INCH-POUND
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PERFORMANCE SPECIFICATION

ULTRALIGHTWEIGHT CAMOUFLAGE NET SYSTEM (ULCANS)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the ultralightweight camouflage net systems (ULCANS) for tactical equipment and field installations including helicopters and fixed wing aircraft.

1.2 Classification. The ULCANS covered by this specification shall be of the following types as specified:

Type I - Aviation, *OH-58D Helicopter System*, Radar Scattering

Type II - Aviation, *AH-64/UH-60 Helicopter System*, Radar Scattering

Type III - General Purpose, Modular, Radar Transparent

Type IV - General Purpose, Modular, Radar Scattering

Class 1 - Woodland

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: USA COMMCTNS-ELECT CMD, LOG RSCH CTR, ATTN AMSEL LC ED BD, 10115 GRIDLEY RD, STE 228, FT BELVOIR VA 22060-5849 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 1080

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are needed to meet the requirements specified in sections 3, 4, and 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3, 4, and 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified or referenced to herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-W-4088 - Webbing, Textile, Woven Nylon.
MIL-C-52765 - Camouflage Screening Support Systems.
MIL-C-53004 - Camouflage Screening Systems Lightweight, Synthetic, Woodland, Desert and Snow.

STANDARDS

FEDERAL

FED-STD-191 - Textile Test Methods.

DEPARTMENT OF DEFENSE

MIL-STD-130 - Identification Marking of U.S. Military Property.
MIL-STD-810 - Environmental Test Methods and Engineering Guidelines.
MIL-STD-882 - System Safety Program Requirements.
MIL-STD-1472 - Human Engineering Design Criteria For Military Systems, Equipment and Facilities.

(Unless otherwise indicated, copies of the above specifications and standards are available from the: STDZN DCMNT ORDER DESK, BLDG 4D, 700 ROBBINS AVE, PHILADELPHIA PA 19111-5094.)

2.2.2 Other Government drawings. The following other Government drawings form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those in effect on the date of the solicitation.

DRAWINGS - ME

13226E0964	-	Case, Camouflage screen, Woodland/Desert.
13227E0131	-	Cloth, Vinyl-Nylon.
13227E0132	-	Pole, Aluminum, Support.
13227E0134	-	Pole, Plastic, Support.
13227E0136	-	Stake, Anchor, Class 1.
13227E0137	-	Case, Carrying, Camouflage Screening Support Systems.

(Copies of drawings required by contractors in connection with specific acquisition functions should be obtained from the: US Army CECOM Research, Development and Engineering Center, Night Vision and Electronic Sensors Directorate, ATTN AMSEL-RD-NV-CD-CCD, 10221 Burbeck Road, Suite 430, Fort Belvoir VA 22060-5806.)

2.3 Non-Government publications. The following non-Government publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

B 117	-	Standard Test Method of Salt Spray (Fog) Testing.
D 751	-	Standard Test Methods for Coated Fabrics
D 2244	-	Standard Test Method of Color Differences from Instrumentally Measured Color Coordinates E1.
D 2247	-	Standard Test Method for Testing Water Resistance of Coatings in 100% Relative Humidity.
D 2261	-	Standard Test Method for tearing Strength of Woven Fabrics by the Torque (Single Rip) Method (Constant-Rate-of-Extension Tensile Test Method).
D 3659	-	Flammability of Apparel Fabrics by Semi-Restraint Method.
D 3787	-	Standard Test Method for Bursting Strength of Knitted Goods-Constant-Rate-of-Traverse (CRT) Ball Burst Test.
D 5034	-	Standard Test Method for Breaking Force and Elongation of Textile Fabrics.
E 308	-	Standard Method for Computing the Colors of Objects Using the CIE System.
G 26	-	Standard Practice for Operating Light Exposure Apparatus (Xenon-Arc type) with and without Water for Exposure of Nonmetallic Materials.

(Copies of ASTM standards can be obtained from: AMERICAN SOCIETY FOR TEST AND MATERIALS, 1916 RACE STREET, PHILADELPHIA PA 19103.)

CIE 51 - A Method for Assessing the Quality of Daylight Simulators for Colorimetry.

(Copies of CIE documents can be obtained from TLA Lighting Consultants, Seven Pond Street, Salem MA 01970.)

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

30 1988 - Anti-Fungal Activity, Assessment on Textile Materials, Mildew and Rot Resistance of Textile Materials.

(Copies of these documents can be obtained from the American Association of Textile Chemists and Colorists, 1 Davis Drive, PO Box 12215, Research Triangle Park, Raleigh NC 27709.)

NATIONAL AERONAUTICAL STANDARD

NAS 1756 - Streamer, Warning.

(Copies of this document can be obtained from the Aerospace Industries Association of America, Inc., 1250 Eye Street NW, Washington DC 20005.)

2.3 *Order of precedence*. In the event of a conflict between document and 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 System description. Ultralightweight camouflage net system (hereafter designated "ULCANS") is to provide concealment of military aircraft and ground equipment when tactically deployed (see 6.3.5). ULCANS shall provide visual, electro-optic, radar, and infrared signature reduction characteristics. ULCANS shall be made of easily and rapidly deployable and recoverable (see 6.3.6), snag-resistant, ultralightweight material. ULCANS types I and II shall be used for aviation and ULCANS types III and IV shall be used for general purpose. ULCANS shall not be the source of Foreign Object Damage (FOD). ULCANS shall be field repairable and maintainable, fire retardant, shall not show performance degradation when exposed to Petroleum, Oil or Lubricants (POL) or when properly stored for extended periods, and shall be mildew and rot resistant. ULCANS shall be used in all weather conditions by soldiers dressed in full Mission Oriented Protective Posture (MOPP) gear and cold weather clothing.

3.1.1 System size.

3.1.1.1 Type I. Type I ULCANS shall be capable of concealing an OH-58D helicopter in accordance with figure 1.

3.1.1.2 Type II. Type II ULCANS shall be capable of concealing an AH-64 helicopter or a UH-60 helicopter in accordance with figure 2.

3.1.1.3 Types III and IV. Types III and IV ULCANS shall be in accordance with figure 3.

3.1.2 System weight.

3.1.2.1 Screen weight. The finished screen, with becket loops, reinforced edging and stake loops shall not exceed an average weight of 6 ounces per square yard.

3.1.2.2 Total system weight. Total system weight includes both screen and support system with storage and transport containers and shall not exceed the weights listed in table I.

TABLE I. Total system weight.

Screen Type	Total System Weight
I	180 Lbs.
II	350 Lbs.
III & IV	120 Lbs.

3.1.3 System volume. Aviation type screen system volume includes both screen and support systems when field packed in accordance with the operator's manual.

3.1.3.1 Type I. Type I ULCANS volume, when field packed, shall not exceed 25 cubic feet.

3.1.3.2 Type II. Type II ULCANS volume, when field packed, shall not exceed 40 cubic feet.

3.1.4 System components. ULCANS shall consist of the following components:

3.1.4.1 Screen system. Screen system shall consist of camouflage screens, repair kit, operator and maintenance manual, and storage/transport container. In addition, types I and II shall have rotor blade tip covers, wire cutter covers and snag cover for main rotor hubs.

3.1.4.2 Support system. Support system shall consist of ground stakes, screen supports, shape disrupters, and storage/transport container in the quantities listed in table II.

TABLE II. Number of support system components.

Support system	Stakes	Screen Supports	Shape Disrupters	Storage/Transport Container
Type I	40	6	6	1
Type II	56	10	10	1
Types III & IV	24	12	6	1

3.1.4.2.1 Height of support poles. Table III lists the height of support poles.

TABLE III. Height of support poles.

ULCANS support system	Height of poles	Height of poles retracted
Type I	192" (max. extension)	62"
Type II	192" (max. extension)	62"
Types III & IV	48"	N/A

3.2 System performance requirements.

3.2.1 Total system requirements.

3.2.1.1 Erection times. ULCANS shall be designed so that the screens can be erected in the times specified under the following conditions.

3.2.1.1.1 ULCANS type I and II. ULCANS types I and II shall be designed so that three experienced soldiers (see 6.3.10) can deploy the system in less than 40 minutes in standard conditions, as defined in 3.2.1.4.1.

3.2.1.1.2 ULCANS types III and IV. When tested as specified in 4.4.2.1.1.2, ULCANS types III and IV shall be designed so that three experienced soldiers can deploy the system in a time equal to or less than it takes to deploy an equivalent number of the Army's current Lightweight Camouflage Screen System (LCSS) screens.

3.2.1.2 Removal times. ULCANS shall be designed so that the screens can be removed (recover) (see 6.3.6) in the times specified under the following conditions.

3.2.1.2.1 ULCANS types I and II. ULCANS types I and II shall be capable of going from a state of full deployment to being broken down by three experienced soldiers in such a manner that the aircraft can fly away, leaving all ULCANS components behind, within 5 to 10 minutes under standard conditions; and no longer than 10 minutes while at MOPP level IV.

3.2.1.2.2 ULCANS types III and IV. When tested as specified in 4.4.2.1.2.2, ULCANS type III and IV shall be designed so that three experienced soldiers can remove the system in a time equal to or less than it takes to remove an equivalent number of LCSS screens.

3.2.1.3 Performance life. ULCANS shall display no degradation of performance during the shelf and service lives defined in 3.2.1.3.1 and 3.2.1.3.2.

3.2.1.3.1 Shelf life. ULCANS shall be designed to have a shelf life of 5 years in open storage when the container is in its original sealed condition.

3.2.1.3.2 Service life. ULCANS shall be designed to have a service life (see 6.3.12), of 2 years, following 5 years of storage starting when the container is opened for the first time.

3.2.1.4 Environmental conditions. ULCANS shall display no degredation of performance when subjected to the climatic design, standard and severe conditions defined in 3.2.1.4.1, 3.2.1.4.2, and 3.2.1.4.3.

3.2.1.4.1 Climatic design conditions. ULCANS shall be designed to function in climates as follows: 80 percent basic, 15 percent hot, 5 percent cold as defined in table IV, when used by personnel dressed according to climatic conditions.

3.2.1.4.2 Standard conditions. Standard conditions for deployment, recovery, and concealment use of ULCANS shall be limited to conditions defined in table IV as B3, B1, B2, A2.

3.2.1.4.3 Severe conditions. Severe conditions for recovery and concealment use of ULCANS shall be the same as standard conditions defined in 3.2.1.4.2 and conditions defined in table IV as cold, with troops wearing appropriate protective clothing.

Climatic Design Type	Daily Cycle (QSTAG 360*)	Operational Conditions					Storage and Transit Conditions	
		Ambient Air Temperature °F (°C)	Solar Radiation Bph (W/m²)[1]	Ambient Relative Humidity %	Ground Surface Temp °F (°C)	Windspeed fps	Induced Air Temperature °F (°C)	Induced Relative Humidity %
Hot	Hot-Dry (A1)	90 to 120 (32 to 49)	0 to 355 (0 to 1120)	3 to 8	145 (63)	13	91 to 160 (33 to 71)	1 to 7
Hot	Hot-Humid (B3)	88 to 105 (31 to 41)	0 to 343 (0 to 1080)	59 to 88	130 (54)	8 to 17	91 to 160 (33 to 71)	14 to 80
Basic	Constant High Humidity (B1)	Nearly Constant 75 (24)	Negligible	95 to 100	NA	NA	Nearly Constant 80 (27)	95 to 100
Basic	Variable High Humidity (B2)	78 to 95 (26 to 35)	0 to 307 (0 to 970)	74 to 100	130 (54)	7	86 to 145 (30 to 63)	19 to 75
Basic	Basic Hot (A2)	88 to 110 (30 to 43)	0 to 355 (0 to 1120)	14 to 44	140 (60)	10 to 18	86 to 145 (30 to 63)	5 to 44
Basic	Basic Cold (C1)	-5 to -25 (-21 to -32)	Negligible	Tending toward saturation	-35 (-37)	<16	-13 to -28 (-25 to -33)	Tending toward saturation
Cold	Cold (C2)	-35 to -50 (-37 to -46)	Negligible	Tending toward saturation	-50 (-46)	<16	-35 to -50 (-37 to -46)	Tending toward saturation
Severe Cold	Severe Cold (C3)	-60 (Cold soak) (-51)	Negligible	Tending toward saturation	-60 (-51)	<18	-60 (-51)	Tending toward saturation

* Designations in parentheses refer to corresponding climatic categories in quadripartite Standardization Agreement 360 *Climatic Environmental Conditions Affecting the Design of Military Materiel.* Two of the QSTAG 360 categories, C0 and C4, are not used by the United States.

NOTE: The numbers shown for the climatic elements represent only the upper and lower limits of the cycles that typify days during which the extremes occur, e.g., for the Hot-Dry cycle, 120 °F is the maximum daytime temperature and 90 °F is the minimum nighttime (or early morning temperature). Materiel shall be designed to function at any and all points in the applicable range.

TABLE IV. Climatic design conditions.

[1] W=watt, m²=meter squared

3.2.1.4.4 Sand, dust, freezing rain and ice. When tested in accordance with 4.4.2.1.3.2 and 4.4.2.1.3.3, ULCANS support systems shall be designed to withstand exposure to sand and dust particles up to 1000 micrometers in size, and ice and freezing rain glaze of 0.9 specific gravity at 1/2-inch thickness with no system component failures.

3.2.1.4.5 Wind. When tested in accordance with 4.4.2.1.3.1, ULCANS shall remain erect in wind conditions up to 46 miles per hour (mph). ULCANS types I and II shall also remain deployed when subjected to 46 mph winds from a hovering helicopter.

3.2.2 Screen system requirements. ULCANS screen system, consisting of camouflage screens, repair kit, operators and maintenance manual, storage/transport container and, for types I and II, rotor blade tip covers, wire cutter covers, and snag cover for main rotor hubs shall conform to the following requirements.

3.2.2.1 Foreign object damage. Screens shall be designed to eliminate FOD and snagging, and shall not contain any materials that could become a source of damage. Screens shall be constructed to prevent stones, twigs, leaves and other debris from becoming enmeshed in the screens when they are on the ground and then falling onto equipment when the screen is deployed. Screens shall also not produce any residue or discharge including carbon dust or fibers that could present the potential for damage to any electrical systems or components.

3.2.2.2 Color and spectral reflectivity. When tested as specified in 4.4.2.2, before and after POL exposure, the color and spectral reflectivity shall be as specified in 3.2.2.2.1 and 3.2.2.2.2.

3.2.2.2.1 Color. When tested as specified in 4.4.2.2.1, the total color difference $DE^*_{a,b}$ between each finished material sample measurement and the appropriate values specified in table V shall be less than 2.0. DE*a,b shall be calculated for each measurement using the CIE 1976 $L^*a^*b^*$ (CIELAB) color-difference formula in accordance with ASTM D 2244.

TABLE V. Color requirements for finished screen materials.

COLOR	L^*	a^*	b^*
Black	15.28	.52	1.07
Light green	26.91	-1.39	14.16
Forest green	18.41	-.69	5.00

3.2.2.2.2 Spectral reflectivity. When tested as specified in 4.4.2.2.2, finished material samples for each color shall have spectral reflectivity values within the appropriate limits specified in table VI. For wavelengths between 600 and 2500 nanometer (nm) not shown in the tables, linear interpolation shall be used to calculate the correct values.

TABLE VI. Spectral reflectivity limits for finished screen materials.

NIR reflectance limits - black		
Wavelength (nm)	Min (%)	Max (%)
600	0	10
660	0	10
700	10	20
720	15	25
740	20	30
760	30	35
800	30	35
1200	30	35
1400	20	30
1800	0	20
2500	0	10
NIR reflectance limits - green		
Wavelength (nm)	Min (%)	Max (%)
600	0	10
660	0	10
700	10	33
720	18	40
740	30	50
760	40	60
800	40	60
1200	40	60
1400	30	50
1800	20	40
2500	0	20

3.2.2.3 Screen patterning. Patterning of the screens shall be performed in accordance with figures 1, 2, and 3 for each net design.

3.2.2.4 Thermal properties.

3.2.2.4.1 Thermal transmission. When tested as specified in 4.4.2.3.1, transmission of ULCANS measured in the 3 to 5 and 8 to 12 micron band shall be less than 30 percent required and less than 20 percent desired.

3.2.2.4.2 Screen thermal signature. When tested as specified in 4.4.2.3.2, the ULCANS apparent temperature measured in the 3 to 5 and 8 to 12 micron band, shall be a maximum of 8 °C above and below ambient air temperature. An apparent temperature difference of 5 °C above and below ambient air temperature is desired.

3.2.2.5 Radar properties.

3.2.2.5.1 Radar transparent properties. Nothing shall be in or applied to the ULCANS screen which would interfere with the transmission of the emitted or reflected radar signals. When tested as specified in 4.4.2.4.1, the one-way transmission of the ULCANS radar transparent screen shall not be less than 90 percent.

3.2.2.5.2 Radar scattering properties. Finished screen shall have an average transmission of less than or equal to 50 percent, a standard deviation of between 10 and 25 percent and a correlation length of less than 2 inches as measured in accordance with 4.4.2.4. ULCANS shall have radar properties equal to or better than LCSS.

3.2.2.6 Screen material properties.

3.2.2.6.1 Flame resistance. When tested in accordance with 4.4.2.5.1, screen material test specimens shall be self-extinguishing prior to burning 60 percent of the specimen area.

3.2.2.6.2 Fungus resistance. When tested in accordance with 4.4.2.5.2, finished screens shall not support fungus growth.

3.2.2.6.3 Weight increase after water immersion. Weight increase after immersion in water shall be less than 30 percent of original conditioned weight of the specimen required and less than 15 percent desired in accordance with 4.4.2.5.3.

3.2.2.6.4 Breaking strength. When tested as specified in 4.4.2.5.4, the breaking strength of the screen material shall not be less than that specified in table VII.

TABLE VII. Breaking strength requirements.

Test Method	Material	Requirement	
Grab Test	Woven	Warp Direction 55 Lbs.	Fill Direction 80 Lbs.
Grab Test	Garnish Cloth	Warp Direction 40 Lbs.	Fill Direction 40 Lbs.
Ball Burst Test	Knitted	75 Lbs.	

3.2.2.6.4.1 Breaking strength after exposure. When tested as specified in 4.4.2.5.4.1 through 4.4.2.5.4.7, the breaking strength of the screen material shall not be less than that specified in table VIII.

TABLE VIII. Breaking strength requirements after exposure.

Test Method	Material	Requirement	
Grab Test	Woven	Warp Direction 50 Lbs.	Fill Direction 60 Lbs.
Grab Test	Garnish Cloth	Warp Direction 36 Lbs.	Fill Direction 36 Lbs.
Ball Burst Test	Knitted	65 Lbs.	

3.2.2.6.5 Tear strength. When the garnish cloth material is tested as specified in 4.4.2.5.5, the warp thread pull out or break value of the garnish cloth shall be a minimum of 5 pounds or the fill thread shall break before the warp threads can be pulled out of the coating.

3.2.2.7 Seams and rip stop. Both becket loop seams and the seams around the edges of the net must be reinforced to preclude tearing. Screens shall be constructed so that, should a rip occur in the net, it will tear no further than 5 feet.

3.2.2.8 Labeling. Screens shall be marked as described in MIL-STD-130. For ULCANS types I and II, net markings for orientation and alignment should be applied to screens to help orient them over aircraft. Label shall include type and class as a minimum.

3.2.2.9 Covers.

3.2.2.9.1 Rotor blade tip covers. Covers shall be so constructed as to prevent main and tail rotor blades from tearing screens. Covers for AH-64 helicopter main rotor blades must be able to be attached to existing rotor blade tiedowns when deploying ULCANS.

3.2.2.9.2 Wire cutter cover. Wire cutter covers shall be included for types I and II screens. These covers shall be designed to fit snugly over the wire cutters on each individual aircraft configuration. Cover shall be held in place by means of hook and loop type fastener.

3.2.2.9.3 Snag cover for main hub. A snag proof cover for the main rotor hub shall be included for the types I and II screens. This cover shall be designed to enwrap the entire main rotor hub area to a point 12 inches past the position of main rotor blade attachment. Cover shall be held in place by means of hook and loop type fastener.

3.2.2.9.4 Labeling. Covers shall be marked with contrasting ink, for guidance only use MIL-STD-130.

3.2.2.9.5 Marking. Covers shall include a red tag measuring 3 inches wide and 24 inches long with the words "Remove Before Flight" clearly imprinted in white ink in accordance with NAS 1756.

3.2.2.10 Repair kit. Kit shall contain all items necessary to make field repairs of the screen and return the system to service. Screen materials in kit shall meet requirements for ULCANS and include a minimum of 25 square feet of material. Kit for types I and II screens shall include needles and thread to attach material to the screen. Kit for types III and IV screens shall include 300 cable ties to attach material to the screen. A separate container shall be provided for the repair kit for types II and IV screens.

3.2.2.10.1 Antenna flange assembly. An antenna flange assembly must be used on the screen when erecting it over vehicles and equipment that are equipped with antennas. This assembly shall be constructed of non-radar reflective material and in accordance with figure 4. The antenna flange assembly shall be placed on the screen in the area where the antenna(s) will protrude. After the assembly is placed on the screen, an X-shaped incision must be made (within the inner diameter of the flange) that shall allow the antenna to extend through the screen. The flange assembly shall then slip over the antenna and allow for screen adjustment. Antenna flange assembly shall be capable of withstanding repeated deployment and recovery of the screen without failure. The antenna flange assembly shall also be capable of removal from the screen and reuse. Five assemblies shall be included in each repair kit.

3.2.2.11 Storage/transport container(s). Container(s) shall be sized to hold all screen system components and large enough for repackaging components after they have been deployed. No one storage/transport container shall exceed the maximum weight of 147 pounds (for a four-soldier carry).

3.2.2.11.1 Design.

3.2.2.11.1.1 ULCANS types I and II. Types I and II containers shall be configured as a cloth clamshell style bag with a water resistant slide fastener (zipper) around three top sides, forming a flap. Inside pockets shall be provided for the repair kit, technical manual, stakes, and covers. Pockets shall have a hook and loop type closure. Container shall have additional outside straps for closure included in the design, guidance Drawing 13226E0964.

3.2.2.11.1.2 ULCANS types III and IV. Guidance Drawings 13226E0964 and 13227E0137 for the design of these containers.

3.2.2.11.2 Fabric. Guidance Drawing 13227E0131, containers shall be made of waterproof polyester or nylon coated cloth.

3.2.2.11.3 Handles. Guidance MIL-W-4088, handles shall be made of 1-23/32-inch wide nylon webbing type VIII, olive drab 7. At least one handle shall be provided for each soldier required to carry the full container, guidance MIL-STD-1472 to determine the number of soldiers required based on the system weight. Handles shall be placed so that balance of the bag contents is maintained.

3.2.2.11.4 Labels. Container shall be marked with contrasting ink (guidance MIL-STD-130) and as specified in 3.4. Labeling shall include contents, packed container weight and number of soldiers required to carry container.

3.2.3 Support system requirements.

3.2.3.1 Screen supports. Supports shall be provided to erect screens without touching vehicle/aircraft and to disrupt shape. Telescoping poles are required for types I and II aviation netting while segmented poles are required for types III and IV, general purpose netting.

3.2.3.1.1 Material. Supports shall be made of aluminum or composite materials and shall be sufficiently strong to resist denting that precludes support sections fitting together or prevents telescoping - depending on support design. Type III support system shall not interfere with electromagnetic emanations. If made of aluminum or other conductive materials, each support section shall have a warning notice regarding conduction of electricity permanently affixed. If the tubes of the support are made of a composite material, they shall not exhibit shattering, bursting or produce sharp projectiles in a failure mode.

3.2.3.1.2 Design. Telescoping poles shall positively lock in the open (extended) and closed mode, with variable height adjustment. If variable height adjustment is not obtainable, an adjustment height in 2-foot increments is required. The bottom of these supports shall be closed and finished so that dirt, mud, and debris cannot enter support end. Dents or grit shall not result in loss of function. Drain holes shall be included in design to prevent collection of water. Poles

shall be held in place under the net by use of a stake (see 3.2.3.3) either through a loop attached to base of pole or a hole in pole base itself. Telescoping poles must also be designed with a positive locking device to attach the shape disrupter to the pole. A flexible joint which aids in transitioning the wind load from the net to the pole is also required for types I and II support poles. For types III and IV screens, use of segmented poles is required. Both the telescoping and segmented poles must be compatible with current batten spreader adapter assembly. Support poles, for guidance use MIL-C-52765, Drawings 13227E0132 and 13227E0134, must also operate in environmental conditions as specified in 3.2.1.4.

3.2.3.2 Spreader/Shape disrupter. Spreaders/shape disrupters shall be designed to be approximately one foot in diameter or any other design such that sufficient surface area to disrupt shape is provided of screen when deployed. Spreader/shape disrupter must provide an aggressive grip onto camouflage screen to prevent poles from falling if billowing of net occurs in gusty conditions. For ULCANS types I and II support systems, it shall also be provided with a positive locking device attaching it to the support pole.

3.2.3.3 Stakes. Stakes shall be provided to secure ULCANS to the ground in a woodland environment. Guidance Drawing 13227E0136 for the design of the stakes.

3.2.3.4 Storage/transport container(s). Container(s) shall be of a size to hold all components.

3.2.3.4.1 Design.

3.2.3.4.1.1 ULCANS types I and II Containers shall be configured as a cloth clamshell style bag with a water resistant slide fastener (zipper) around three top sides, forming a flap. Container shall have additional outside straps for closure included in design, guidance Drawing 13226E0964.

3.2.3.4.1.2 ULCANS types III and IV. Design for types III and IV guidance Drawing 13227E0137.

3.2.3.4.2 Fabric. Guidance Drawing 13227E0131, containers shall be made of waterproof polyester or nylon coated cloth.

3.2.3.4.3 Handles. Guidance MIL-W-4088, handles shall be made of 1-23/32-inch wide nylon webbing type VIII, olive drab 7. At lease one handle shall be provided for each soldier required to carry the full container, guidance MIL-STD-1472 to determine the number of soldiers required based on the system weight. Handles shall be placed so that the balance of bag contents is maintained.

3.2.3.4.4 Labels. Container shall be marked with contrasting ink (guidance MIL-STD-130) and as prescribed in 3.4. Labeling shall include contents, packed container weight and number of soldiers required to carry container.

3.3 Durability. When tested as specified in 4.4.2.6, ULCANS shall be capable of being deployed and recovered 112 times without any system failure (see 6.3.11).

3.4 Human engineering. ULCANS design shall conform to human engineering design criteria, guidance MIL-STD-1472. Special design emphasis shall be given to general requirements, labeling, anthropometry, and small systems and equipment, portability and load carrying as applicable.

3.5 Maintenance support. When tested as specified in 4.4.2.7, repair kit and operator and maintenance manuals shall be adequate to return ULCANS to system level performance.

3.6 Workmanship. The finished items shall be clean, free of burrs and sharp edges, smoothly finished, and shall not be broken or malformed. The finished screens shall be clean and free from all foreign matter. There shall be no excessive, or smeared adhesive and no loose threads longer than 1.5 inches.

3.7 Recovered materials. For the purpose of this requirement, recovered materials are those materials which have been collected from solid waste and reprocessed to become a source of raw materials, as distinguished from virgin raw materials. The components, pieces, and parts incorporated in the ULCANS may be newly fabricated from recovered materials to the maximum extent practicable, provided the screening system produced meets all other requirements of this specification. Used, rebuilt, or remanufactured components, pieces, and parts shall not be incorporated in the ULCANS.

3.8 Pollution prevention. Non-hazardous and environmentally acceptable materials or, if not possible, less hazardous and more environmentally acceptable alternative materials shall be used to the maximum extent possible whenever feasible. Pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

3.9 Safety and health hazards. Safety and health hazards associated with the operation, transportation, maintenance, set-up/tear-down, storage and disposal of the ULCANS shall be eliminated or controlled to acceptable levels. Hazards shall be classified as to their severity category and probability level (guidance MIL-STD-882), no "high" or "medium" risk safety or health hazards shall exist. ULCANS shall not rely on the use of protective clothing and equipment (e.g., gloves, goggles, respirator) to control exposure to safety or health hazards.

3.10 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article tests (see 4.2).
b. Conformance inspection (see 4.3).

4.2 First article. First article examination and tests as specified in 4.4, shall be performed by the contractor. ULCANS will be tested on a one-time Production Verification Test (PVT) / First Article (FA) test by the U.S. Army CECOM Research, Development and Engineering Center (CERDEC), Night Vision and Electronic Sensors Directorate (NVESD). PVT/FA testing shall consist of visual, near infrared, thermal and radar field tests plus the specified tests herein. Failure of any test performed by the contractor or Government shall be cause for rejection.

4.3 Conformance inspection.

4.3.1 Inspection. The ULCANS shall be inspected as specified in 4.4. Presence of any defects or failure of any tests shall be cause for rejection.

4.3.1.1 Frequency of conformance inspection. Screens shall be inspected every 20,000 units of production.

4.3.1.2 Government verification tests. Verification testing for first article tests and conformance inspections when required by the Government shall be performed by CERDEC, NVESD. Failure of any test performed is cause for rejection.

4.3.2 Tests. The ULCANS shall be subjected to the tests in table IX. Failure of any test shall be cause for rejection.

4.4 Inspection procedures.

4.4.1 Examinations. ULCANS shall be examined as specified herein for the following defects.

101. Material not as specified.
102. Components missing, not as specified, or damaged.
103. Dimensions not as shown on drawings.
104. Weight of system not as specified.
105. Volume of system not as specified.
106. Repair kit not as specified.
107. Screen identification missing, incorrect, or illegible.
108. Used, rebuilt, or remanufactured components, pieces, or parts incorporated in the screen.

109. Workmanship not as specified.
110 Human engineering not as specified.
111. Patterns not as specified.
112. Foreign Object Damage.
113. Safety and health features not as specified.

4.4.2 Tests. ULCANS shall be tested as specified herein for conformance in accordance with the test schedule shown in table IX.

TABLE IX. Test schedule.

Test	Test Paragraph	Requirements Paragraph
Total system performance tests	4.4.2.1	3.2.1
Color and spectral reflectivity	4.4.2.2	3.2.2.2
POL exposure	4.4.2.2.3	3.2.2.2
Thermal properties test	4.4.2.3	3.2.2.4
Radar properties test	4.4.2.4	3.2.2.5
Flame resistance	4.4.2.5.1	3.2.2.6.1
Fungus resistance	4.4.2.5.2	3.2.2.6.2
Wt. increase after water immersion	4.4.2.5.3	3.2.2.6.3
Breaking strength	4.4.2.5.4	3.2.2.6.4
Accelerated weathering	4.4.2.5.4.1	3.2.2.6.4.1
Accelerated aging	4.4.2.5.4.2	3.2.2.6.4.1
Accelerated fading	4.4.2.5.4.3	3.2.2.6.4.1
Water immersion	4.4.2.5.4.4	3.2.2.6.4.1
Petroleum immersion	4.4.2.5.4.5	3.2.2.6.4.1
Salt fog	4.4.2.5.4.6	3.2.2.6.4.1
Humidity	4.4.2.5.4.7	3.2.2.6.4.1
Tear strength	4.4.2.5.5	3.2.2.6.5
Durability	4.4.2.6	3.3
Maintenance support test	4.4.2.7	3.5

4.4.2.1 Total system performance tests. The Government will conduct the following performance tests. Any system failure for any of these tests is reason for rejection.

4.4.2.1.1 Erection time.

4.4.2.1.1.1 ULCANS types I and II. After reading the technical manual and inventorying the system, three experienced soldiers will deploy the system within the time specified in 3.2.1.1.1.

4.4.2.1.1.2 ULCANS types III and IV. After reading the technical manuals and inventorying the systems, three experienced soldiers shall assemble (connect) two ULCANS systems (two hexagon screens and two rhombic screens) and deploy the systems. The same three soldiers shall then assembly and deploy two LCSS systems in the same configuration. Each exercise shall be timed from the opening of the containers until the soldiers are clear of the deployed systems. The times shall then be compared and Nonconformance with 3.2.1.1.2 shall constitute failure of this test.

4.4.2.1.2 Removal times.

4.4.2.1.2.1 ULCANS type I and II. The three experienced soldiers, who erected the types I/II systems, will take it down as specified in 3.2.1.2.1.

4.4.2.1.2.2 ULCANS types III and IV. Three experienced soldiers will break down and store two connected ULCANS systems (two hexagon screens and two rhombic screens). The same three soldiers shall then break down and store two LCSS systems in the same configuration. Each exercise shall be timed from the beginning of break down until soldiers have packed all components into storage containers. The times shall then be compared and Nonconformance with 3.2.1.2.2 shall constitute failure of this test.

4.4.2.1.3 Environmental conditions. ULCANS shall be tested under the following conditions. Any system failure is reason for rejection.

4.4.2.1.3.1 Wind. After deployment, ULCANS shall be subjected to a steady wind of 25 mph or greater with 10 gusts of 46 mph or greater during a two-hour period. Nonconformance to 3.2.1.4.5 shall constitute failure of this test.

4.4.2.1.3.2 Freezing rain/Ice. Support components shall show no signs of structural safety or operability degradation when subjected to ice and freezing rain tests, guidance MIL-STD-810, method 521. Nonconformance to 3.2.1.4.4 shall constitute failure of this test.

4.4.2.1.3.3 Sand/Dust. Support components shall show no signs of structural, safety, or operability degradation when subjected to sand and dust tests, guidance MIL-STD-810, method 510. Nonconformance to 3.2.1.4.4 shall constitute failure of this test.

4.4.2.1.4 Environmental tests. ULCANS components shall be subjected to extreme climatic conditions in an environmental laboratory guidance MIL-STD-810. Function of all components shall not be adversely affected.

4.4.2.2 Color and spectral reflectivity.

4.4.2.2.1 Color testing. Samples of finished camouflage screen material measuring 1 m (meter) x 1 m are required for color testing. A sample is required for each color present in the screen pattern.

4.4.2.2.1.1 Test apparatus. A spectroradiometer meeting parameters specified in table X is required.

TABLE X. Radiometer parameters.

Bandpass<=10 nm
Sampling Interval<=5 nm
Acceptance Angle>=5 degrees[1/]
Sensitivity[2/]>=10^{-8} W/cm²
Spectral Range 380-780 nm
Wavelength Accuracy<=1 nm
Wavelength Repeatability<=0.5 nm

[1/] Cone half angle>=2.5 degrees.
[2/] In native units of the instrument

The room where the measurements are made shall be painted matte black using paint with an average reflectance of 0.05 (5 percent) or less in the range 0.4 to 2.5 microns. Louvered diffusers for ceiling lamps shall be painted with the same black paint and direct the light straight down to prevent entry and reflection of stray light from the lamps. The floor shall be covered with a black rubber pebble-grained mat or similar material with a reflectivity similar to the paint for the walls. All entrances shall be light tight to block stray radiation.

Two CIE D65 simulators shall be used to illuminate the samples. The lamps shall be qualified by CIE Publication 51 requirements for color rendering with a rating of C or better for both color and UV rating. Lamps shall be used in pairs and each lamp shall deliver a minimum of 75 foot-candles of illumination at 0.75 meters. The lamps shall be capable of illuminating a 1 m x 1 m area with a uniformity of ±20 percent.

A fixture is required to support test specimens vertically at the required orientation without creating folds or wrinkles in the sample. The net specimens shall be mounted on the glossy side of a 1/4-inch thick black acrylic sheet four feet square.

A diffuse white panel of known spectral reflectivity shall be used as a guidance standard. The panel shall be a primed aluminum sheet at least .125-inch thick and four feet square, painted with a high quality, TiO_2-rich matte white paint free of barium sulfate ($BaSO_4$) and other white pigments.

4.4.2.2.1.2 Test procedure. Four spectral reflectivity measurements shall be made for each of the required screen samples. The screen samples shall be rotated 90 degrees within the plane of the sample between measurements. The screen samples and reflectance standard shall be positioned vertically and normal to the line-of-sight of the spectroradiometer for all measurements.

The lamps shall be angled at 45 degrees (nominal) and positioned as close to each other and the mounting fixture as possible without obscuring the field of view of the spectroradiometer or interfering with production of uniform illumination. The distance from the radiometer to the specimen shall permit viewing an area of the specimen at least 0.5 meter in diameter, and shall be pointed at the center of the specimen position. The height of the instrument aperture, the support fixture specimen mount center, and centers of the lamps shall all be the same.

Lamp positioning shall be determined with the black acrylic support in place and the room lights off. The lamps shall be moved until there is no specular component coming from the black support toward the location of the spectroradiometer.

With the white reference in place, the room lights out and the lamps on, the uniformity of the illumination of the white reference surface shall be checked by holding a photometer against the reference in sixteen uniformly spaced positions (4X4 grid). As required, maneuver the illuminators to flatten the field of illumination. Individual departures from uniformity shall not exceed 20 percent of the average of all the readings.

Place the spectroradiometer at a distance that allows its view angle to encompass a measurement area at least 0.5 meter in diameter. The final position of the radiometer shall be determined by iterative radiometric mapping using a black matte surface for a background. The radiometer shall be pointed at the center of the specimen position. Mapping can be done by holding a small (7.5 watt) lamp at fixed grid points and observing and mapping the instrument response. After each mapping the position of the instrument shall be refined and checked. For this purpose the native response units of the uncalibrated radiometer (voltage or current) are an adequate measure.

The preparation of the white reference panel shall include at least two witness coupons, 1 inch by 1 inch. The reflectivity of these coupons shall be measured in a spectrophotometer referenced to a NIST-traceable standard. Measurements shall be at 5 nm intervals. The reflectivity, evaluated

between 380 and 750 nm, of the white panel as a function of wavelength is the average value at each wavelength in the wavelength range. No measured value between 380 and 750 nm shall be more than 0.003 in reflectivity and the root mean squared (rms) error for all coupons at all wavelengths between 380 and 750 nm shall not exceed 0.005 reflectivity units.

The black panel shall be positioned and a net specimen attached. Tape may be used to fasten the edge of the netting to the mount. Position the screen sample so that fabric threads running lengthwise in the machine direction are oriented horizontally. Pull the screen sample taut to eliminate folds and wrinkles without distorting the scrim or the garnish. Illuminate the screen sample, and acquire spectroradiometric measurements. Rotate the screen sample 90 degrees within the plane of the sample and reposition sample over the background plate. Repeat the test procedure for each of the four sample orientations.

4.4.2.2.1.3 Calculation of color coordinates. A reflectivity versus wavelength function shall be

$$R(\lambda) = \frac{I_{tst}(\lambda)}{I_{std}(\lambda)} R_{std}(\lambda)$$

calculated for each of the test specimens using the following relationship:

where

$R(\lambda)$ = test specimen reflectivity as a function of wavelength

$I_{tst}(\lambda)$ = measured spectral radiance reflected from the test specimen, averaged at each measured wavelength over each of the four sample orientations

$I_{std}(\lambda)$ = measured spectral radiance reflected from the reflectance standard and

$R_{std}(\lambda)$ = absolute spectral reflectivity of the reflectance standard for $\lambda = 380$ to 750 nm

Tristimulus values and CIELAB color coordinates shall be calculated from spectral reflectivity data for each specimen in accordance with ASTM E 308 using standard illuminant D_{65} and CIE 1964 supplementary standard (10 degrees) observer. Nonconformance to 3.2.2.2.1 shall constitute failure of this test.

4.4.2.2.2 Spectral reflectivity.

4.4.2.2.2.1 Test specimens. Samples of finished camouflage screen material measuring 1 m x 1 m are required for spectral reflectivity testing. A sample is required for each color present in the screen pattern.

4.4.2.2.2.2 Test apparatus. A spectroradiometer capable of operation over the wavelength range 600 to 2500 nm is required for acquisition of radiometric data. Measurements shall be performed in a darkened room or enclosure having matte black interior surfaces with nonspecular reflectivity values less than 5 percent over the wavelength range 600 to 2500 nm. Room or enclosure and all entrances or openings must be must be light tight to block stray radiation. Two banks of quartz-halogen lamps or two arrays of lamps having a suitable reflector or lens capable of illuminating a 1 m x 1 m area with a minimum intensity of 50 W/m² is required. Illuminance over this area shall be uniform to within ±20 percent of the average value. A fixture is required to support test specimens vertically at the required orientation without creating folds or wrinkles in the sample or preventing transmission of light through the sample area. A diffuse white reflectance standard with dimensions 1 m x 1 m having nonspecular reflectivity coated with high grade TiO2 paint is required for determination of sample spectral reflectivity. A black acrylic flat plate measuring 1 m x 1 m is required as a background for measurement of test samples.

4.4.2.2.2.3 Test procedure. Four spectral reflectivity measurements shall be made for each of the required screen samples. Screen samples shall be rotated 90 degrees within the plane of the sample between measurements. Screen samples and reflectance standard shall be positioned vertically and normal to the line-of-sight of the spectroradiometer for all measurements. The height of the spectroradiometer aperture, the support fixture specimen mount center, and lamps shall all be the same.

Two banks of quartz-halogen lamps shall be angled at 45 degrees (nominal) and positioned as close to the mounting fixture as possible without obscuring the field of view of the spectroradiometer and without interfering with production of a uniform illumination over a 1 m x 1 m area. Lamp positioning shall be determined with the black support in place and the room lights off. The lamps shall be moved until there is no specular component coming from the black support toward the spectroradiometer.

Place the spectroradiometer at a distance that allows its view angle to encompasses a measurement area at least 0.75 m in diameter. The final position of the radiometer shall be determined by iterative radiometric mapping to ensure that the radiometer shall be pointed at the center of the specimen position. Mapping shall be done by holding a 7.5 watt lamp against a black mat background at fixed grid points and mapping the instrument response. After each mapping the position on the instrument shall be refined and checked. For this purpose the native response units of the uncalibrated radiometer (voltage or current) are an adequate measure.

Acquire spectroradiometric measurements of reflectance standard over the wavelength range 600 to 2500 nm with a maximum interval of 20 nm between measurements. Replace the reflectance standard with black background plate and attach a screen sample. Position the screen sample so that fabric threads running lengthwise in the machine direction are oriented horizontally. Pull the screen sample taut to eliminate folds and wrinkles without distorting the scrim or the garnish. Illuminate the screen sample, and acquire spectroradiometric measurements as before for the reflectance standard. Rotate screen sample 90 degrees within the plane of the sample and

reposition sample over the background plate. Repeat the test procedures for each of the four sample orientations.

4.4.2.2.2.4 Calculation of spectral reflectivity. A reflectivity versus wavelength function shall be calculated for each of the test specimens at each of the four sample orientations using the

$$R(\lambda) = \frac{I_{tst}(\lambda)}{I_{std}(\lambda)} R_{std}(\lambda)$$

following relationship:

where

$R(\Sigma)$ = test specimen reflectivity as a function of wavelength
$I_{tst}(\Sigma)$ = measured spectral radiance reflected from the test specimen
$I_{std}(\Sigma)$ = measured spectral radiance reflected from the reflectance standard

and

$R_{std}(\Sigma)$ = absolute spectral reflectivity of the reflectance standard for λ = 600 to 2500 nm.

Nonconformance to 3.2.2.2.2 shall constitute failure of this test.

4.4.2.2.3 POL exposure for color test. Appropriate size and number of samples as required by 4.4.2.2.1 and 4.4.2.2.2 shall be prepared for POL exposure. Separate samples shall be prepared for helicopter fuel JP-8 and diesel fuel DF-2. Immerse test sample for 15 minutes in fuel. Remove and blot excess liquid from screen. Samples shall be tested as specified in 4.4.2.2.1 and 4.4.2.2.2. Nonconformance to 3.2.2.2 shall constitute failure of this test.

4.4.2.3 Thermal properties test.

4.4.2.3.1 Thermal transmission. Thermal transmission testing shall be performed indoors. Two heated plate targets, each having an area of at least 10 feet square (10 ft²), shall be heated to temperatures of 25 ±2 °C and 40 ±2 °C respectively, above ambient air temperature. Target temperatures shall be maintained to within 0.5 °C of these values throughout the testing. Imagery of each target in the 3 to 5 and 8 to 12 micron band shall be acquired with targets filling the imagers' field of view and average radiance levels for each of the targets shall be determined. The finished ULCANS shall then be supported so that a single layer of material hangs vertically at a distance of ten feet in front of both targets. Thermal imagery of that portion of the ULCANS which conceals each of the targets shall be acquired and average radiance levels for each of the 10 ft² minimum sections of material which covers each target shall be determined. The percentage transmission shall be calculated as follows:

$$\%Transmission = \frac{R_{U,40} - R_{U,25}}{R_{B,40} - R_{B,25}} X100$$

Where R = Radiance level
U = ULCANS covered target
B = Bare target
40 = Target 40 °C above ambient air temperature
and 25 = Target 25 °C above ambient air temperature

The ULCANS shall be repositioned so that a different area of the screen conceals the targets after imagery of the bare targets is reacquired and the above procedure shall be repeated. A total of five measurements shall be made to obtain an average transmission value for the ULCANS. Nonconformance to 3.2.2.4.1 shall constitute failure of this test.

4.4.2.3.2 Screen thermal signature. Screen thermal signature testing shall be performed outdoors. The ULCANS shall be deployed in its intended configuration in an open area so that it receives full solar radiation in daytime. Imagery of the ULCANS in the 3 to 5 and 8 to 12 micron band shall be acquired during the day after exposure of the screen to solar radiation levels greater than 800 W/m² and an average wind speed of less than 2 m/s for a period of at least one hour. The imager shall be positioned at ground level so that those screen surfaces which receive the greatest solar loading are in the imager's field of view. An ambient temperature black body having an emissivity of 0.98 or higher in the 3 to 5 and 8 to 12 micron band shall be placed in the imager's field of view at the same distance from the imager as the ULCANS and shielded from incident solar radiation. Ambient air temperature shall be determined by measuring actual ambient black body temperature. Daytime thermal imagery shall be collected while the solar radiation level is greater than 800 W/m² and the average wind speed is less than 2 m/s. Imagery of the ULCANS shall be acquired at three different times with a period of at least 15 minutes between readings. Ambient black body temperature shall be used as a reference point in calibrating the imagery. Daytime imagery shall be analyzed to identify the 1 m ² area of the ULCANS which has the highest average apparent temperature. Visual inspection of imagery may be used to limit the analysis to those regions of the ULCANS which appear to have a high apparent temperature relative to the rest of the screen. The difference between the average apparent temperature of this area and ambient air temperature shall be determined for each reading and these values shall be averaged. Imagery in the 3 to 5 and 8 to 12 micron band shall also be acquired at night while there is minimal cloud cover (less than ten percent). The wind speed specified for daytime testing does not apply to nighttime testing, however, wind speed shall be recorded. An ambient temperature black body shall be used to determine ambient air temperature and calibrate imagery as in the daytime test. Nighttime imagery of the ULCANS shall be acquired at three different times with a period of at least 15 minutes between readings. Nighttime imagery shall be analyzed to identify the 1 m² area of the ULCANS which has the lowest average apparent temperature. Visual inspection of imagery may be used to limit the analysis to those regions of the ULCANS which appear to have a low apparent temperature relative to the rest of the screen. The difference between the average apparent temperature of this

area and ambient air temperature shall be determined for each reading and these values shall be averaged. Nonconformance to 3.2.2.4.2 shall constitute failure of this test.

4.4.2.4 Radar properties test. Average percent power transmitted through a finished net shall be measured at two orthogonal antenna polarizations relative to the screen and at least 51 discrete frequencies over a bandwidth of 2 GHz centered at 6.0, 10.0, 17.0, 35.0, and 94.0 GHz using the procedure outlined in 4.4.2.4.1. The standard deviation and correlation length shall be measured at 10 GHz using the procedure outlined in 4.4.2.4.2. Nonconformance to 3.2.2.5 shall constitute failure of this test.

4.4.2.4.1 Average transmission test.

4.4.2.4.1.1 Admittance tunnel. Construct admittance tunnel as shown in figure 5. The interior of the tunnel shall be coated with radar absorbing material. The dimensions of the tunnel shall be such that the tunnel aperture is in the far field of all antennas used in the measurements. The aperture of the tunnel shall provide at least 625 square inches of area unoccluded by any radar absorbing material.

4.4.2.4.1.2 Calibration. At each discrete frequency and polarization measure and record the complex voltage response of the admittance tunnel with no screen covering the aperture. Store this data for use in the calculations outlined in 4.4.2.4.1.4. A new set of calibration data shall be taken for each screen measured.

4.4.2.4.1.3 Screen data. Take screen data as follows: Stretch screen tightly over tunnel aperture so that continuous contact is made on all four edges of the aperture and no obvious folds or heavy wrinkles are evident. Measure and record complex voltage response of the screen. Repeat this procedure six times per frequency and relative polarization with a different section of screen positioned over tunnel each time.

4.4.2.4.1.4 Calculations. Calculate percent power transmitted for each sample, polarization,

$$T_{ijk} = \left|\frac{V_s(i,j,k)}{V_c(i,k)}\right|^2 x\ 100\% \quad i = 1,2,...N\ \ j = 1,2,...6\ \ k = 1,2$$

and discrete frequency using the following formulas:

where

T_{ijk} = percent power transmitted for sample j and frequency i at polarization k.
$V_c(i,k)$ = complex voltage response of the open tunnel at frequency i and polarization k measured in 4.4.2.5.1.

$V_s(i,j,k)$ = complex voltage response of screen for sample j, frequency i, and polarization k measured in 4.4.2.4.1.3.
N = Number of discrete frequencies.

The resulting values of T for each polarization and each band are averaged by sample number

$$< T >_k = \frac{1}{6N} \sum_{i=1}^{N} \sum_{j=1}^{6} T_{ijk}$$

and frequency to obtain the average T by the following formula.

where $<T>_k$ is the average transmission at polarization k.

4.4.2.4.2 Standard deviation and correlation length test.

4.4.2.4.2.1 Scanning apparatus. An apparatus for linearly positioning an open ended X band (WR-90) waveguide at any arbitrary location in the aperture plane of the admittance tunnel of section 4.4.2.4.1.1 shall be constructed. The scanning apparatus replaces the receiving antenna in figure 5. The apparatus shall be capable of accurately positioning the waveguide to within .01-inch. The open end of the waveguide shall be positioned as close as possible to the aperture without making physical contact with any camouflage material covering the aperture.

4.4.2.4.2.2 Calibration. With no material covering the aperture, measure and record the complex voltage response from the open waveguide as it is scanned in .10-inch steps across the aperture of the admittance tunnel with the transmitter operating at 10 GHz. The open waveguide and the transmitting antenna shall have the same polarization. The linear extent of the scan must be within the half power points of the tunnel aperture and shall be at least 25 inches.

4.4.2.4.2.3 Scan data. Take scan data as follows: Stretch screen tightly over tunnel aperture so that continuous contact is made on all four edges of the aperture and no obvious folds or heavy wrinkles are evident. Measure and record the complex voltage response of the screen as the waveguide is scanned across the material in .10-inch steps over the length of the scan determined in 4.4.2.4.2.2. Repeat this procedure six times with a different section of screen positioned in front of the waveguide each time. Screen samples shall be rotated 90 degrees within the plane of the sample between measurements.

4.4.2.4.2.4 Calculations. The calibrated transmission at each position of the scan is calculated

$$T_{ij} = \frac{|V_s(i,j)|^2}{|V_c(i)|^2} \qquad i = 1,2...N \quad j = 1,2,...6$$

using the following formula.

where

N = the number of data points per scan.
$V_s(i,j)$ = the measured complex response of the screen sample j at position i.
$V_c(i)$ = the measured calibration value at position i.

$$S = \sqrt{v} \times 100\%$$

$$v = \frac{1}{6N - 1} \sum_{i=1}^{N} \sum_{j=1}^{6} (T_{ij} - \overline{T})^2$$

$$\overline{T} = \frac{1}{6N} \sum_{i=1}^{N} \sum_{j=1}^{6} T_{ij}$$

$$R_n = \sum_{i=1}^{N} \sum_{j=1}^{6} (T_{ij} - \overline{T})(T_{kj} - \overline{T}) \quad k = i + n$$

The autocovariance function of the scan is then computed by the following formula.

To obtain a correlation length of less than 2 inches, the screen data must then meet the following

$$\overline{R}_{20} = \frac{R_{20}}{R_0} < \frac{1}{e}$$

condition.

where e is Euler's number (approximately 2.71828).

4.4.2.5 Screen material properties tests.

4.4.2.5.1 Flame resistance. Test specimen shall be prepared by using a 12-inch x 12-inch piece of screen. Specimens shall not be selected from the same roll. Each specimen shall be conditioned according to option B of ASTM D 3659. Each specimen shall be attached to and hung from a horizontal support so that the entire 12-inch x 12-inch area is exposed. The middle of the bottom edge of the specimen shall be positioned in the center of a 1-1/2 inch burner flame.

The burner, gas regulator valve, and fuel shall be as specified in ASTM D 3659. The flame shall be applied for 15 seconds then removed. Nonconformance to 3.2.2.6.1 shall constitute failure of this test.

4.4.2.5.2 Fungus resistance. The screens shall be tested in accordance with ACT 30, test III. Nonconformance to 3.2.2.6.2 shall constitute failure of this test.

4.4.2.5.3 Weight increase after water immersion. For guidance use FED-STD-191, method 5502 to determine the screen weight increase after immersion in water. A 6 x 6 inch sample shall be used. Nonconformance to 3.2.2.6.3 shall constitute failure of this test.

4.4.2.5.4 Breaking strength. The breaking strength of the garnish cloth and woven screen material shall be tested in accordance with ASTM D 5034 grab test method. The breaking strength of the knitted screen material shall be tested in accordance with ASTM D 3787 bursting ball test method. Nonconformance to 3.2.2.6.4 shall constitute failure of this test.

4.4.2.5.4.1 Accelerated weathering. The material shall be conditioned in accordance with ASTM G 26, method 1, type BH for 300 hours and tested as specified in 4.4.2.5.4. Nonconformance to 3.2.2.6.4.1 shall constitute failure of this test.

4.4.2.5.4.2 Accelerated aging. The material shall be conditioned in accordance with ASTM D 751, test method: accelerated heat aging of fabrics coated with rubber or plastics by the oven method, for ten days at 175 ±5 °F, and tested as specified in 4.4.2.5.4. Nonconformance to 3.2.2.6.4.1 shall constitute failure of this test.

4.4.2.5.4.3 Accelerated fading. The material shall be conditioned for 140 hours, guidance FED-STD-191 method 5660, and tested as specified in 4.4.2.5.4. Nonconformance to 3.2.2.6.4.1 shall constitute failure of this test.

4.4.2.5.4.4 Water immersion. The finished cloth shall be immersed in distilled water for 24 hours at 73 ±2 °F, and tested as specified in 4.4.2.5.4. Nonconformance to 3.2.2.6.4.1 shall constitute failure of this test.

4.4.2.5.4.5 Petroleum immersion. The finished cloth shall be immersed in both JP-8 helicopter and DF-2 diesel fuels for 2 hours at 73 ±2 °F, and tested as specified in 4.4.2.5.4. Nonconformance to 3.2.2.6.4.1 shall constitute failure of this test.

4.4.2.5.4.6 Salt fog. The finished cloth shall be conditioned for 300 hours in accordance with ASTM B 117 and tested as specified in 4.4.2.5.4. Nonconformance to 3.2.2.6.4.1 shall constitute failure of this test.

4.4.2.5.4.7 Humidity. The finished cloth shall be conditioned for 14 days in accordance with ASTM D 2247 and tested as specified in 4.4.2.5.4. Nonconformance to 3.2.2.6.4.1 shall constitute failure of this test.

4.4.2.5.5 Tear strength. The garnish cloth material shall be tested in accordance with ASTM D 2261 except with the following modifications:

a. The specimen size shall be 1 inch by 8 inches.
b. The test shall be performed only with specimens with the short distance (1-inch width) parallel to the warp yarns.
c. The average break value shall be calculated based on the average of the five highest peaks of each sample tested.

Nonconformance to 3.2.2.6.5 shall constitute failure of this test.

4.4.2.6 Durability. ULCANS shall be deployed and recovered into storage/transport containers 112 times. Nonconformance to 3.3 shall constitute a failure.

4.4.2.7 Maintenance support test. Prior to conducting Government verification performance tests, make an "L" shaped incision in screen 24 inches in each direction (each leg) and repair with items in repair kit. At end of test any evidence of screen deterioration in the repaired area is reason for rejection.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available form the managing Military Department's or Department Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES.
(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. ULCANS is the camouflage system designed for use with all military materiel including tactical vehicles and aircraft. ULCANS is the only camouflage screen system employed by aviation units to camouflage aircraft. It is intended to increase vehicle survivability by countering visual, wide band radar, near infrared and thermal detection capabilities. During high winds and heavy snowfalls, ULCANS should be checked frequently. A great accumulation

of snow or ice should not be allowed to accumulate on screens. Snow or ice must be removed from the screens as soon as they begin to sag or show signs of stress or strain due to the extra weight.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of the specification.
b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual document referenced (see 2.2 and 2.3).
c. When a first article is required for inspection and approval and number of units required (see 3.10 and 4.2).
d. Packaging requirements (see 5.1).
e. Marking if other than as specified (see 5.2).

6.3 Definitions.

6.3.1 ULCANS type I. Ultralightweight Camouflage Net System, type I consists of the components (modular camouflage screens, rotor blade tip covers, wire cutter covers, repair kit, operators and maintenance manual, and storage/transport containers) required to conceal an OH-58D helicopter.

6.3.2 ULCANS type II. Ultralightweight Camouflage Net System, type II consists of the components (modular camouflage screens, rotor blade tip covers, wire cutter covers, repair kit, operators and maintenance manual, and storage/transport containers) required to conceal an AH-64 or UH-60 helicopter.

6.3.3 ULCANS types III and IV. Ultralightweight Camouflage Net System, types III and IV consists of the components (modular camouflage screens, repair kit, operators and maintenance manual, and storage/transport containers) required to conceal ground equipment.

6.3.4 Terms. The terms "net", "netting" and "screen" are synonymous in this specification.

6.3.5 Deploy. The act of erecting ULCANS, from the storage case being opened until the soldiers walk clear of the ULCANS.

6.3.6 Recover. The act of taking down ULCANS and putting it in the storage containers with all components clear of equipment or aircraft. Types I and II shall be secured and aircraft able to depart safely.

6.3.7 Concealment. Hiding an aircraft or vehicle under an ULCANS.

6.3.8 Identification. Ability to determine the presence of an aircraft or vehicle under an ULCANS.

6.3.9 Open storage. A covered storage area without environmental control (i.e., hangar, warehouse, etc.).

6.3.10 Experienced soldier. Any soldier that has deployed ULCANS a minimum of 3 times.

6.3.11 System failure. A system failure is defined as any malfunction that can not be repaired by the crew and which causes or may cause failure to commence operation, cessation of operation or degradation of performance below specified levels or poses serious personnel safety hazards.

6.3.12 Service life. Service life shall be considered 112 cycles.

6.4 Subject term (key word) listing.

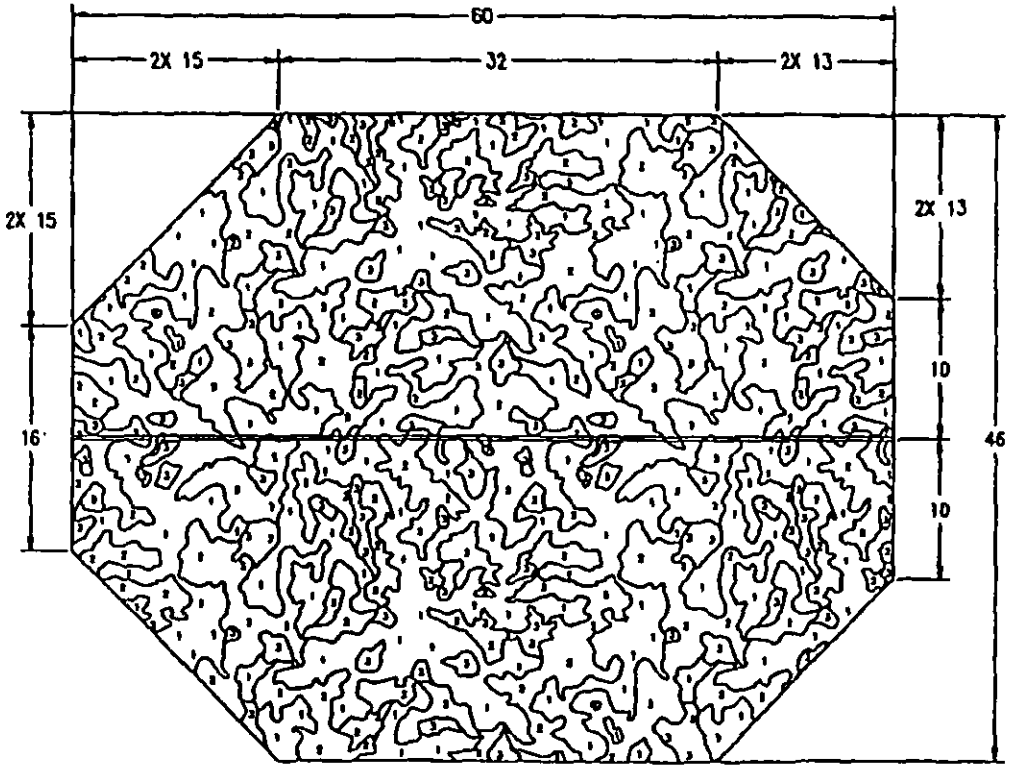
concealment
near infrared suppression
netting
radar suppression
screen
screening
thermal suppression
visual suppression

Custodians:
Army - ME
Navy - MC

Preparing activity:
Army - ME

Project 1080-0083

Review activities:
Army - AV, CR, GL, MI



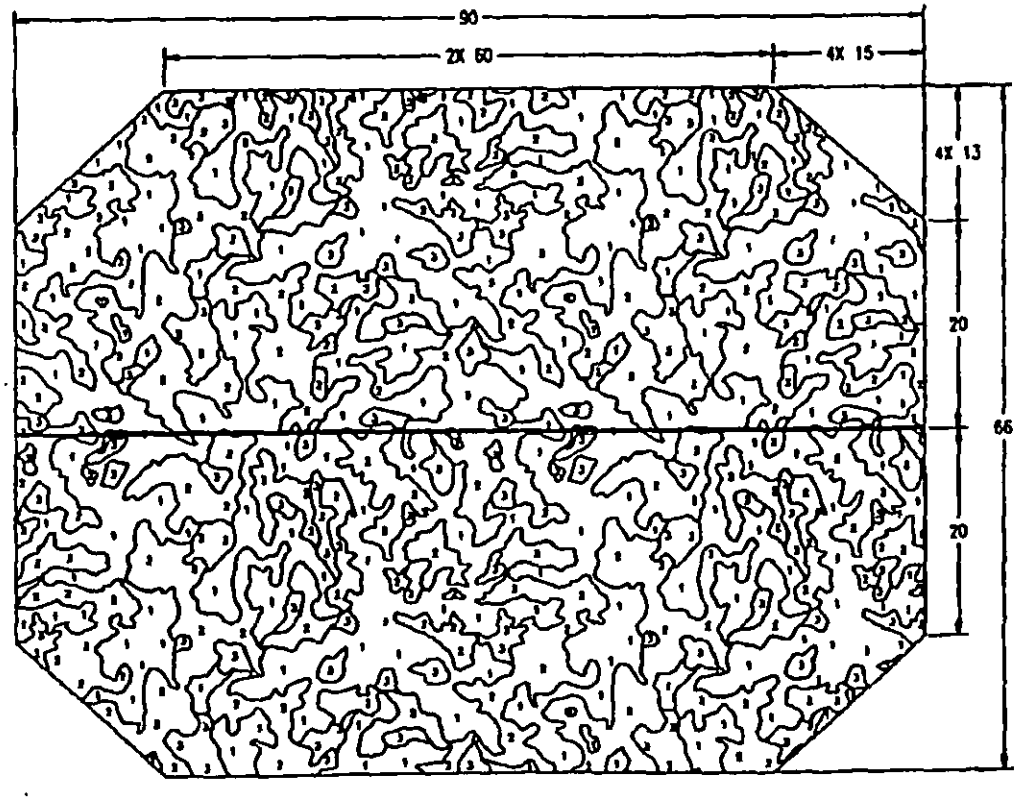
DO NOT SCALE FROM THESE SKETCHES

NOTES:

1. STAKE LOOPS WILL BE LOCATED AT CORNERS AND SHALL BE EVENLY SPACED ALONG EACH SIDE AT A MAXIMUM SEPARATION OF FIVE FEET ON CENTER.
2. EDGES MUST BE REINFORCED.
3. BECKET LOOP AND HOLES FOR JOINING HALVES WILL BE LOCATED ON 6" CENTERS.
4. ALL DIMENSIONS SHOWN ARE AFTER TWO HALVES ARE JOINED TOGETHER.
5. ALL DIMENSIONS IN FEET.

COLOR CODES	
NO	COLOR
1	BLACK
2	LIGHT GREEN
3	FOREST GREEN

Figure 1. ULCANS Type I



DO NOT SCALE FROM THESE SKETCHES

NOTES:

1. STAKE LOOPS WILL BE LOCATED AT CORNERS AND SHALL BE EVENLY SPACED ALONG EACH SIDE AT A MAXIMUM SEPARATION OF FIVE FEET ON CENTER.
2. EDGES MUST BE REINFORCED.
3. BECKET LOOP AND HOLES FOR JOINING HALVES WILL BE LOCATED ON 8' CENTERS.
4. ALL DIMENSIONS SHOWN ARE AFTER TWO HALVES ARE JOINED TOGETHER.
5. ALL DIMENSIONS IN FEET.

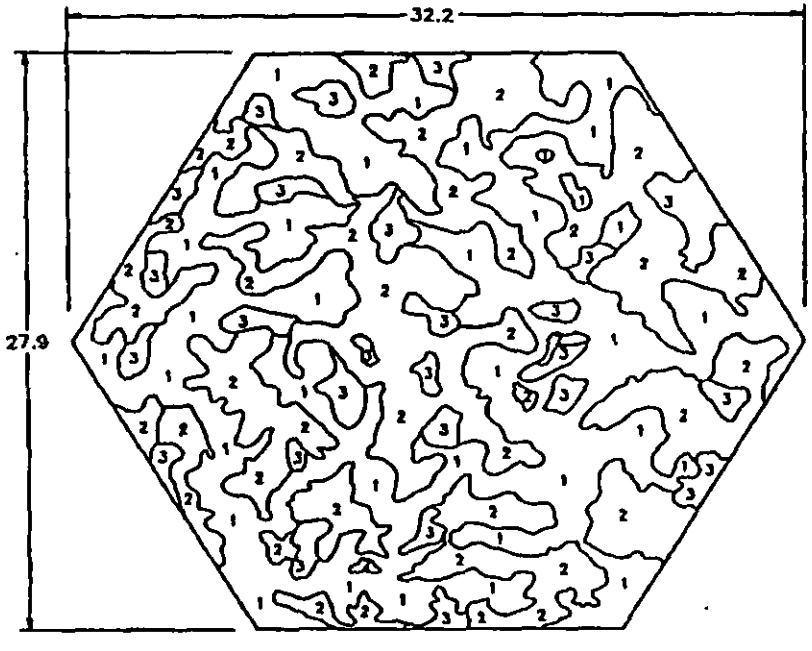
COLOR CODES	
NO	COLOR
1	BLACK
2	LIGHT GREEN
3	FOREST GREEN

Figure 2. ULCANS Type II

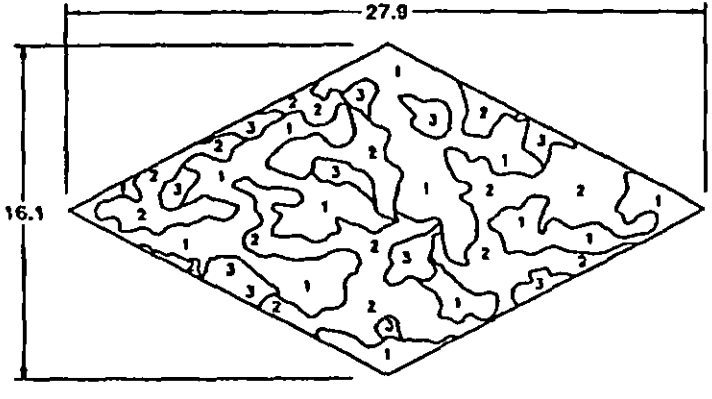
NOTES:

1. STAKE LOOPS WILL BE LOCATED AT CORNERS AND SHALL BE EVENLY SPACED ALONG EACH SIDE AT A MAXIMUM SEPARATION OF FIVE FEET ON CENTER.
2. EDGES MUST BE REINFORCED.
3. BUCKET LOOP AND HOLES FOR JOINING HALVES WILL BE LOCATED ON 8 CORNERS.
4. ALL DIMENSIONS SHOWN ARE AFTER TWO HALVES ARE JOINED TOGETHER.
5. ALL DIMENSIONS IN FEET.

COLOR CODES	
NO.	COLOR
1	BLACK
2	LIGHT GREEN
3	FOREST GREEN



DO NOT SCALE FROM THESE SKETCHES



DO NOT SCALE FROM THESE SKETCHES

Figure 3. ULCANS Types III & IV

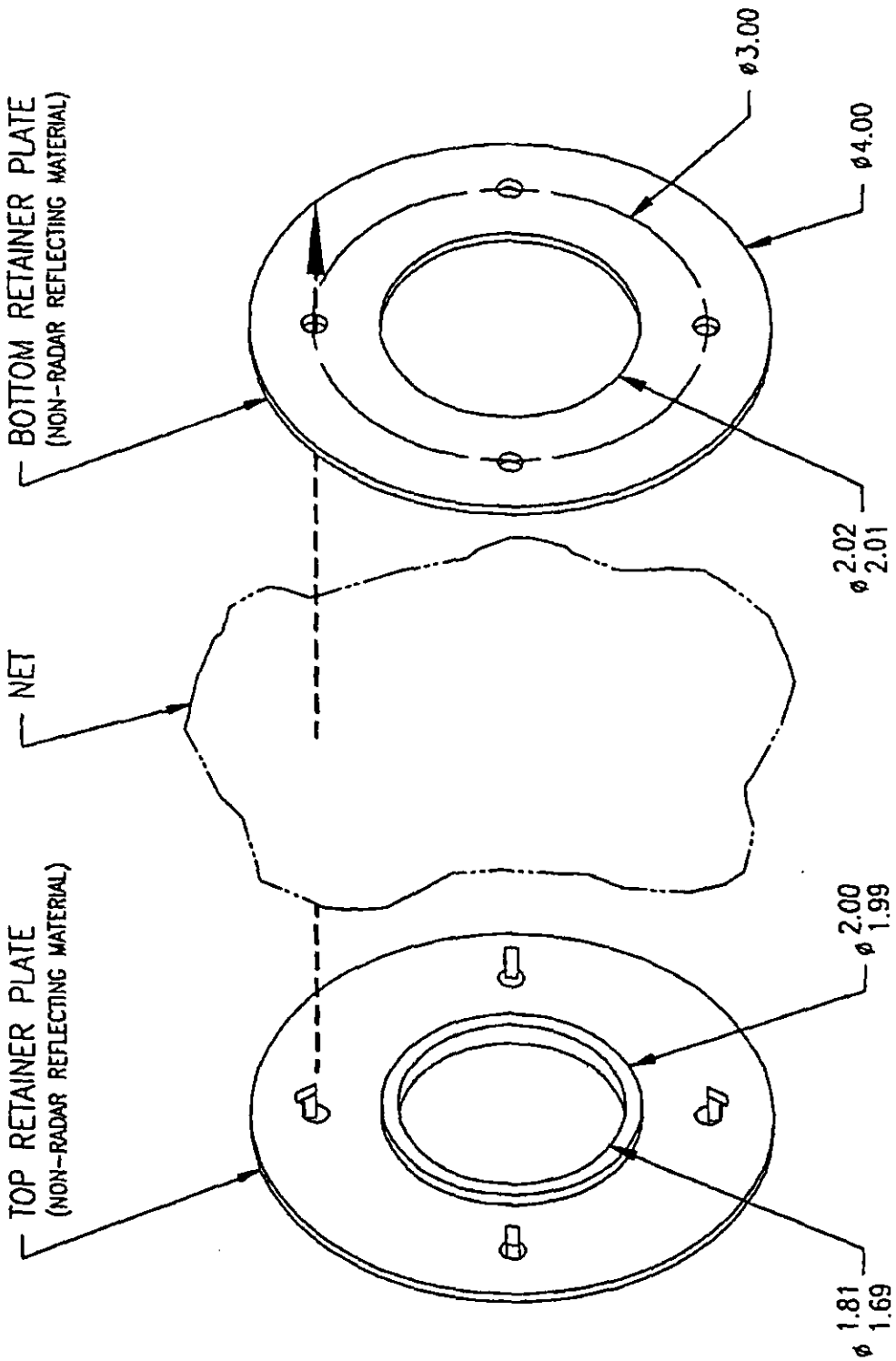


Figure 4. Antenna Flange Assembly

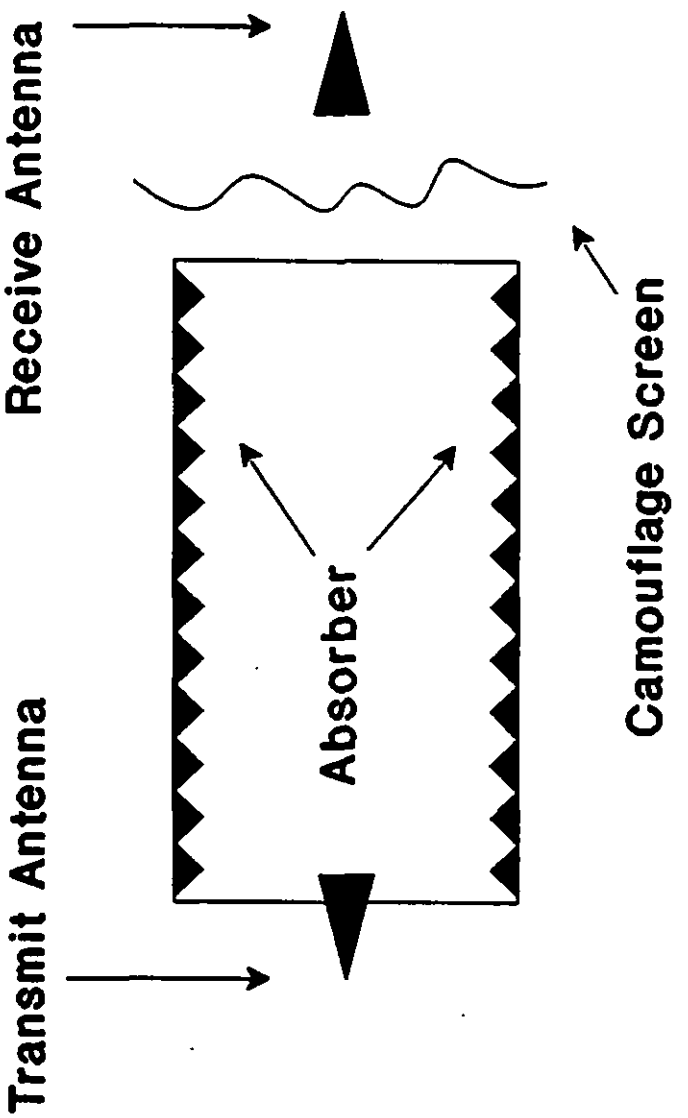


Figure 5. Admittance Tunnel

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-53134	2. DOCUMENT DATE (YYMMDD) 960126

3. DOCUMENT TITLE ULTRALIGHTWEIGHT CAMOUFLAGE NET SYSTEM (ULCANS)

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (if applicable) (2) DSN	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. NAME Carolyn B. Johnson	b. TELEPHONE (Include Area Code) (1) Commercial (703) 704-3468 (2) DSN 654-3468
c. ADDRESS (Include Zip Code) USA COMMUNICATIONS-ELECTRONICS CMD, BELVOIR PIPE SOUTH LOGISTICS & READINESS CENTER ATTN: AMSEL-LC-ED-BD FT BELVOIR VA 22060-5849	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: DEFNS QLTY & STDZN OFC 5203 LEESBURG PIKE STE 1403 FLS CHURCH VA 22041-3466 Telephone (703) 756-2340 DSN 289-2340