23 March 2004

PURCHASE DESCRIPTION
BINOCULAR: stabilized, M25

AR-PD-121

1. SCOPE

This Purchase Description (PD) establishes the operational requirements, environmental requirements, and evaluation testing for the M25 Stabilized Binoculars hereinafter referred to as the M25.

2. APPLICABLE DOCUMENTS

The following documents are incorporated by reference. Where a document listed below refers to or incorporates one or more other documents that are not listed, the issues or version (including all changes and amendments) in effect on date of receipt of this PD shall govern.

2.1 Government Documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this purchase description to the extent specified herein.

SPECIFICATIONS
MILITARY

MIL-C-675C	Coating of Glass Optical Elements, 22 Aug 1980 with Amend 3, 20 Aug 1986
MIL-G-174B	Glass, Optical, 5 Dec 1986
MIL-PRF-13830B	Optical Components for Fire Control Instruments, General Specification Governing the Manufacture, Assembly and Inspection of, 9 Jan 1997
MIL-F-13926B	Fire Control Materiel, Manufacture and Inspection, General Specification for, 26 Mar 1984 with Amend 5, 8 Jul 1991
MIL-DTL-83723/73F	Connector, Electric, (Circular, Environment Resisting), Receptacle, (Single Hole Mount, Bayonet Coupling, Crimp Socket Contact) (Series III, Classes A, G, R, And W), 20 October 2000 with Amend 1, 20 Sep 2002 and Supplement 1A, 8 Jun 2001

STANDARDS	
MIL-STD-171E	Finishing Of Metal And Wood Surfaces, 23 Jun 1989, with Change Notice 1, 19 Nov 2001
MIL-STD-129P(2)	Marking for Shipment and Storage, 10 February 2004
MIL-STD-2073-1D(1)	Standard Practice For Military Packaging, 15 Dec 1999, with Notice 1, 10 May 2002
ANSI/ISO/ASQC A8402	Quality Management and Quality Assurance-Vocabulary
MIL-STD-810F	Department Of Defense Test Method Standard For Environmental Engineering Considerations And Laboratory Tests, 1 Jan 2000, with Change Notice 1, 1 Nov 2000, and Change Notice 2, 30 Aug 2002, and Change Notice 3, 5 May 2003
ISO 10012-1	Quality Assurance Requirements for Measuring Equipment
ISO 10012-2	Guidelines for Control of Measurement Processes
MIL-STD-461E	Requirements For The Control Of Electromagnetic Interference Characteristics Of Subsystems And Equipment, 20 Aug 1999
MIL-STD-1275B	Characteristics of 28 volt DC Electrical Systems in Military Vehicles, 20 Nov 1997
MIL-STD-1472F	Department of Defense Design Criteria Standard Human Engineering, 23 August 1999
ASTM D 5118	Standard Practice for Fabrication of Fiberboard Shipping Boxes
FEDERAL	
10CFR	10 Code of Federal Regulation
FED-STD-595B(1)	Colors Used in Government Procurement, 11 Jan 1994

2.1.2 Other Government documents, drawings and publications. The following other government documents, drawings and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

AR 70-38	Research, Development, Test and Evaluation of Extreme Climatic Conditions
11682338	Vehicle Receptacle Assembly
Army FM 3-5	NBC Decontamination
Addendum A	Human Factors Engineering Design for Army Materiel Metric, Optical instruments and associated equipment.

Laser Protection Addendum to the Statement of Work for M25 Stabilized Binocular (Non-DODISS)

2.2 Order of Precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Description: The M25 Stabilized Binoculars are a hand held, light weight, internally stabilized binocular (see 6.1.1), with laser protection and a rubber or other non-slip coating. The M25 incorporates laser hardening In Accordance With (IAW) the classified addendum to this purchase description. Each M25 Stabilized Binocular includes: straps, eye lens covers, objective lens covers, fold-down eye cups, a plastic or nylon carrying strap, hand strap (if more than 1.0 kg), day eyepieces, a mil scale reticle similar to the M22 Binocular, mounting hole cover, both a soft carrying and hard transportation case, and an operator's manual. The M25 is hardened against lasers and against natural and man-made environmental conditions. The M25 is designed to be upgraded for night vision capability without modification. Night vision eyepieces and Anti-Reflection Devices (ARD's) shall be available as accessories but two (2) of each shall be considered as part of the M25 for purposes of the performance requirements in this PD and as part of any First Article Test or First Article Sample deliverables.

3.1.1 If the M25 requires power the M25 also includes an integral battery state indicator, a set of batteries, external power cord, external power connection cover, and HMMWV power adapter. An M3A2 Bradley Fighting Vehicle power adapter, M1 tank power adapter, and arctic kit shall be available as accessories but shall be considered as part of the M25 for purposes of the performance requirements in this PD and as part of any First Article Test or First Article Sample deliverables.

3.2 Physical Characteristics. Note: All requirements are with laser hardening.

3.2.1 Capabilities. A 5th through 95th percentile soldier (stature), wearing appropriate climatic clothing, to include arctic garments and Nuclear, Biological, & Chemical (NBC) protective, equipment, and eyeglasses, shall be able to hold and use the M25 with one hand. Human capabilities and limitations (see MIL-STD-1472, paragraph 5.6 and 5.11; and Addendum A to this PD) as well as ease of use must be considered in the design, engineering, operation, and maintenance of the M25; however, the following are the minimum required capabilities:

3.2.1.1 Weight. The maximum in use weight of the M25, including strap, eye cups/shields, eye lens caps, objective lens cover, and batteries shall not exceed 2.3 Kg (5.06 lbs) with day eyepieces nor 2.75 Kg (6.05 lbs) with night eyepieces.

3.2.1.2 Size. The maximum width between outer edges of the binocular perpendicular to, but in the plane of, the optical paths shall not exceed 8 inches. The height between the upper and lower edges of the binocular, perpendicular to the optical paths and the plane of the optical paths, shall not exceed 4 inches. The length at zero diopter setting, parallel to the optical path, not including lens cap, shall not exceed 12 inches in the day mode.

3.3 Design and Construction.

3.3.1 Workmanship. Unless otherwise specified, workmanship of the M25 shall conform to MIL-F-13926B. Finished items and parts shall not exhibit poor material and processing such as cracks, sharp edges, nicks, burrs, deformations and missing parts which may affect appearance, operations or safety. Extraneous metal shall be removed from castings or forgings.

3.3.2 Cleanliness.

3.3.2.1 The M25 shall be designed and constructed to provide a clear image free of glare from non-optical surfaces. When viewed through the aperture entrance, no evidence of moisture, grease, condensates, fingerprints, fractures or adhesive separations shall be found on any glass component.

3.3.2.2 The optical parts and entire interior of the M25 shall be clean and free from dirt, dust, grease and other foreign matter. There shall be no foreign matter obvious to the unaided eye which would impair optical performance when looking into the binocular eyepiece against a background having the brightness of the sky in average daylight. The M25's interior shall be free from lubricants and coatings which may bleed, outgas, chip, or flake.

3.3.3 Sealing and Purging. All internal optical areas of the M25, except for the space between any interchangeable day/night objective assemblies and the next optical element forward, shall be purged with dry nitrogen. Body openings shall be sealed so that the interior is moisture-free after purging.

3.3.4 External Covering. The external surfaces of the M25 body shall be of a rubber or other non-slip covering with a matte surface, and designed to prevent slipping while in the user's hands. The covering shall also serve to protect the M25 from minor bumps, shocks, and abrasion. Leather is not an acceptable covering.

3.3.5 Color. The M25 shall be predominantly one basic color: black, color No 37030; green, color No 34094; or field drab, color No 33105 per Federal Standard 595. All external metal parts that do not have a cover, including: chains, straps, caps, rivets, etc. shall have a non-reflective matte finish.

3.3.6 Night Vision Capability. The M25 shall be designed to accept without modification two Third Generation Omnibus IV or better Image Intensifier technology eyepieces for night use. If the M25 requires power to operate, the night vision eyepieces must utilize this power. The night vision eyepieces may not have a separate set of batteries nor external power connection. The power connection shall be automatically made when the night eyepieces are installed. If no power is required for the M25, separate power for the eyepieces is acceptable.

3.3.7 Operability. All adjusting mechanisms, closures, latches, switches, etc., shall be operable by a 5th to 95th percentile soldier (stature) while wearing the woolen inserts of arctic mittens.

3.3.8 Maintainability. The M25 shall be designed so that all external parts can be replaced in the field by the user using common tools. These parts at a minimum shall include:

Item No.	Quantity Per Binocular	Item Description
1	1	Strap, Neck
2	1	Strap, Hand
3	2	Cover, Objective Lens
4	2	Eye Cup, Day Eyepiece
5	1	External Power Cord
7	1	External Power Connection Cover
8	1	Eyepiece, Day
9	1	Eyepiece, Day w/ Reticle
10	1	Arctic Battery Kit
11	1	Cover, Mounting Hole
12	As Req'd	Batteries, AA
13	1	Case
14	1	Cover Battery Compartment
15	1	Soft Case/Chest Pouch
16	2	Eyepiece, Night
17	2	Anti-Reflection Device

3.3.9 Marking. Each M25 shall be marked on the eyepiece end with the words "M25 STABILIZED BINOCULAR", "S/N" followed by a unique serial number, and "CAGE" followed by the proper cage code. The color white (FED STD 595, color number 37875) shall be used for these markings. A blackened stamped impression in a reverse color field shall be acceptable for the serial number field.

3.4 Components.

3.4.1 Eyepiece Interchangeability. The day and night eyepieces shall be easily interchangeable in darkness, using no tools.

3.4.1.1 Day Eyepieces. The M25 and the Day Eyepieces shall be specially designed with a unique interface (e.g., pining) so that commercial (non-laser hardened) eyepieces cannot be used. The manufacturer shall maintain an interface control document/drawings that boldly note(s) this as a safety critical specification.

3.4.1.2 Image Intensifier Night Vision Eyepieces (see 3.3.6 above). The eyepieces shall consist of an optical cell assembly and an image intensifier tube. The image intensifier tube shall meet the Mil-Spec requirements of and be common with the most recent US Army night vision goggles being procured (at least AN/PVS-7D, GEN 3, Omnibus 4). The eyepieces shall be interchangeable between different base units with no internal adjustments required. A well protected place in the M25's

carrying/storage case shall be provided for one set of eyepieces.

3.4.1.2.1 The Night Vision Eyepieces shall be marked with a unique identifying (serial) number.

3.4.2 Eye Cups/Shields, Eye Lens Caps, and Objective Lens Covers. The M25 shall be provided with separate eye cups/shields for day and night modes which shall be foldable to allow for use with eyeglasses. The eye cups/shields for the night mode shall minimize light leakage around the eyes when in use. The M25 shall also be provided with covers for the objective lenses. These components shall be made of tear resistant rubber or elastomer material. Leather shall not be acceptable. The objective lens covers shall be attached to the M25 by straps or extensions of the cover material so that the covers will fall below the field of view when the binocular is in use. Caps shall be provided with night vision eyepieces to protect the front surface of the image intensifier tube when in storage. The cups/ shields and covers shall be interchangeable between different binoculars of the same type and from side to side.

3.4.3 Neck Strap.

3.4.3.1 The M25 shall be equipped with a carrying strap of a plastic or nylon material with high strength/stress reinforcement. The strap shall be between 97 and 112 cm (38 and 44 inches) in length. The strap shall have between 2.5 and 4 cm (1 and 1.5 inches) wide padding at the center section. This section shall be 31 cm (12 inches) long and shall have equidistant strap ends whose length shall be no less than 33 cm (13 inches) nor more than 41 cm (16 inches). The padding shall be made from web strapping or other suitable material. The strap shall be firmly attached to the binocular body and shall be detachable for replacement. The straps and connections shall be able to withstand a fall of the M25 from a height equal to the strap's total length.

3.4.3.2 The strap shall be equipped with a quick release mechanism for emergency egress purposes. The quick release mechanism shall allow the user to break away the strap, in one motion, using one hand while wearing the woolen inserts of arctic mittens.

3.4.4 Hand Strap. If the M25 weighs more than 1.0 Kg (2.2 lbs) and is more than 5 cm (2 in) thick it shall be furnished with an adjustable hand strap. The hand strap shall be firmly attached to the binocular body in such a manner that a hand in the strap can engage and disengage the stabilization easily.

The M25 shall be capable of being switched from the caged to uncaged mode while held by one hand and by that hand that is holding it. This strap shall provide an adjustable clearance for the hand of 12.2 cm (4.82 in) wide and 8 cm (3 in) high. It shall allow for easy adjustment without having to remove the hand from under the strap and without having to remove the strap from the binocular body.

3.4.5 ON/OFF Switch. If the M25 requires the use of electricity it shall have an ON/OFF switch. The words "ON" and "OFF" shall be inscribed on the binocular body and the color white (FED STD 595, color number 37875) shall be used. Letter size shall be 2.3mm (0.09 in). When in the OFF position there shall be no drain on the power source. Also, see 3.4.12.

3.4.6 Cage/Uncage. The M25 shall be equipped with a device to lock the stabilization platform in a caged position.

3.4.6.1 A Cage/Uncage switch shall be provided that is operable by the hand holding the M25 while in the viewing position. If a hand strap is provided the switch shall be operable by the hand in the hand strap while the woolen inserts of arctic mittens are worn. No force shall be required to keep the binocular in the caged ("locked") position. If a push-button or pressure sensitive switch is used the words "PUSH BUTTON TO STABILIZE" or "TOUCH PAD TO STABILIZE" respectively shall inscribed on the binocular body. If a two position switch is used, the words "LOCKED" and "STABLE" shall be inscribed on the binocular body. The inscription shall either be the color white (FED STD 595, color number 37875) or, in the case of a touch pad, raised lettering in the color of the binocular body.

3.4.6.2 In the event of a power loss to the system the operator shall be able to cage the stabilization platform or the binoculars shall automatically cage themselves. In the caged mode, the M25 shall function as a standard (unstabilized) binocular.

3.4.6.3 If a continuous force needs be applied to keep the platform uncaged, an ON/OFF micro-switch or pressure sensitive pad shall be used to ensure the system is caged when digital pressure is released. Requirements for such a switch are as follows:

Resistance: 283 g (10 oz) max. per 0.5 inch diameter area
Displacement: 0.63 cm (0.25 in) max.

3.4.6.4 The caging mechanism shall hold the cage tightly when submitted to the following test: The M25 binocular in the powered on - caged mode is to be held at the midpoint with the

axis of rotation 2.0 plus/minus 0.5 inches below the center line of the optical axis while a 30 degree excursion is conducted at a rate of 150 cycles per minute for a total of 10 cycles. The caging mechanism shall hold the cage tightly during the full 10 cycles.

3.4.7 Tripod Mountability. The M25 shall have a standard camera tripod threaded mounting hole (1/4 - 20) located on the lower side of the binocular body for mounting the M25 to a tripod. This hole shall be located as close as possible to the center of mass. This hole shall be provided with a cover or insert that is tethered to the binocular body.

3.4.8 Operator's Manual. A government approved operator's manual shall be provided with each M25. The manual shall fit into the M25 carrying/storage case.

3.4.9 Carrying/Storage Case. The M25 shall be provided with a hard waterproof and airtight carrying/ storage case equipped with a pressure relief valve. The color of the case shall be black, color No 37030; green, color No 34094; or field drab, color No 33105 (FED STD 595). The inside of the case shall be padded with foam and have cutouts to hold the M25; all accessories including night eyepieces and Anti-Reflection Devices (even if not provided); a government approved operator's manual; and if power is required, a spare set of AA batteries and vehicle power cord.

3.4.10 Chest Pouch/Soft Case. The M25 shall be provided with a chest pouch with harness that shall double as a soft carrying case. The chest pouch shall be designed to fit a 5th through 95th percentile soldier (stature), wearing appropriate climatic clothing, to include arctic garments. It shall be suitable for dropping the binoculars into so that the soldier may run without the binoculars swinging free. It shall also have a top closure. The chest pouch shall be predominantly one basic color: black, color No 37030; green, color No 34094; or field drab, color No 33105 per Federal Standard 595. All external metal parts that do not have a cover, including: chains, straps, caps, rivets, etc. shall have a non-reflective matte finish.

3.4.11 Anti-Reflection Device (ARD). The ARD is a generic term to describe a device that is placed over the visibly exposed lens of an optical device, totally inhibits any reflection of light outside the field of view which could reveal a user's position. The ARD is a lightweight filter/shield that can be attached to optical devices without the use of any tools.

3.4.11.1 ARD Performance. The ARD should totally inhibit any reflection of light outside the field of view and minimize reflection of light inside the field of view of the M25, (see paragraph 3.7.6).

3.4.11.2 Resolution with ARD. Resolution of the M25 shall not be degraded by more than 10 percent using a 4 to 6 power dioptometer.

3.4.11.3 Field of View with ARD. The field of view of the optical device shall not be reduced when the ARD is used.

3.4.11.4 Entrance Aperture with ARD. The entrance aperture of the optical device shall not be reduced when the ARD is used.

3.4.11.5 ARD Cleanliness. The ARD shall be free of glare from surfaces and free from lubricants and coatings which may bleed.

3.4.11.6 ARD External Covering. The external surface shall be of rubber or other non-slip covering with a matte surface, and shall be of the same color as the M25. Leather is not an acceptable covering.

3.4.11.7 ARD Operability. The ARD shall have the durability to be used in standard military battlefield environments and the ARD's weight, length and width shall not adversely impact the operational use of the M25. The ARD shall attach and detach freely without the use of tools (fingers only), and shall take no more than one minute per system. This shall also apply when using cold weather and MOPP gloves.

3.4.11.8 ARD Environmental Resistance. The ARD shall meet all the above requirements of section 3.4.11 and not detach from the M25 after exposure to each and all the requirements of section 3.8, "Environmental Resistance."

3.4.12 Knob Durability. All knobs, rotary switches, and other parts that are designed to be rotated by hand during the use or maintenance of the M25 and their interfaces shall be designed and constructed so as not to fail or degrade when subjected to a torque after reaching their stops in both the clockwise and counter-clockwise directions as per the following table (for knobs falling in-between two diameters, use the larger diameter):

Diameter (inches)	Torque in Inch-Ounces
1/4	30
3/8	50
1/2	73
3/4	160
1	187
1-1/2	222
2	308
2-1/2	599
3	751

3.5 Power Requirements. If the M25 requires power to operate, the following requirements are applicable.

3.5.1 Battery Power.

3.5.1.1 Power shall be supplied by standard AA batteries. The battery compartment shall be integral with the binocular. Battery orientation shall be clearly marked on the binocular and the color white (FED STD 595, color number 37875) shall be used. Reverse polarity protection shall be incorporated. The battery compartment cover must be captive to the binocular body. A 5th through 95th percentile soldier (stature) shall be able to open and close the compartment while wearing the woolen inserts of arctic mittens. Also see 3.4.12.

3.5.1.2 Battery powered operating time shall be measured at an ambient temperature in the range from 70+/-8 deg Fahrenheit and shall be as follows:

3.5.1.2.1 The M25 Stabilized Binocular shall be capable of continuous stabilized operation in the day mode for a minimum of 8 hours using standard alkaline batteries, without the use of an external power source, and without changing any batteries.

3.5.1.2.2 The M25 shall be capable of continuous operation in the day mode with a minimum of 24 cycles from caged to uncaged and back again per hour for a minimum of 8 hours using standard alkaline batteries, without the use of an external power source, and without changing any batteries.

3.5.2 Vehicular Power. The M25 shall also be capable of being powered from vehicular power in the range of 6 to 28 volts DC without the use of an external adapter, regulator, or converter. Reverse polarity protection shall be incorporated.

A 10 foot (3.05 meter) long (when extended) coiled cord shall be supplied with a connector (MS3116E8-33P) functionally equivalent to that found on the Service Light, drawing number 9379604, found on the M3A2 Bradley Fighting Vehicle. This connector shall allow the M25 to be powered directly from the power cable designed for the Service Light or to be plugged into the adapter (3.5.2.1.1) and "T" connectors (3.5.2.1.2 & 3.5.2.1.3) described below. The other end of the power cord shall be supplied with a connector that positively locks to the binocular body. This cord shall be capable of being easily disconnected from the M25 and a place in the binocular storage case shall be provided for it. The external power connector on the binocular body shall have a cover that when removed to expose the power connection is still affixed to the binocular body. The cover and its connection to the binocular body shall be one of the colors specified in 3.3.5 above. The cord and its connections to the connectors shall be durable enough to withstand (support) a 1 foot (30.5cm) drop of the M25 without separating, loosening, or malfunctioning.

3.5.2.1 The M25 Stabilized Binocular shall be supplied with one adapter for providing vehicular power from a HMMWV. A space in the carrying case shall be provided for it. Two additional adapters as described below shall be available as accessories. Each adapter shall be clearly labeled for its application.

3.5.2.1.1 An adapter shall be provided that is suitable for allowing the M25 to be powered directly from the batteries of a HMMWV. The adapter shall be constructed of straight, (non-coiled), wire and shall be 8 feet (2.4 meters) in length. The adapter shall have the proper receptacle at one end to allow the specified power cord connector (MS3116E8-33P) to attach. The other end shall consist of wires with affixed "U" or circular connectors for fastening to the bolts of the battery terminal clamps. These connectors shall be able to accommodate a 3/8 inch bolt and shall be clearly marked "+" and "-". A cap on a cord, chain, or loop shall be provided to cover the connection, for the M25, when not in use. The "+" lead shall be fused with a standard fuse that is replaceable in the field without using any tools. Six zip ties, at least three inches in length shall be included for fastening the wire and recepticle to the HMMWV.

3.5.2.1.2 A "T" type adapter shall be available as an accessory that is suitable for inserting in the line between the M3A2 Bradley Fighting Vehicle Service Light, drawing number 9379604, and its power source. This "T" connector shall then allow the M25 to be powered in addition to the Service Light. A cap on a cord, chain, or loop shall be provided to cover the connection for the M25 when not in use.

3.5.2.1.3 A "T" type adapter shall be available as an accessory that is suitable for inserting in the line between the M1 Tank Commander's Dome Lamp, drawing number 12324064, and its power source. One arm of the "T" will consist of a connector functionally equivalent to that on the Dome Lamp (MS3474W8-98P). The other arm will consist of the respective socket. The leg shall consist of the proper connector to allow the above specified power cord connector (MS3116E8-33P) to attach. This "T" connector shall then allow the M25 to be powered in addition to the Dome Lamp."

3.5.3 Arctic Kit. The M25 shall be supplied with the availability, as an accessory, of an external battery pack and power cord suitable for allowing the binoculars to be used in cold conditions where the batteries in the binoculars would otherwise fail. The battery pack shall be capable of being secured to a soldier underneath a coat.

3.5.4 Battery Indicator. The M25 shall have an integral battery power indicator. At a minimum this indicator shall, through visual observation only, inform the operator when the power remaining in the batteries has dropped to 10-25% of full power in terms of operational time.

3.5.5 Battery Isolation. External power shall be able to be applied without removing the batteries. When external power is applied the batteries shall automatically be disconnected from the circuit.

3.6 Stabilization.

3.6.1 Output Amplitude. The M25 shall limit the output amplitude, over the operating temperature range, when subjected to inputs as specified in the following table:

FREQUENCY (HZ)	AMPLITUDE (deg. PEAK TO PEAK)	MINIMUM REQUIRED COMPENSATION (%)
0.2	1.0	24 (15 below 0°C)
0.5	1.0	60 (50 below 0°C)
1	1.0	75
3	1.0	94
5	0.5	97
10	0.5	98
20	0.25	98

3.6.2 Stabilization Freedom. The stabilization mechanism shall be capable of absorbing movements of up to +/-5 degrees without encountering a stop.

3.6.3 Stabilized Scan Rate. The M25 shall be capable of being used for scanning at a rate of up to 8 degrees per second without erratic movement of the image (see 6.1.3).

3.6.4 Electro-Magnetic Interference (EMI). The M25 in all modes of operation shall not emit any electro-magnetic signal that could interfere with the operation of any communication, navigational, or other electronic equipment found on military vehicles or aircraft. The M25 in all modes of operation shall meet all emission and susceptibility characteristics as established by MIL-STD-461.

3.7 Laser Eye Protection and Optical Characteristics.

3.7.1 Laser Eye Protection. Each optical channel of the M25 shall provide system level laser eye protection per the Laser Protection Addendum to this Statement of Work. The Addendum is classified SECRET. All optical coatings used for laser rejection shall be located in the sealed nitrogen purged confines of the optical system. Laser eye protection for the day optics shall not degrade performance of the Third Generation Image Intensifier Night Vision Eyepieces.

3.7.2 Thorium and Other Radioactive Materials. All glass elements used in the M25 shall be free of thorium and all other radioactive materials.

3.7.3 Optics. All optical elements shall be per MIL-PRF-13830. All optical elements shall be made of optical glass per MIL-G-174, Grade C minimum.

3.7.4 Anti-Reflection Coatings. All optical elements shall be coated with an anti-reflection coating per MIL-C-675.

3.7.5 Magnification. Magnification of each telescope of the binocular in the day mode shall be designed for a minimum of 14 power and in production shall measure no less than 13.6 power. Magnification in the night mode shall be optimized for maximum magnification combined with performance. Night mode magnification shall not be less than 11.8 power nor more than that of the day mode +0.4 power. The magnification shall not vary between telescopes by more than 2 per cent.

3.7.6 Field of View. The field of view in the day mode at 1000 meters shall be 73 meters or greater. The field of view in the night mode at 1000 meters shall be 66 meters or greater.

3.7.7 Collimation. The binocular collimation shall be within the following range for all interpupillary settings, at the zero diopter setting:

Divergence	40 minutes of arc max.
Dipvergence (from horizontal)	30 minutes of arc max.
Convergence	3 minutes of arc max.

3.7.8 Eye Relief. The eye relief shall be a minimum of 14 mm (.55 in) and a maximum of 22 mm (.87 in).

3.7.9 Nose Clearance. A minimum clearance of 45mm (1.77 in.) from a point 38 mm (1.5 in.) below the midpoint of the two eye positions shall exist to all parts of the binocular excluding the eyepieces. A minimum clearance of 45 mm (1.77 in.) from a point 38 mm (1.5 in.) above the midpoint of the two eye positions shall exist to all parts of the binocular excluding the eyepieces.

3.7.10 Resolution. All resolution requirements are without the ARD (Anti-Reflection Devices) installed.

3.7.10.1 The day system resolution in the caged mode with the unit powered down shall be 4.3 seconds of arc (per line pair) or better, when measured at the center of the field of view. Horizontal and vertical lines shall be resolvable within 0.5 diopter.

3.7.10.2 The day system resolution in the uncaged mode with the stabilization active, and the unit bench mounted, shall be 6.0 seconds of arc (per line pair) or better, when measured at the center of the field of view. Horizontal and vertical lines shall be resolvable within 0.5 diopter.

3.7.10.3 The night system resolution in the caged mode with the unit powered up shall be a minimum of 60 line pairs per millimeter.

3.7.11 Image Tilt. The images of an infinity plumb line formed by the two optical systems shall be parallel to each other within one degree of arc. Neither image shall vary from the vertical by more than one degree of arc.

3.7.12 Parallax. Parallax when measured at the center of the field, shall not exceed 2 mils.

3.7.13 Focus. The M25 shall be fixed focus from 50 meters to infinity.

3.7.14 Eyepiece Focus. Individual eyepiece focus is required. The individual eye pieces shall be adjustable through a range of +/-4 diopters centered on either 0 or -2 diopters. The individual diopter scales shall be graduated through a minimum range of +/-4 diopters from the center setting (either 0 or -2 diopters). Markings shall be provided every diopter. Markings shall be accurate within +/-0.25 diopter.

3.7.15 Eyepiece Torque. The torque required to turn the diopter scale shall not be greater than 4618 g-cm (64 inch ounces) at any temperature in the range from -40 degrees C to +70 degrees C (-40 degrees F to 158 degrees F).

3.7.16 Interpupillary Adjustment. The M25 must have an interpupillary adjustment which covers a minimum range of 60 to 72 millimeters (2.36 to 2.83 in). A graduated scale shall be provided which covers this range and shall be suitable for the intended purpose. Marked settings shall be accurate within +/-1 millimeter (+/-0.04 in.) of true position.

3.7.17 Interpupillary Torque/Force. The interpupillary distance hinge shall be fitted and adjusted with sufficient tightness and hinge lubricant shall be of such a consistency that the following range of torque/force values are obtained:

+15 to 33 deg. C (+59 to 91 deg. F)	3.46 to 32.3 Kg-cm (3 to 28 in-lb)
-40 deg. C (-40 deg. F) (-40 deg. F)	49.5 Kg-cm Max (43 in-lb Max)
+70 deg. C (+158 deg. F)	49.5 Kg-cm Max (43 in-lb Max)

3.7.18 Entrance Pupil Diameter. The entrance pupil diameter shall be no less than 40mm.

3.7.19 Reticle. The M25 shall contain a reticle as described below with the reticle pattern approximately centered in the field of view. The reticle may be contained within either ocular and if not projected shall be a two piece cemented type consisting of a reticle and a cover plate. The cover plate shall have a thickness of 0.25 cm +/- .025 cm (0.100 in +/- 0.01 in).

3.7.19.1 The cover plate and the reticle shall be from the same glass melt. The index of refraction of the cement used shall match the indices of the glass within +/-0.001. External surfaces shall have a surface quality of 20-10 or better. The back surface (air-to-glass) of the reticle and the air-to-glass

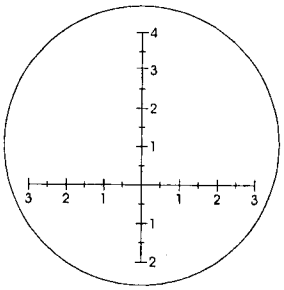
surface of the cover glass shall be coated per MIL-C-675. The surface quality at the reticle surface of both pieces shall be 10-5.

3.7.19.2 The horizontal reticle line is to cover a total range of at least 60 meters at 1000 meters distance. The scale shall be etched with graduations depicting 5 meter increments at 1000 meters. The reticle shall contain a vertical scale which is centered along the horizontal line. The vertical scale shall cover a total range of at least 60 meters at 1000 meters distance with 20 meters at 1000 meters distance below the horizontal line and shall be graduated so as to depict 5 meter increments at 1000 meters distance.

3.7.19.3 The horizontal reticle line shall be parallel to a line joining the centers of the right and left objective at an interpupillary distance setting of 63 +/-1 millimeter (2.5 +/- .04 inches). The reticle shall be of such a design that the user can readily identify the 10 meter graduations from the center of the scale. The reticle shall be otherwise suitable for its intended purpose.

See depiction of reticle below.

RETICLE DEPICTION



(NOT TO SCALE)

3.7.19.4 Reticle Illumination. If the M25 requires electrical power to operate a means of illuminating the reticle shall be provided.

3.7.19.4.1 The reticle shall be illuminated by a non-radioactive source.

3.7.19.4.2 The reticle illumination shall be adjustable.

3.7.19.4.3 At full illumination, the reticle shall not be detectable at a distance of greater than 15 meters in any direction by a 20/20 corrected eye.

3.8 Environmental Resistance. The M25 shall be capable of withstanding the following environments and shall remain operational without physical damage (see 6.1.2) or degradation of optical characteristics during and after each test. The M25 shall be designed so that it automatically cages when released from hand held uncaged use OR it shall meet all the requirements of this section in the uncaged mode. Note: All tests will be performed with the M25 OUT of its carrying case unless otherwise specified.

3.8.1 Shock. The M25 in both the caged mode and when released from hand held uncaged use, without manually switching to the caged mode; both with the main power on and off, shall be operational and shall not be damaged (see 6.1.2) after being subjected to a total of 12 shocks; four shocks along each of three mutually perpendicular axes, one of which shall be parallel to the optical path. In each position the binocular shall be subjected to four shock impulses with two impulses in each direction along the respective axis, for a total of 12 shocks. Each impulse shall be 40 +/- 4 "G's", half sine with a time duration of 11 +/-1 millisecond (see MIL-STD-810F, Method 516.4, Procedure I).

3.8.2 Transportation Vibration. The M25 in both the caged mode and when released from hand held uncaged use without manually switching to the caged mode; both with the main power on and off, shall be operational and shall not be damaged (see 6.1.2) after exposure in three mutually perpendicular axes to random vibration 5-500 Hz, with a representative spectral shape IAW figure 514.4-4 of MIL-STD-810F. Data points shall be obtained from table 514.4-AII of MIL-STD-810F. Time duration shall be 40 minutes per axis and the test shall be performed at temperatures of -46 and +49 deg. Centigrade (-50.8 and +120.2 deg Fahrenheit).

3.8.3 Drop. The M25 in both the caged mode and when released from hand held uncaged use without manually switching to the caged mode; both with the main power on and off, shall be operational and shall not be damaged (see 6.1.2) after being dropped: a.) with the M25 in its case 122 cm (4 ft) onto each face, edge and corner of the case for a total of 26 drops, the 26 drop requirement may be divided among up to five copies of the same test item; and b.) with the M25 out of its case 61 cm (2 ft) onto the objective side, eyepiece side, one other side, and either top or bottom of the binocular for a total of 4 drops. In both cases the floor or barrier receiving the impact shall be of two inch plywood backed by concrete (see MIL-STD-810F, Method 516.4, Procedure IV).

3.8.4 High Temperature Storage and Operation. The M25 shall be operational and shall not be damaged (see 6.1.2) by storage for 7, 24 hour cycles to +71 degrees C (+160 degrees F) and shall operate as specified herein on the last of 3, 24 hour cycles to +49 degrees C (+120 degrees F),(hot, dry conditions), (See MIL-STD-810F, Method 501.3).

3.8.5 Low Temperature Storage and Operation. The M25 shall be operational and shall not be damaged (see 6.1.2) by storage in any temperature to -46 degrees C (-51 degrees F) and shall operate as specified herein when exposed to (Threshold) -32 degrees C (-26 degrees F),(cold conditions); (Objective) -46 degrees C (-51 degrees F), for 24 hours (See MIL-STD-810F, Method 502.3).

3.8.6 Temperature Shock. The M25 shall be operational and shall not be damaged (see 6.1.2) and shall operate as specified herein when exposed to temperature shock from ambient (21 degrees C) to cold (-46 degrees C) conditions of ground transfer/air delivery - arctic (See MIL-STD-810F, Method 503.3).

3.8.7 Watertightness. The M25, preheated to 27 degrees C above the water temperature, shall not indicate leakage (including all internal optical areas, pre-eyepiece area, day and night eyepiece assemblies, and battery compartment) and not be damaged (see 6.1.2) after having been immersed under one meter of water for 120 minutes (see MIL-STD-810F, Method 512.3). No moisture or fogging of the lenses shall be observed. No moisture shall be observed in any internal cavity.

3.8.8 Humidity. The M25 shall be operational and shall not be damaged (see 6.1.2) after being subjected to five (5) continuous temperature-humidity cycles following the temperature and watertightness test (see MIL-STD-810F, Method 507.3). Each cycle to be conducted as follows:

a. Subsequent to the installation of the item in a suitable test chamber, the internal temperature shall be gradually raised to 71 degrees C (160 degrees F) and the relative humidity to at least 95 percent over a period of 2.0 + 0.25 hours.

b. The conditions of 3.8.7.a above shall be maintained for not less than six (6) hours.

c. While maintaining a relative humidity of at least 85 percent the internal chamber temperature shall be reduced to 20 degrees C (68 degrees F) over a period of 16 + 1.0 hours.

3.8.9 Altitude. The M25 shall be subjected to an equivalent altitude pressure of 4,572 meters (15,000 feet) above the sea level (see MIL-STD-810F, Method 500.3).

3.8.10 Salt Fog. The M25 shall be operational and shall not be damaged (see 6.1.2) after exposure to a 48 hour salt fog test using 5 +/- 1 percent salt solution at constant temperature of 35 degrees C (see MIL-STD-810F, Method 509.3). The salt used for this test shall be sodium chloride (NaCl).

3.8.11 Nuclear, Biological, & Chemical Decontamination Compatibility. All external elements of the M25 including the exterior of the carrying case shall not be damaged by NBC decontamination procedures. These procedures shall be as specified by Army FM 3-5 NBC Decontamination. A resultant insoluble white residue on non-optical surfaces is not cause for failure.

3.8.12 Fungus Resistance. The M25 shall be fungus resistant in accordance with MIL-STD-810 for a 28 day cycle.

3.8.13 Dust. The M25 with lens caps in place shall meet the dust requirements of MIL-STD-810.

3.9 Reliability. The M25 shall be constructed so as to demonstrate a mean time between essential function failures of not less than 230 hours when subjected to soldier use in an operational environment.

4. QUALITY ASSURANCE PROVISIONS.

4.1 Responsibility for Inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use its own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this Purchase Description where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.1.1 Responsibility for Compliance. All items shall meet all requirements of section 3 and 5. The inspection set forth in this Purchase Description shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in this Purchase

Description shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract.

Sampling inspection, as part of manufacturing operation, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 General Provisions. Unless otherwise specified, the provisions of MIL-F-13926B apply and form a part of this Specification. Reference shall be made to ANSI/ISO/ASQC A8402 to define quality assurance terms used herein.

4.1.3 Calibration. Inspection equipment used shall be calibrated in accordance with ISO 10012-1 AND ISO 10012-2.

4.2 Inspection Equipment. The inspection equipment required to perform the inspections specified herein is identified in the "Inspection Method Reference" column of the Classification of Characteristics listed starting with 4.4.2.1. Contractor inspection equipment designs shall be submitted for Government approval as specified in the contract. Designs which provide variable measurements instead of attributes information are preferred in order to facilitate the use of statistical data.

4.3 Classification of Inspection. The inspection requirements (examinations and test) specified herein are classified as follows:

a. First Article Inspection (see 4.4)

b. Quality Conformance Inspection (see 4.5)

4.4 First Article Inspection.

4.4.1 Submission. The contractor shall submit a first article sample as designated by the Contracting Officer for evaluation in accordance with provisions of 4.4.2. The first article sample shall consist of assemblies, components and test specimens listed below in the quantities indicated.

QUANTITY	NOMENCLATURE	INSTRUCTIONS
12 each	Binocular, Stabilized, M25	Completely assembled and with its container, and all accessories including HMMWV, M3A2 Bradley

		Fighting Vehicle, and M1 Tank power connectors and Arctic Kits
6 each	Night Vision Eyepiece	Image Intensifier Night Vision Eyepieces

4.4.2 Inspection to be Performed. As determined by the Government, the first article assemblies, components and test specimens may be subjected to any or all of the examinations and test specified in the detail Purchase Description and be inspected for compliance with any or all requirements of the applicable drawings.

4.4.2.1 TABLE I Classification of Characteristics, First Article Test

	CHARACTERISTIC	CONFORMANCE CRITERIA	REQUIREMENT SECTION	INSPECTION REFERENCE
1	Capabilities	100%	3.2.1	4.6
2	Weight	100%	3.2.1.1	4.6
3	Size	100%	3.1.1.2	4.6
4	Workmanship	100%	3.3.1	Visual/Tactile
5	Cleanliness	100%	3.3.2	4.6
6	Sealing and Purging	100%	3.3.3	4.6
7	External Covering	100%	3.3.4	COC
8	Color	100%	3.3.5	Visual/FED-STD-595
9	Night Vision Capability	100%	3.3.6	4.6
10	Operability	100%	3.3.7	4.6
11	Maintainability	100%	3.3.8	4.6
12	Marking	100%	3.3.9	Visual
13	Eyepiece Interchangeability	100%	3.4.1	4.6
14	Day Eyepieces	100%	3.4.1.1	4.6
15	Third Generation I^2 Eyepieces	100%	3.4.1.2	4.6
16	Night Vision Eyepiece Serial Number	100%	3.4.1.2.1	Visual
17	Eye Cups and Lens Covers	100%	3.4.2	COC/4.6
18	Neck Strap	100%	3.4.3	COC/4.6
19	Neck Strap Strength	100%	3.4.3	4.6
20	Hand Strap	100%	3.4.4	4.6
21	On/Off Switch	100%	3.4.5	4.6
22	Cage/Uncage Switch	100%	3.4.6	4.6
23	Tripod Mountability	100%	3.4.7	4.6
24	Operator's Manual	100%	3.4.8	Visual
25	Carrying Case	100%	3.4.9	4.6
26	Chest Pouch/Soft Case	100%	3.4.10	4.6
27	Anti-Reflection Device (ARD)	100%	3.4.11	4.6
28	Knob Durability	100%	3.4.12	4.6
29	Battery Power	100%	3.5.1	4.6
30	Vehicular Power	100%	3.5.2	4.6
31	Arctic Kits	100%	3.5.3	4.6
32	Battery Indicator	100%	3.5.4	4.6
33	Battery Isolation	100%	3.5.5	4.6
34	Output Amplitude	100%	3.6.1	4.6

4.4.2.1 TABLE I (con't) Classification of Characteristics, First Article Test

	CHARACTERISTIC	CONFORMANCE CRITERIA	REQUIREMENT PARAGRAPH	INSPECTION REFERENCE
35	Stabilization Freedom	100%	3.6.2	4.6
36	Stabilization Scan Rate	100%	3.6.3	4.6
37	Electro-Magnetic Interference	100%	3.6.4	4.6
38	Laser Eye Protection	100%	3.7.1	4.6/Addendum
39	Thorium and Radioactivity	100%	3.7.2	COC
40	Optics	100%	3.7.3	COC
41	Anti-Reflective Coating	100%	3.7.4	COC
42	Magnification	100%	3.7.5	4.6
43	Field of View	100%	3.7.6	4.6
44	Collimation	100%	3.7.7	4.6
45	Eye Relief	100%	3.7.8	4.6
46	Nose Clearance	100%	3.7.9	4.6
47	Resolution	100%	3.7.10	4.6
48	Image Tilt	100%	3.7.11	4.6
49	Parallax	100%	3.7.12	4.6
50	Focus	100%	3.7.13	4.6
51	Eyepiece Focus	100%	3.7.14	4.6
52	Eyepiece Torque	100%	3.7.15	4.6
53	Interpupillary Adjustment	100%	3.7.16	4.6
54	Interpupillary Torque	100%	3.7.17	4.6
55	Entrance Pupil Diameter	100%	3.7.18	4.6
56	Reticle	100%	3.7.19	4.6
57	Shock	100%	3.8.1	4.6
58	Transportation Vibration	100%	3.8.2	4.6
59	Drop	100%	3.8.3	4.6
60	High Temperature	100%	3.8.4	4.6
61	Low Temperature	100%	3.8.5	4.6
62	Temperature Shock	100%	3.8.6	4.6
63	Watertightness	100%	3.8.7	4.6
64	Humidity	100%	3.8.8	4.6
65	Altitude	100%	3.8.9	4.6
66	Salt Fog	100%	3.8.10	4.6
67	NBC Decontamination Compatibility	100%	3.8.11	4.6
68	Fungus Resistance	100%	3.8.12	4.6
69	Dust	100%	3.8.13	4.6

4.4.3 Rejection. If any assembly, component of the test specimen fails to comply with any of the applicable requirements, the first article sample shall be rejected. The Government reserves the right to terminate inspection upon any failure of an assembly, component or test specimen to comply with any of the requirements.

4.5 Quality Conformance.

4.5.1 Inspection Lot Formation. The term "inspection lot" is defined as a homogeneous collection of units of production from which a representative sample is drawn or which is inspected 100 percent to determine conformance with applicable requirements. Units of product selected for inspection shall represent only the inspection lot from which they are drawn and shall not be construed to represent any prior or subsequent quantities presented for inspection. Homogeneity shall be considered to exist provided the inspection lot has been produced by one manufacturer, in one unchanged process, using the same materials and methods, in accordance with the same drawings, same drawing revisions, same specification and same specification revisions. The Purchase Description shall comply with the homogeneity criteria specified herein, regardless of the type of inspection procedure which is being applied to determine conformance with requirements.

4.5.2 Lot Size. Lot size for M25 Stabilized Binocular Quality Conformance Testing shall be determined by the contractor with regard to Quality Assurance policy, delivery schedules and production capacity. Each lot shall not exceed one month's production.

4.5.3 Examinations and Test.

a. Classification of Characteristics: Quality conformance examinations and tests are specified in the

levels stated in Classification of Characteristics paragraphs.

TABLE II Attributes Sampling Inspection

Lot Size	Inspection Levels		
	I	II	III
2 to 8	*	5	2
9 to 15	*	5	2
16 to 25	*	5	2
26 to 50	32	5	2
51 to 90	32	13	2
91 to 150	32	13	2
151 to 280	32	20	2
281 to 500	32	20	2
501 to 1200	80	20	2

Number under inspection levels indicate sample size; asterisks (*) indicate one hundred percent inspection. If sample size exceeds lot size, perform one hundred percent inspection. Accept on zero and reject on one or more for all inspection levels.

b. Alternative Quality Conformance Provisions: Alternative quality conformance procedures, methods, or equipment, such as statistical process control, tool control, other types of sampling procedures, etc., may be used by the contractor when they provide, as a minimum, the level of quality assurance required by the provisions specified herein. Prior to applying such alternative procedures, methods, or equipment, the contractor shall describe them in a written proposal submitted to the Government for evaluation (see 6.3). When required, the contractor shall demonstrate that the effectiveness of each proposed alternative is equal to or better than the specified quality assurance provision(s) herein. In case of dispute as to whether the contractor's proposed

4.5.3.1 TABLE III Classification of Characteristics, Quality Conformance Test

CHARACTERISTIC		CONFORMANCE CRITERIA (Table II)	REQUIREMENT PARAGRAPH	INSPECTION REFERENCE
MAJOR				
101	Cleanliness	Level I	3.3.2	4.6
102	Cage/Uncage Switch	Level I	3.4.6	4.6
103	Carrying Case	Level III	3.4.9	4.6
104	Stabilization	Level I	3.6	4.6
105	Laser Eye Protection	Per Addendum	3.7.1	4.6/Addendum
108	Thorium Content	Level II	3.7.2	COC
109	Field of View	Level I	3.7.6	4.6
110	Collimation	Level I	3.7.7	4.6
111	Eye Relief	Level I	3.7.8	4.6
112	Resolution	Level I	3.7.10	4.6
113	Image Tilt	Level I	3.7.11	4.6
114	Parallax	Level I	3.7.12	4.6
115	Focus	Level I	3.7.13	4.6
116	Eyepiece Torque	Level III	3.7.15	4.6
117	Interpupilary Adjustment	Level I	3.7.16	4.6
118	Interpupilary Torque	Level III	3.7.17	4.6
120	Reticle	Level I	3.7.19	4.6
121	Shock	Level III	3.8.1	4.6
122	Watertightness	Level III	3.8.6	4.6
123	Knob Durability	Level II	3.4.12	4.6
MINOR				
201	Workmanship	Level II	3.3.1	Visual/Tactile
202	Sealing and Purging	Level II	3.3.3	4.6
203	Color	Level II	3.3.5	Visual/FED-STD-595

4.6 Methods of Inspection: Where specified herein, inspection and test methods and procedures necessary to assure compliance with all the requirements contained in this purchase description or specified in the contract shall be established by the contractor. Each requirement shall be carefully analyzed, and a determination made as to the methods, procedures, equipment, and sequence of inspection and tests which will best insure the acceptance of those components and products which meet the specified requirements and reject those that do not. Documents such as MIL-PRF-13830 and MIL-STD-810F can be used as guides.

5. PACKAGING

5.1 Preservation.

5.1.1. Cleaning and Drying. Exposed surfaces of optical elements or assemblies shall be cleaned in the following manner:

a. Loose particles of dust shall be removed from the surface of the optic with a camel hair brush.

b. The surface to be cleaned shall be wiped with a circular motion using lens paper or microfiber lens cloth specifically made for lens cleaning purposes. Drying shall be by wiping with clean lens paper or freshly laundered cheese cloth. CAUTION: Only lens tissue paper or batiste cloth shall be used to clean plastic lens elements. (NNN-P-40 lens tissue type I, class 2 and class 3 shall not be used on precision coated optics or optical plastics).

c. A swab shall be made by wrapping one piece of lens tissue paper around the end of an orange stick or equal. One or two drops of alcohol shall be added on the tip of the swab. The swabbing operation shall begin at the center of the polished surface. A light downward pressure

5.1.2 Protection of Optical Surfaces: Cover optical surfaces with a double thickness of commercial grade lens tissue and secured in place with appropriate covers as supplied with the item.

5.2 Unit Package. Package each M25 as follows:

a. Assure batteries are removed from the M25 and separately wrapped to prevent shorting and damage (from leakage) to the M25, components or the carrying case.

b. Item shall be placed in its airtight case and the pressure relief valve, if applicable, shall be put in a closed position.

c. The case shall be placed in a fiberboard container and sealed with tape. When returning a repaired M25 Binocular the contractor shall use a Weather Resistant fiberboard container in accordance with ASTMD 5118.

5.3 Intermediate Package. Four (4) unit packs shall be packed in a larger heavy-duty, waterproof fiberboard container and sealed with tape. The contractor shall use a Weather Resistant fiberboard container in accordance with ASTMD 5118 for the shipping container.

5.4 Marking. Marking shall be in accordance with MIL-STD-129. 2D Barcoding is required.

5.5 Unitization. Unitize the item following procedures listed in MIL-STD-2073-1, Appendix F.

6. NOTES

6.1 Definitions:

optical performance; or any failure of the knobs or other adjusting features to perform their function.

6.1.3 Erratic Movement. It is understood that when a stabilized binocular is used to scan a scene there will be a lag of the image from the physical axis of the binocular. This lag may be in either a direction parallel to that of the movement, perpendicular, or both. The lag that is proportional to the rate of scanning is normal movement. A deviation from this smooth, consistent, proportional curve; or, any movement in other than a parallel direction to the scan motion equal to more than 20 percent of the field of view; is Erratic Movement.

6.2 Intended use. This stabilized Binocular is intended for use as a surveillance and battle damage assessment device.

6.3 Submission of Contractor Inspection Equipment Design for Approval. Submit copies of designs as required to: Commander, U.S. Army ARDEC, ATTN: AMSTA-AR-QAT-F, Picatinny Arsenal, NJ 07806-5000 unless otherwise instructed on the Contract Data Requirements List, DD Form 1423 in the contract.

ADDENDUM A - HUMAN FACTORS ENGINEERING DESIGN FOR ARMY MATERIEL METRIC

1 Optical instruments and associated equipment.

1.1 General. This section pertains to image forming optical systems. The information is quantitatively presented in order that human capabilities and limitations can be adequately taken into consideration in the design, engineering, operations, and maintenance of optical military equipment. Detailed instrument parameters, and characteristics will be regulated by governing military specifications and user applications and requirements. Necessary characteristics of military optical instruments in addition to user comfort, safety, and clarity of vision usually include a minimum of weight and bulk, the largest possible field of view and brightness of image consistent with the necessary magnifying power, freedom from optical distortions, and a combination of ruggedness with simplicity.

1.2 Visual parameters. The following should be considered as observer vision parameters or tolerances.

a. Visual spectrum: 400 nm (400×10^{-9} m) through 700 nm.

b. Visual acuity: 60 sees of arc for the emmetropic eye.

c. Maximum tolerable astigmatism: 1/4 diopter.

e. Stereoscopic acuity: 12 sees of arc.

f. Extra ocular limits for possible onset of ocular fatigue.

(1) Abduction: 15 minutes.

(2) Adduction: 30 minutes.

(3) Supraduction: '15 minutes.

g. Stimulation - intensity range

(1) Smallest detectable (threshold) using rod vision: 3×10^{-6} cd/m^2 ; cone

a. Within the constraints of good optical design practice, physical and configuration limitations, and environmental and terrain limitations, magnifications should be between 1 power and 20 power.

b. Because of hand tremors and body motion, magnification of unstabilized, unsupported hand-held sights should not exceed:

Rifle and pistol telescopic sights--4 power.

Monocular or binoculars--8 power.

c. If more than one magnification is required, two discrete magnifications should be provided for optimum image quality and boresight integrity. Varifocal (zoom) systems should only be considered for use in systems where sighting accuracy is relatively unimportant and it results in overall simplification.

1.3.2 Field of view. The field of view is the area visible through the instrument. Field of view should be compatible with intended use and optical-mechanical design limitations.

1.3.2.1 Apparent field of view. The apparent field of view is the true field of view multiplied by the magnification. A practical maximum for a highly corrected eyepiece is 60°.

1.3.3 Entrance pupil. The entrance pupil should be equal to the product of the magnification and the exit pupil diameter and therefore is defined by these parameters.

1.3.4 Exit pupil. The diameter of the exit pupil should be consistent with intended use and size/weight limitations. In order to accommodate average pupillary diameters:

a. for daylight application, the exit pupil diameter should be no less than 3 mm, and

b. for maximizing performance at twilight and lower light levels, the exit pupil should not be less than 7 mm.

1.3.6.1 4-power and less. Fixed-focus eyepieces set between -0.5 and -1.00 diopter may be utilized for instruments 4-power and less.

1.3.6.2 Over 4-power. Eyepiece dioptric (focusing) adjustments (-6 to +2 diopters, desired) should be provided and marked on all instruments over 4-power magnification.

1.3.7 Optical quality.

1 .3.7.1 Axial resolution. Axial resolution should be equal or better than 300 of arc divided by the magnification in order to provide an eye limited instrument.

1.3.7.2 Aberrations. Aberrations should be controlled in accordance with standard optical design practices and consistent with a cost effective instrument.

1.3.7.3 Luminous transmission. Luminous transmission should be as high as possible, preferably greater than 50°%. Optical elements should be anti-reflection coated with the exception of focal plane components.

1.3.7.4 Boresighting and zeroing. Method of boresighting and zeroing the sights should provide adjustments which are fine enough to enable the operator to position the sights so as to meet weapon system criteria.

a. Boresight knobs should be provided with a positive lock. The boresight setting should not change when locking.

b. Boresight knob locks should not require more than 4.5 N force to lock and unlock the knob lock.

c. Boresight adjustment knobs and locking should be capable of being adjusted, locked-or unlocked by suitably-clothed and –equipped users with hand dimensions varying between the 5th and 95th percentiles.

1.3.8 Reticles.

1.3.8.1 General. The reticle should be in focus at a range of primary interest to limit the parallax to an acceptable value throughout the usable range.

1.3.9.2 Magnification differences. Magnification differences of the two barrels should not exceed 2%.

1.3.9.3 Luminous transmission. Luminous transmission differences of the two barrels should not exceed 5%.

1.3.9.4 Collimation. In order to avoid eyestrain and minimize fatigue, alignment of the binoculars at the eye should not exceed a divergence of the rays at 15.0 minutes of arc, a divergence of the rays at 40.0 minutes of arc, and a convergence of the rays at 25.0 minutes of arc.

1.3.9.5 Weight. Weight of hand-held binoculars/bioculars should not exceed 1 kg. Instruments should be sized and configured for compatibility with anthropometric requirements.

1.4 Environmental conditions. Instruments exposed to adverse conditions should be provided with appropriate auxiliary equipment, including cases, windshield wipers, defoggers, and defrosters.

1.5 Accessories.

1.5.1 Filters. Light filters, removable from the optical path, should be provided to reduce glare or light intensity, or to protect the observer's eyes against hazardous light levels. A complete analysis should be made of the reduction in illumination and possible decrease in target to background contrast before filters are used.

1.5.1.1 Use. Use of color or neutral density filters will depend upon the application. For use in observing bright light sources, neutral filters should be considered for reducing overall brightness without affecting contrast. The use of polarizing filters should be considered where it is necessary to reduce glare and increase apparent contrast from sun, snow, or water.

1.5.1.2 Hazardous light levels. For hazardous light levels from items such as lasers or search lights filter density should be sufficient to reduce energy levels below that specified by the Surgeon General.

1.5.2 Shutters. Shutters having closure and reopening times appropriate for

specified by the Surgeon General.

1.5.2.2 Nuclear flash protection. Shutters for protection of the observer's eye from flashes in the field of view resulting from a nuclear device should reduce energy levels below that specified by the Surgeon General. Complete closure within 50 microseconds from flash detection to an optical density of 5 is deemed sufficient to meet minimum protection criteria.

1.5.3 Cases. Carrying/transport cases should be provided for instruments to be hand-carried or mounted/dismounted frequently.

1.5.4 Eyecups and headrests. Any optical instrument that requires steady orientation of the eye should be provided with a headrest and/or eyecups.

1.5.4.1 Eyecups. Eyecups should be provided to maintain proper eye relief, eliminate stray light, and when required, protect or cushion the eyes and orbital region against impact with the eyepieces. Design should also be compatible with protective masks (NBC gear). The radii of Figure 142 define a surface of revolution within which a satisfactory symmetrical eyepiece and cup should be designed if interferences with facial features are to be avoided. These should be supplied to cushion forms when they are compressed to the maximum.

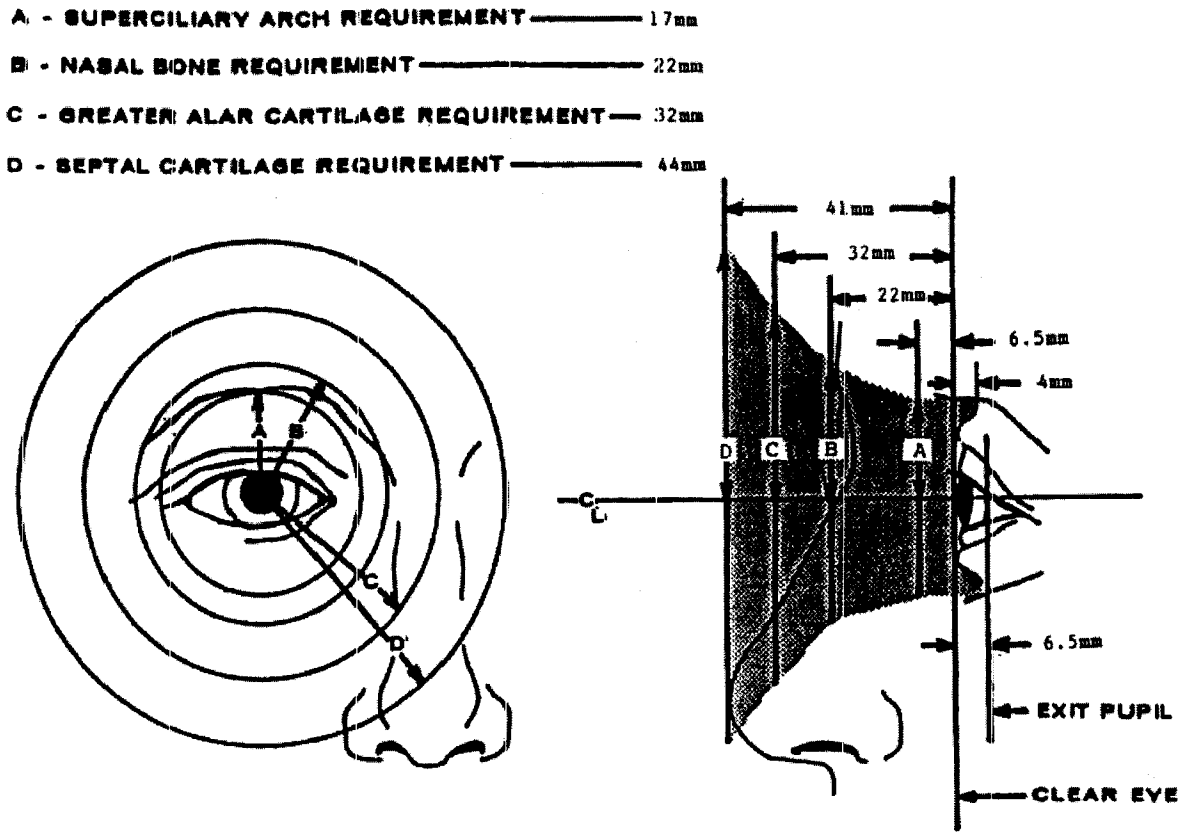


FIGURE 142. Anatomical limits on auxiliary symmetrical ocular metal parts

1.5.4.2 Compatibility with clothing and personal equipment. Eyecups and headrests should be compatible with helmets, protective masks, and other clothing and personal equipment.

1.5.5 Mechanical effect of gun recoil on the gunner. The mechanical shock to . the tank gunner is primarily transmitted by a pulse in the +X axis (in the direction of the recoil) as the result of contact of his forehead with the brow pad/headrest, and secondarily, by a pulse in the +Z axis (vertically upward) applied by the seat. Loading components are applied in the other two directions both at the head [Y (side to side) and Z axes] and at the seat (X and Y axes), but these are considered to be of lesser importance. The two major loading components applied at the +X axis of the head and the +Z of the seat are felt by the gunner at

Degradation of secondary tasks, such as communications, could affect the target acquisition time and influence overall system performance.

1.5.5.1 Brow pad function. One of the primary purposes of the brow pad, headrest, or other cushioning device, such as that mounted on the tank gunner's optics, is to modify the pulse at the gunner's head (acceleration transmitted at the weapon recoil) to levels that will not produce performance deterioration and to minimize the potential for injury. The tank gunner's brow pad also provides the proper eye relief as well as a measure of head stability for the use of the optics during on-the-move operations. An initial pressure exerted by the gunner against a brow pad prevents worsening of the exposures from an abrupt direct impact and reduces involuntary motions of the gunner's head/neck system which compromise his ability to perform the required tasks.

1.5.5.2 Load characterization. The character of the transient load is defined by means of acceleration histories that have been measured at the head of a human gunner and at the center of gravity of the head of an Alderson CG 98 dummy whose physical and mechanical features resemble that of the human test subject. Under these conditions, it appears that an instrumented dummy may be used initially to estimate the overall acceleration pulse transmitted to the human head. Acceptability of the dummy response then allows for the evaluation of acceptability for experienced gunners. Subsequently, the suitability of the system for training novice gunners should be demonstrated. The parameters that may be critical in the histories of both linear and angular acceleration profiles are numerous. These parameters include the peak amplitude, its rise time, the pulse duration and shape, and the dominant frequency of its components, as well as the total pulse applied and the average acceleration level experienced. By analogy with more intensive loads causing trauma (long-term and permanent damage, including fatality), the most important parameter in the evaluation of performance deterioration may be peak or average acceleration, although other factors cited also are of importance. Experience has indicated that the preponderance of gunners can sustain a peak level of 4g (+X direction) associated with the firing of a 152mm gun from the M60A2 tank and remain in constant combat-ready condition. The acceleration histories recorded at the head and base of the neck of a human gunner firing this tank system are shown in Figure 143. A similar set of acceleration histories, shown in Figure 144, which were derived from the response of the same human gunner firing the 152mm cannon from an M551 vehicle, resulted in a peak acceleration of 12g at the head (+X direction). Subjective responses of the gunners to this latter acceleration

cost changes as these design restraints are relaxed. Under no circumstances should the peak +X acceleration be allowed to exceed +8g unless acceptable gunner performance and exposure level acceptance have been demonstrated.

1.5.5.3 Design considerations. Achievement of minimum acceleration levels and the total impulse to the gunner's head as well as appropriate rise time and duration are crucial for effective gunner performance and every effort should be made to accomplish this objective by overall tank design. Suspension system design has minimal influence on the acceleration input to the gunner's head at recoil. Data indicate that the response of the vehicle suspension occurs after cessation of the recoil input to the gunner's head. There is also no evidence to suggest that variations in brow-pad material will significantly reduce accelerations to the gunner's head. Although development of efficient damping and mounting systems for the brow pad and seat may offer potential modification of the acceleration input to the gunner, the key to achieving a significant reduction in this input appears to lie in the design of the recoil mechanism.

1.6 Mounts and supports. Mounts and supports should provide for positive positioning and positional adjustment of the instruments. These devices should be designed so as to facilitate insertion and removal of instruments. All level vials, scales, and pointers required for indicating the movement and/or position of the instrument should be readily visible and not subject to damage or displacement.

1.7 Lighting. Means should be provided for illumination of reticles, internal and external scales, and level vials under low-level conditions which only minimally affect the dark adaptation of the observer. Red illumination or red filters should be used to maintain dark adaptation. Variability of illumination should be provided as required by weapon system characteristics.

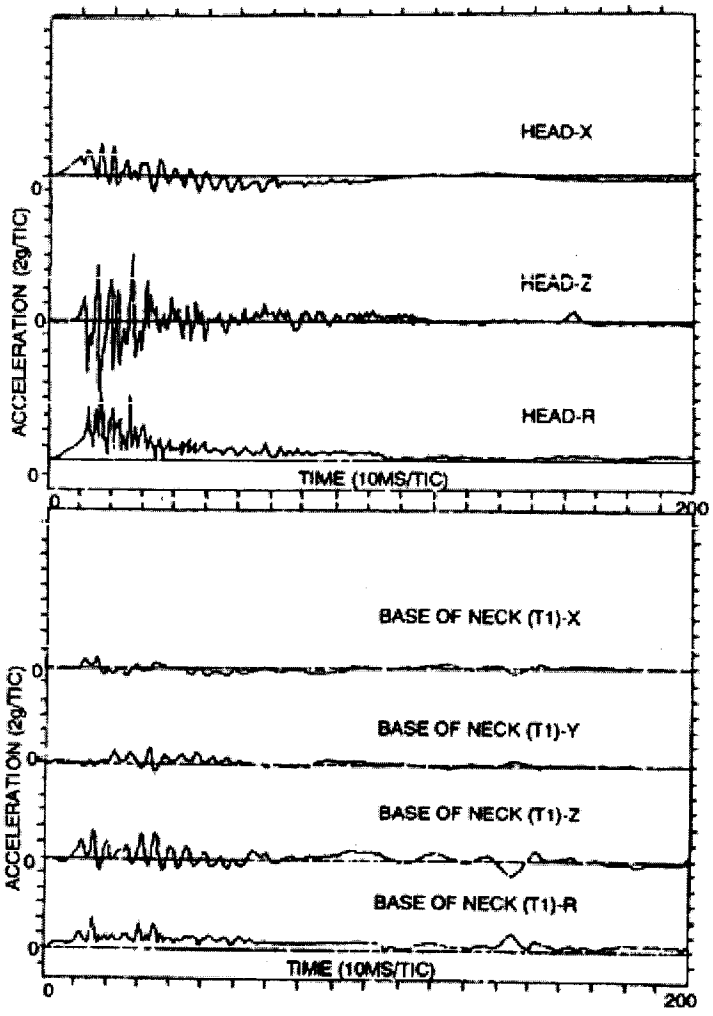


FIGURE 143. Accelerations to human gunner firing 152mm gun from M60A2 tank

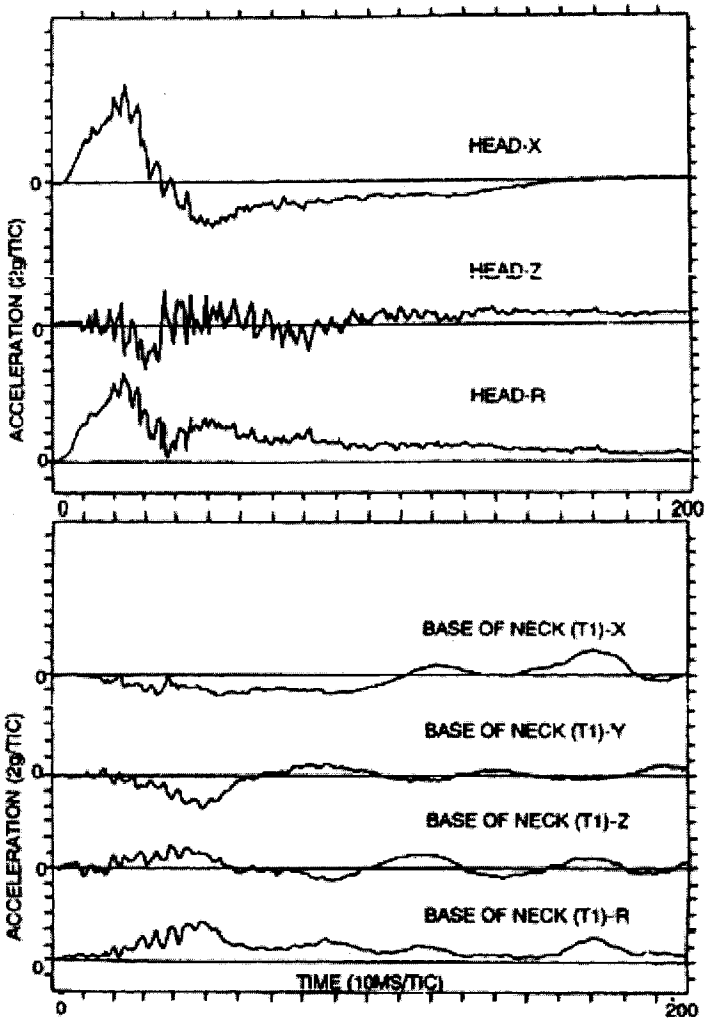


FIGURE 144. Accelerations to human gunner firing 152mm gun from M551 Sheridan vehicle

1.8 Maintenance.

1.8.1 Design. When practical, optical equipment should be developed utilizing modular design which will provide for interchangeability of optical subassemblies.

1.9 Component replacement. Easy access should be provided for components requiring frequent replacement, checkout, or maintenance without the use of special tools or disassembly of other components. Items requiring special tools and/or equipment should have provisions for storage of such special equipment in the near vicinity, preferably on the specific equipment. This particularly applies to items such as light bulbs or other items whose failure could make the instrument inoperable.