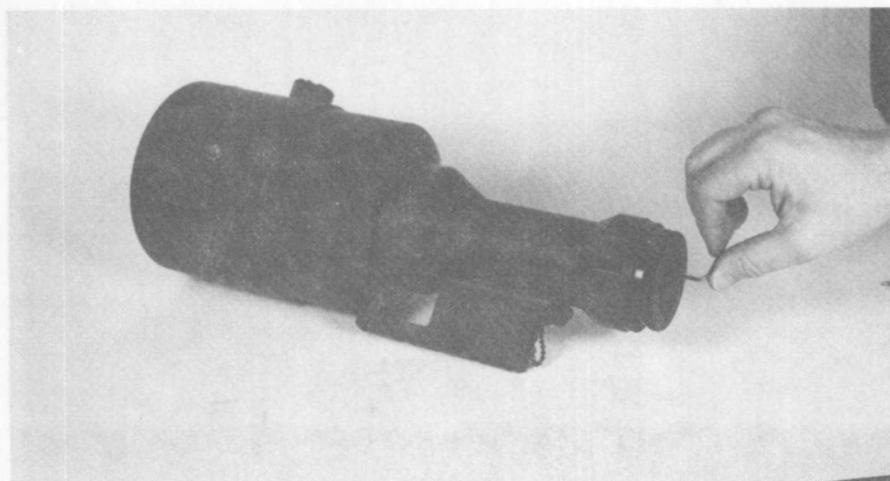


FIGURE 6.6 INSTALLATION OF COUPLING RING

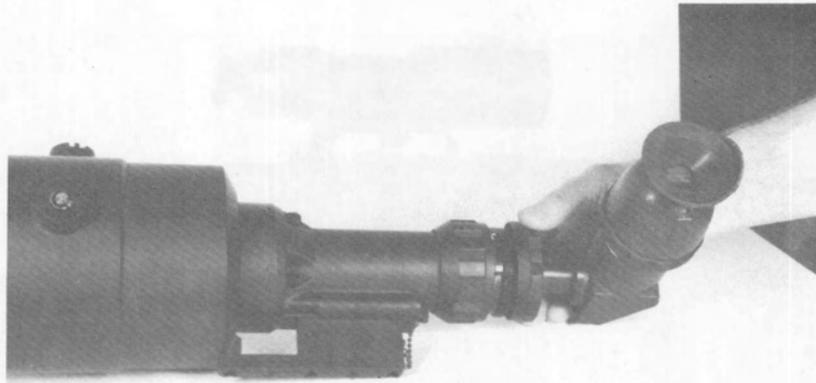


FIGURE 6.7 INSTALLATION OF RIGHT ANGLE ADAPTER

CHAPTER 7 – RECOMMENDED SPARE PARTS

Item No.	Illustration Fig. No.	Page	Description	Part No.	
				95 mm	155 mm
1	—	—	Boresight Cover Assy	100C877G1	100C877G1
2	1.3	3	18mm Image Intensifier	100C741	100C741
3	1.3	3	Objective Lens Assy	100D387G1	100D756G1
4	4.2	12	Reticle Light Source	100D571G1	100D571G1
5	—	—	Battery Housing Assy	100D747G3	100D747G3
6	—	—	Close-out Plate Assy	100D760G2	100D760G2
7	1.3	3	ON/OFF Switch	MS24655-221	MS24655-221
8	1.3	3	Brightness Adjust Reticle Potentiometer	100B771P1	100B771P1
9	1.3	3	Battery Cover	100C770G1	100C770G1
10	1.3	3	Mounting Foot	100C735	100C390G1
11	1.3	3	Eyepiece Assy	100C736G1	100C736G1
12	1.3	3	Eyeshield Assy	100C737G2	100C737G2
13	6.2	18	M16 Adapter	100C912	
Set of O-Rings consisting of:					
14	—	—	O-Ring	MS9021-022	MS9021-022
15	—	—	—	MS9021-029	MS9021-029
16	—	—	—	MS9021-031	MS9021-031
17	—	—	—	MS9021-033	MS9021-033
18	—	—	—	MS9021-041	MS9021-041
19	5.4	15	Connector	100B407P1	100B407P1
20	1.3	3	Range Focus Ring serial no. 1 - 105	100C381P1	100C381P1
			serial no. 106 on	100C381P2	100C381P2
21	1.3	3	Coupling Ring	305-062-401	305-062-401
22	2.1	5	Batteries	“Mallory” RM401	“Mallory” RM401
23	5.3	14	Stop Ring, Range Focus	100C380	100C380
24	5.3	14	Focus Stopscrew	MS16997-11	MS16997-11
25	5.2	14	Spacer, Eyepiece Focus Stop	100B712	100B712
26	—	—	Adapter, Eyepiece/Tube	100D750	100D750
27	4.2	12	Reticle Projector Cap	100D556	100D556
28	6.1	17	M2 Reticle	—	100D580G2
29	6.1	17	Cross Reticle	100D580G3	100D580G3
30	6.1	17	Circle Reticle	100D580G4	100D580G4
31	6.1	17	M72A1 Reticle	100D580G5	—
32	6.1	17	M67 Reticle	100D580G6	—
33	6.1	17	M40 Reticle	—	100D580G7
34	6.1	17	Nato Reticle, 7.62 mm	100D580G8	—
35	—	—	M85 Reticle	—	100D580G9
36	—	—	M139 Reticle	—	100D580G10
37	—	—	M14 Reticle	100D580G11	—
38	—	—	Reticle, 7.62	—	100D580G13
39	—	—	Reticle, Tank Mod., M2	—	100D580G14
40	—	—	Reticle, FN & Carl Gustaf	100D580G15	—
41	—	—	Reticle, 88.92 Launcher	100D580G16	—
42	—	—	Reticle, MG42	—	100D580G17

