MEPROLIGHT®

27 June 2000

US Nuclear Regulatory Commission (NRC)
Materials Safety Branch
Division of Industrial & Medical Nuclear Safety, NMSS
Source Containment and Devices Branch
Sealed Source Safety Section
Two White Flint North
11545 Rockville Pike
North Bethesda, MD 50852

Attention: Mr. Anthony Kirkwood

Subject: **Application for Device Evaluation and Registration MEPROLIGHT gun sights and other illuminated products containing H-3 as exempt items**

Dear Mr. Kirkwood,

Enclosed, please find two copies of our application for Device Evaluation and Registration of three families of MEPROLIGHT illuminated products. These products are covered by HESCO's Registration Certificates NR-352-D-101-E, NR-352-D-102-E and NR-352-D-103-E that list HESCO as the sole distributor.

Due to commercial considerations, we respectfully request that the three Registration Certificates cited above be amended to show Scopus Light USA, Inc. (1 Lawton Street, Yonkers, NY 10705) as an additional distributor. A letter from HESCO also requesting such amendment is enclosed herein.

We have one important question relating to the above requested amendment. In the event that, at some future date, HESCO (as holder of the registration certificates) chooses to abandon the certificates (and stop marketing the products), what will happen to us – as second distributors? Can we automatically "pick up" the certificates? If such a decision by HESCO leads to the certificates becoming inactive, then Scopus Light USA, Inc would no longer be able to distribute the products. Therefore, if this would be the case, we request that in addition to amending HESCO's existing certificates, all three Registration Certificates be duplicated under the name Scopus Light USA, Inc., and that any applicable fees levied take into consideration the possibility that complete safety evaluations may not be required.

Scopus Light (1990) Ltd. Kibbutz Maayan Zvi 30805 Israel
Tel: 972-6-6395060 Fax: 972-6-6396861 E-mail: mepro_eng@mayan.org.il

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We hope that, if necessary, the application attached herein can be used as the basis for issuing new certificates under our own company name as shown above. It has been prepared according to the requirements stated in 10CFR30.19 and following the guidelines of NUREG-SR1556, Volume 3.

All quality assurance/quality control programs in use - both in the manufacturing facility and at the initial point of acceptance and storage in the United States – are identical to those sited in the HESCO license and certificates, as reiterated in the attached application.

As discussed with you, no application fee is being remitted at this time since it is not certain what steps are contemplated by your office with regard to this matter.

Please note that the name "MEPROLIGHT" is a registered trademark for both our company and its products. In the future, it may also become the name of our U.S. based company (presently Scopus Light USA, Inc.). We ask, therefore, that the two names be considered as synonymous throughout this application as they apply to our U.S. based company.

If further technical information is required, please contact the undersigned directly at the address, telephone or email shown below.

Thank you for your prompt attention to this request.

Sincerely,

Brad Fisher

Brad Fisher
Operations Manager
Scopus Light USA, Inc.
Email – mepro_eng@mayan.org.il

HESCO
INCORPORATED
2139 Greenville Road • LaGrange, Georgia 30241
Phone: 706-884-7967 • Fax: 706-882-4683
Web:www.anfire.com/hesco.html
email:Hesco@worldnet.att.net

June 29, 2000

U.S. Nuclear Regulatory Commission
Division of Industrial and Medical
Nuclear Safety, NMSS
Source Containment and Devices Branch
Sealed Source Safety Section
Two White Flint North, 11545 Rockville Pike
North Bethesda, MD 50852

HESCO, Inc. presently holds active Registration Certificate NR-352-D-01-E, NR-352-D-102-E and NR-352-D-103-E showing HESCO, Inc. as the sole distributor of products manufactured by MEPROLIGHT (formerly Scopus Light (1990) Ltd.).

Because of commercial considerations, HESCO feels that it would be advantageous to add a second distributor to these certificates-Scopus Light USA, Inc.-and we understand that they have submitted a request to make such a change to the certificates.

MEPROLIGHT (formerly Scopus Light (1990) Ltd.) is the sole manufacturer of all products to be distributed under these certificates. The quality assurance/quality control programs in use-both in the manufacturing facility and at the initial point of acceptance and storage in the United States-will be identical to those sited in the HESCO license.

In light of the above, please consider this letter as a formal request that the three Registration Certificates discussed above be amended to show Scopus Light USA, Inc. (New York) as an additional distributor. The exact address will be supplied by Scopus Light in their requests for registration amendment and/or license.

Sincerely,

Kerry R. Kinder

Kerry R. Kinder
Sales Manager

SUMMARY DATA

Name and Complete Mailing Address of the Applicant:

Scopus Light USA, Inc.
1 Lawton Street
Yonkers, NY 10705

Name, Title, and Telephone Number of the Individual to Be Contacted If Additional Information or Clarification Is Needed by the NRC:

Bradley D. Fisher, Operation Manager
(972) - 6-6395060

The Applicant is (check one):

	Custom User
	Manufacturer
X	Distributor
	Manufacturer and Distributor

If the Applicant Is Not the Manufacturer, Provide the Name and Complete Mailing Address of the Manufacturer:

MEPROLIGHT, LTD.
(Scopus Light (1990) Ltd.)
Kibbutz Maayan Zvi
Hof HaCarmel 30805
Israel

If the Applicant Is a Custom User, Provide the Name and Complete Mailing Address of the Distributor:

N/A

Provide the Name, Complete Mailing Address, and Function of Other Companies Involved:

Model Number: See Attached List

Principal Use Code (see Appendix D): W

Name Used by the Industry to Identify the Product (e.g., Radiography Exposure Device, Teletherapy Source, Calibration Source, etc.):

1. Weapon (Gun) Sights
2. Watches and Altimeters
3. Personal Markers

For Use by:

	Specific Licensees Only
	General Licensees Only
	Both Specific and General Licensees
X	Persons Exempt from Licensing

Leak-Test Frequency:

X	Periodic Leak-Testing is Not Required
	6 Months
	Attached is justification for a leak test frequency of greater than 6 months Tritium - Exempt

Principal Section of the 10 CFR that Applies to the User (e.g., General Licensees under 10 CFR 31.5):

10 CFR 30.19

Radionuclides and Maximum Activities (including loading tolerance):

Hydrogen-3 (tritium) gas
120 mCi maximum (see attached)

CERTIFICATION:

THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30 AND 32 AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANYMATTER WITHIN ITS JURISDICTION.

Certifying Officer -- Typed Name and Title

Bradley D. Fisher, Operations Manager

Signature: Bradley D. Fisher

Date: 27 June 2000

APPENDIX C – SUMMARY DATA

Supplementary information pursuant to application for Device Registration under the name of Scopus Light USA, Inc.

Name and Complete Address of Applicant:

Company Headquarters:

Scopus Light USA, Inc.
1121 12th Street NW
Washington, DC 20005-4632

Company Distribution Location:

Scopus Light USA, Inc.
1 Lawton Street
Yonkers, NY 10705

Model Number: Complete Lists of Model Numbers are provided on the following pages. They are presented as "families" for each of the three device types (as taken from the existing HESCO certificates).

Principal Use Code: (W) Self-Luminous Light Sources

Name Used by Industry to Identify the Product (three certificates):

1. Weapon Sights
2. Watches and Altimeters
3. Personal Markers

Radionuclides and Maximum Activities:

Hydrogen H-3 (tritium)

1. Weapon Sights - maximum of 54 millicuries per set (20 mCi max. per source)
2. Watches - maximum of 25 millicuries (2 mCi max per source)
3. Altimeters - maximum of 40 millicuries (4 mCi max per source)
4. Personal Markers - maximum of 120 millicuries (40 mCi max per source)

MODEL NUMBERS - WEAPON (GUN) SIGHTS

ISOTOPE	MODEL	TYPE	MAXIMUM ACTIVITY	
Hydrogen-3	ML-100	Front	20 millicuries	(0.74 GBq)
	ML-115O	Front	20 millicuries	(0.74 GBq)
		Rear	12 millicuries	(0.44 GBq)
		Total	32 millicuries	(1.18 GBq)
	ML-115P	Front	20 millicuries	(0.74 GBq)
	ML-200A	Front	6 millicuries	(0.22 GBq)
		Rear	24 millicuries	(0.89 GBq)
		Total	30 millicuries	(1.11 GBq)
	ML-260	Front	12 millicuries	(0.44 GBq)
		Rear	12 millicuries	(0.44 GBq)
		Total	24 millicuries	(0.89 GBq)
	ML-300A	Front	12 millicuries	(0.44 GBq)
		Rear	16 millicuries	(0.59 GBq)
		Total	28 millicuries	(1.04 GBq)
	ML-300N	Front	12 millicuries	(0.44 GBq)
		Rear	16 millicuries	(0.59 GBq)
		Total	28 millicuries	(1.04 GBq)
	ML-400	Front	18 millicuries	(0.67 GBq)
	ML-750	Front	18 millicuries	(0.67 GBq)
		Rear	36 millicuries	(1.33 GBq)
		Total	54 millicuries	(2.00 GBq)

MODEL NUMBERS – WATCHES AND ALTIMETERS

ISOTOPE	MODEL	MAXIMUM ACTIVITY	
Hydrogen-3	ML-442xx Series Watches	25 millicuries	(0.925 GBq)
	ML-443xx Series Watches	25 millicuries	(0.925 GBq)
	ML-444xx Series Watches	25 millicuries	(0.925 GBq)
	ML-447xx Series Watches	25 millicuries	(0.925 GBq)
	ML-448xx Series Altimeters	40 millicuries	(1.48 GBq)

MODEL NUMBERS – PERSONAL MARKERS

ISOTOPE	MODEL	MAXIMUM ACTIVITY	
Hydrogen-3	ML-417xx Series Personal Markers	120 millicuries	(4.44 GBq)

SECTION I. B. Description of intended use

The tritium illuminated sight systems are designed as replacement parts for their non-illuminated counterparts on handguns, rifles, shotguns and archery equipment. Utilizing existing weapon features (such as dovetail, existing sight blades, screw mounts, etc), they can be mounted directly with no modification to the sight and no or only minor modification to the weapon. (On weapons with non-removable front sights, a hole must be drilled through the existing non-illuminated front sight.) The sights are used by military and law enforcement personnel, and by sportsmen to improve low-light shooting capability. The addition of luminous elements to the sight designs provides an improved low-light level sighting capability and thereby greatly enhances the hit probability for the user. Since the sights are attached to the weapons, they are normally found in close proximity to the shooter on a limited basis (with the exception of law enforcement personnel who carry them throughout the day). They are not normally in close proximity to the breathing or ingestion

SECTION II. A. Type and quantity of by-product material

All by-product material is tritium H-3 in gaseous form, sealed into borosilicate glass tubes. The sources are purchased from either mb-microtec (source configuration 400/1) or SRB Technologies, Inc (source configuration M-1).

Sight systems consist of one or two (front and rear) sights. The maximum number of sources in a sight system is 3 (one in the front and two in the rear) with total activity of no more than 54 mCi (H-3 gas) per set and with no single source being more than 20 mCi. A full list of models and a detailed explanation of the sight configurations and specific activity for each is presented in Appendix S-I, together with associated tables and drawings, as part of the discussion presented in Section IVA (Construction and Design). The models are cross-referenced to the specific device registration models as currently listed in HESCO Registration Certificate NR-352-D-101-E.

SECTION II. B. Annual distribution and activity stored in one location

1. Annual Distribution

It is anticipated that 5,940 Ci in the following quantities of each of the products will be distributed yearly:

Sights -	175,000 (5,250 Ci)
Watches -	10,000 (250 Ci)
Altimeters -	1,000 (40 Ci)
Personal Markers (based on 2 sources/marker) -	5,000 (400 Ci)

2. Activity stored in one location

   Since, because of economic considerations, large quantities of items are not held in stock, but rather ordered as-needed to fill delivery requirements, an assumption is made that the number of sources stored at one time is one eighth of the yearly amount to be distributed (based on shipments arriving every month to replenish stock and fill orders). Assuming a small residual inventory on hand when a new shipment arrives, we estimate that the maximum activity to be stored at any one time will be 750 Ci.

3. Storage

   Storage will be in a room constructed of concrete block, 10 ft x 10 ft x 14 ft, and located within a larger work area of 30,000 sq ft. The room will be vented to the outside and provide a minimum air change of one change per hour. The room will be under lock control and labeled as containing radioactive materials. The larger work area has a continuous air change of once every two minutes.

SECTION III. A. Chemical and physical form

The watches and altimeters contain H-3 gas encapsulated in borosilicate glass.

SECTION III. B. Solubility in water and body fluids

H-3 gas has a low retention in the body subsequent to inhalation; and, the skin absorption intake for H-3 in this form is relatively insignificant (NUREG/CR-0215). However, H-3 gas may be converted to tritiated water, on contact with the atmosphere, if the gas leaks from the tubes over time. Tritiated water is completely soluble in normal water and body fluids. Inhaled tritiated water is assumed to be totally absorbed in body fluids (ICRP 30).

SECTION IV. A. Construction and design (See drawings, Appendix S-I)

1. Detailed information is provided in Appendix S-I. With regard to the tritium illuminated night sights, material is presented in tabular format with typical drawings to represent each of the various styles covered by the license. The submission includes:

   a. Cross Reference List: A listing of all sights, arranged by groupings of sight models per NRC Device number as shown on HESCO Registration Certificate NR-352-D-101-E, and showing the maximum tritium content allowed in sights of the particular group.

   b. ML Listing and Descriptions: A descriptive list of each night sight model arranged numerically by model number. The list describes the sight and the weapon on which it is designed to be used.

c. Summary Table: A table showing the various models categorized by each NRC Device Number, together with the "allowed by license" and actual amount of tritium, and codes which depict the type of mounting to the weapon and the type of installation used for the tritium light source.

The codes used are alpha-numeric in nature with alpha prefix indicating how the tritium light source is installed, and the numerical suffix indicating how the sight mounts to the weapon. A description of the codes follows:

"A" represents light sources that are installed in such a way that the end of the light is viewed through the sight "window" when aiming the sight.

"B" represents light sources that are installed in such a way that the side of the light is viewed through the sight "window" when aiming the sight.

"1", "2", "3" and "4" represent sights which mount to the weapon via a dovetail, a screw, a pin, or the swaging of a tenon respectively.

As an example of the code, "A1" indicates a sight whose light is installed so that its end is viewed through the sight "window" when the weapon is being aimed, and which mounts by means of a dovetail.

d. Drawing Package: A set of 14 drawings is provided to demonstrate each of the codes currently listed in NR-352-D-101-E. Each drawing is of an actual front or rear sight, is marked with the Code, and has a legend that provides dimensional information. The information provided is:

Maximum and minimum length, width, height, and thickness of all the sights in the particular group.

Actual nominal length, width, height, and thickness of the specific representative sight (model number shown in the legend) being shown.

The minimum protective distance "P" to the light source, from the closest outside spot on the sight. Its location is depicted by an arrow (labeled "P"). Our designs allow for less than 0.50 mm only in very specific instances in code classification group "B2", where the sight is protected by the weapon itself (minimum "P" is 0.30 mm). The M16 for example, has protective "ears" on both sides of the sight. (Section V.A provides details of prototype testing and mounting information for the ML-115 and ML-116 family of sights for the M-16/AR-15 rifles – representing sights having a minimum "P" of 0.30 mm.)

e. Guide to Tritium Light Sources: A listing of all Tritium Light Sources used in the sights. The list shows the activity per source, the source type and model number (mb drawing) and manufacturer of the light source. (SRB uses dimensions to identify light sources and not drawing numbers.)

f. Legend: A table that lists the code types, method of mounting to the weapon, and identifies the specific sight for which a drawing has been provided.

2. The sight systems contain tritium H-3 activated light sources - gaseous H-3 encapsulated in borosilicate glass that is internally coated with a phosphor. These light sources are held in place and sealed into their metal housing with a gluing/sealing system that protects the sight from accidental damage as well as from unauthorized handling of the light source. The system has been designed to protect the H-3 light source and the user under field or extreme environmental conditions. The illuminated window surface is covered by a clear, hard material (MV gluing system) to prevent dirt from entering the viewing system or covering the light; and, the entire light surface is protectively encapsulated by this material. Design considerations require that this material be impervious to gun cleaning solvents, trichloroethane, oils, and MIL-C-372 cleaning mixture.

   Some sights within the type "A" classification utilize a flexible or rigid plastic protective insert, between the light and the metal; and, some also have a crystal window to afford additional protection and more uniform light output. All sights utilize the MV gluing/sealing method.

   The optical archery sight has a small (14 mCi) light source, encased in a flexible plastic protective insert and encapsulated in a hard resin (CR-39 used for the manufacture of ophthalmic shatterproof eyeglasses) to create a "lens". This entire "lens" is then assembled into a metal protective frame and attached to the archery bow sight by means of a standard threaded pin.

   The optical reflex sight has one small (18 mCi) light source, encased in a cavity in the metal housing and encapsulated using the MV gluing/sealing method (all identical to the other gun sights). Then, at one end of the encapsulated light - and at a distance of 0.5 mm from it, a fiber optic is permanently affixed in position using the same MV gluing/ sealing method. The light source is totally inaccessible to the user and, in fact, not even visible since the light output is carried to its imaging plane by means of the fiber optic. The sight is mounted to the weapon by means of screw clamp connection, either directly or by means of an adapter supplied with the sight.

4. **The complete name and address** of the authorized manufacturer of the items to be distributed and the authorized distributor are:

Manufacturer:	**Distributor:**
MEPROLIGHT, Ltd – (Scopus Light (1990) Ltd)	Scopus Light USA, Inc.
Kibbutz Maayan Zvi	1 Lawton Street
30805, Israel	Yonkers, NY 10705

SECTION IV. B. External radiation levels

Tritium is a pure beta emitter with a maximum energy of 0.018 MeV, average energy of 0.0057 MeV, and range of approximately 0.55 mg/cm^2. No significant external exposure is expected either from the intact sources encapsulated in borosilicate glass or the free gas. Due to the low energy of the beta, bremsstrahlung is expected to produce no significant dose.

Bremsstrahlung fraction:

$F = 3.5\ E^{-4}\ Ze$ where Z = atomic number (9 for glass)
E = maximum beta energy (0.018 MeV)

$F = 5.67\ E^{-5}$

Total energy flux for the worst case is presented. (For sights, the worst case is a rifle sight set with 28 mCi in the rear sight).

Total energy flux from 28 mCi H-3 at 5 cm:

$$\phi = \frac{5.67E^{-5} \times 54mCi \times 2.22E^{9} d/m - mCi \times 0.0057MeV/d}{4\pi(5cm)(5cm)}$$

$$\phi = 123MeV/cm^2$$

Calculated dose rate at 5 cm:

Mass absorption coefficient for 0.018MeV gamma = 0.84 cm^2/g

D = 123 MeV/cm^2 - m x 1.6 E^{-6} erg/MeV x 0.01 g-rad/erg x 0.84 cm^2/g = 1.65 E^{-6} rad/m

H = 1.65 E^{-6} rad/m x 1 rem/rad x 60 m/hr = 0.099 mrem/hr

At 25 cm the dose rate would be 0.004 mrem/hr.

These calculations assume a bare H-3 source. In actuality, any low levels of bremsstrahlung created would be absorbed by the housing and protective MV gluing system layer of the sights. (NUREG/CR-0215).

SECTION IV. C. Degree of access

The design of the sights assures that the tritium light sources are not accessible during normal use, storage, handling or maintenance. Full protection is afforded by both the metal housing and hardened glue system which encompasses the source.

SECTION IV. D. Expected useful life

The expected useful life of the sights is 6 years*. This is the length of time in which the brightness decreases to one-half of its initial value (Reference: British Defense Standard 62-4 Issue 3).

- TRUDOT model sights are bright enough to be usable for 12 years.

SECTION IV. E. Proposed method of labeling

The front and rear sights will be permanently marked with the MEPROLIGHT logo and the symbol for tritium (H-3). The combined dimensions of the logo and the tritium symbol on the pistol sights will be 4 mm x 1 mm. While the preferred method is stamping, one sight - a fiber optic archery pin, fabricated from brass tubing - does not lend itself to this method. The tritium light source is located safely near the threaded base of the pin. Since the base is open during manufacture, it is not possible to stamp the markings there as is done on the other types of archery pins. The remainder of the pin contains a fiber optic that carries light to the tip. This section is made of a hollow tube which would be deformed by stamping - thereby degrading or prohibiting the passage of light. Therefore, for this product, we will mark the logo and H-3 on the side of the tube using an epoxy paint, presently used for other identifying nomenclature on most of our products. This paint has been tested for durability and shown to be permanent after environmental testing.

In addition, each sight will be packaged with instructions for installation and use which carry a notification that they contain tritium in sealed sources, what the activity level is, and that no attempt should be made to disassemble them. The notification will also state that the items should be returned to the authorized dealer for any corrective measures or disposal (See Appendix S-I for sight instruction sheet as example). The intent is to influence the user to return the unwanted product rather than simply discarding it. However, the warning does not imply that there is a regulatory requirement for returning these items.

SECTION V. A. Prototype testing

1. Sight prototype testing has been performed on the ML-115 sight system (design qualification and safety testing for "B2" group rifle sights) by the Israel Defense Forces (IDF) (Qualification and Safety Testing - Document #0204 (5520) 6063 dated 23 May 1983). The tests performed are summarized below.

a. Five (5) sets of sights were subjected to the following:
   1) Conformance to drawing requirements
   2) Functional conformance (including interchangeability, zeroing and accuracy)
   3) Conformance to safety requirements (IDF Standard 17070342301)
   4) Brightness (as measured photopically with a photometer)
   5) Vibration (3-axis, 5 g, 0-50 Hz, plus 30 minute dwell at resonance) – frequency continuously varied from minimum to maximum and return
   6) Shock (3 drops from a height of 2 meters onto a cement pad)
   7) Sudden standing shock (1 kg dropped onto a mounted sight from a height of 1 meter)
   8) 1000 round rapid fire shock
   9) Leakage – As a group, the sights were immersed in room temperature water for 24 hours. When tested by liquid scintillation counting methods by the Israel Atomic Energy Commission Nuclear Center of Sorek, total detectable activity was less than 1 E^{-5} μCi.

b. Twelve (12) sets of sights were subject to the following tests:
   1) High temperature (120°C for 60 minutes)
   2) Low temperature (-10°C for 48 hours)
   3) Humidity (RH 100%, 42°C for 48 hours)
   4) Liquid penetrant resistance (48 hours at room temperature) – resistance to trichloroethane, gun oils and cleaning mixture MIL-C-372B

c. In addition to the above stated testing program, similar programs have been conducted by Israel, Belgium and Singapore on sights for the M16, Galil and FNC rifles, and the higher powered UZI and Ultimax sub-machine guns. Qualification testing of the ML-200A sights was conducted by Action Shooting Ltd with similar acceptable test results; and follow on qualification testing of the remaining styles was conducted under the auspices of MEPROLIGHT – all with successful results.

d. The ML-115 sight system (for the M-16) and the ML-10224 (TRU-DOT style for the Glock pistol) recently underwent renewed Prototype testing. Five (5) sets of sights were subjected to the following:

   1) Conformance to drawing requirements
   2) Functional conformance (including interchangeability, zeroing and accuracy)
   3) Conformance to safety requirements (IDF Standard 17070342301)
   4) Brightness (as measured photopically with a photometer)
   5) Liquid penetrant resistance (48 hours at room temperature) – resistance to trichloroethane, gun oils and cleaning mixture MIL-C-372B

6) High temperature (120°C for 60 minutes)
7) Low temperature (-46°C for 48 hours)
8) Humidity (RH 100%, 42°C for 48 hours)
9) Temperature Shock (80°C to -46°C, 15 minutes each with transfer between the two temperatures in a maximum of 15 seconds)
10) Vibration (10 cycles in each of 3-axes, simple harmonic motion of 0.075 cm, 0-50 Hz and back in 1 minute sweeps, plus 30 minute dwell at any resonance frequency) – frequency continuously varied from minimum to maximum and return
11) Penetration (a 60mm long 6mm x 6mm triangular cross section metal weight of 10g, with small point dropped onto the window (exposed surface of light source) from a height of 1 meter)
12) Mechanical Shock mounted on weapon (10 drops in each of the following 6 attitudes (total 60 drops) from a height of 2 meters onto a 4 cm thick 85 durometer rubber pad backed by concrete): Barrel vertical, muzzle down; Barrel vertical, muzzle up; Barrel horizontal, bottom down; Barrel horizontal, bottom up; Barrel horizontal, left side up; Barrel horizontal, right side up
13) Firing test (5000 round rapid firing with pauses only long enough to allow reloading)
14) Evaluation for leakage (contamination) –The sights were immersed in room temperature water for 24 hours (volume of water 10 times that of the sights). The activity of the solution was then tested by liquid scintillation counting and the total detectable activity was less than 50 nanocuries.

At the completion of the testing, the gunsights did not come loose or detached from the weapon, nor did any of the tritium light sources become loose or detached from the sights. Visual observation in a dark room showed the lights to be glowing brightly and testing for signs of external radiological contamination by means of liquid scintillation counting proved negative indicating that all sources were intact and not leaking.

e. A prototype qualification program was conducted by the Bavarian Department of Environmental Protection (Germany) on ML-750 style hand gun sights – the successful results led to these sights being licensed for sale in Germany.

All of the sight designs are equivalent from the standpoint of rigidity, light source mounting and safety – as has been shown by their successful qualification testing.

Further, the light sources themselves are purchased from the same manufacturers (mb-microtec and SRB Technologies) and to the same levels of quality as those presently being used and already qualified by the U.S. Army and other military agencies around the world – as well as by almost all the manufacturers of commercially acceptable applications (currently licensed by the NRC) such as self-luminous watches, compasses, exit signs and night sights.

SECTION VI. A. Estimated radiation dose commitments

1. Normal conditions

a. Normal use

No radiation dose commitment is anticipated during normal use of the sight systems. External radiation dose rate for the sights at 25 cm is estimated to be less than 0.004 mrem/hr. The tritium gas is sealed in borosilicate glass; therefore, no inhalation or ingestion of the radioactive material is expected in normal use.

b. Storage

Storage is based on the total number of sources and not on the specific product, and therefore the calculations are shown for the total anticipated to be stored at any one time. Distilled water immersion tests on the sights and the other products indicated a leakage rate no greater than 1 E^{-5} uCi/sight in 24 hours. Based on the anticipated annual sales and monthly shipments to replenish the inventory on-hand, an assumption is made that the number of sources stored at one time is one eighth of the yearly amount to be distributed. Therefore, the expected number of sources in storage at any given time will not exceed the following:

Product and Sources Per Product	Quantity of Product	Quantity of Sources	Sources in Storage at any given time
Sight Sets (3 sources each)	109,000	327,000	40,875
Single sights (archery pins, fronts or optical – one source each)	66,000	66,000	8,250
Watches (17 sources each)	10,000	170,000	21,250
Altimeters (17 sources each)	1,000	17,000	2,125
Personal Markers (2 sources each)	5,000	10,000	1,250
Total Sources in Storage	-	-	**73,750**

Assuming that these 73,750 sources are stored in a 14 ft x 10 ft x 10 ft room in a 30,000 sq ft work area with an air exchange rate of 1 air change per hour, the calculated equilibrium concentration of tritium is as follows:

$$C = \frac{I}{\lambda V}$$

Where: I = rate of influx of H-3 gas
V = volume of the room
λ = air exchange rate
C = equilibrium H-3 gas concentration

I = 73,750 sources x 1 E^{-5} µCi/source-24 hr = 3.1 E^{-2} µCi/hr

V = 1400 cubic ft x 2.83 E^4 cc/cubic ft = 3.96 E^7 cc

$$C = \frac{3.1E^{-2}\,\mu Ci/hr}{1 airchange \times 3.96E^{7} cc} = 7.8E^{-10}\,\mu Ci/cc$$

C = 7.8 E^{-7} mCi/m^3

The concentration limit set in 10CFR20 Appendix B, Table II, Column 1 for H-3 in air is 2 E^{-7} μCi/ml. Therefore, the calculated equilibrium concentration in the storage area is less than 1% of the 10CFR20 concentration limit for a controlled area.

The annual dose commitment to a warehouse worker, working in the area for 1 hour/day, 250 days/year is as follows:

Assume:

All H-3 gas is converted to tritiated water

Total rate of absorption of tritiated water into body fluids (mCi/minute) from inhalation and skin absorption is 3 E^{-2} C, where C is the concentration of tritiated water in air in mCi/ m^3 (ICRP 30)

Committed dose equivalent per unit intake of tritiated water is 1.7 E^{-11} Sv/Bq (6.3 E^{-2} rem/mCi)

Annual committed dose:

H = 7.8 E^{-7} mCi/m^3 x 3 E^{-2} mCi- m^3/mCi-minute x 60 minutes/hr x 250 hr/yr x 6.3 E^{-2} rem/mCi = 2.21 E^{-5} rem/year

H = 0.022 mrem/year

A similar type calculation in NUREG/CR-0215 "Estimates of Potential Radiation Doses from Wristwatches Containing Tritium Gas" yields a committed dose of 50 mrem from exposure to 2.5 E^{-5} μCi/cc for 24 hours or 8.3 E^4 mrem-cc/μCi-hr. Using that factor, the annual committed dose to a warehouse worker would be:

H = 8.3 E^4 mrem-cc/μCi-hr x 250 hr/yr x 7.8 E^{-10} μCi/cc = 0.016 mrem/yr

c. Transportation

As was the case for storage, the transportation calculation is based on the total number of sources and not on the specific product, and therefore the calculations are shown for the total number of sources to be transported. Assume a truck driver transports all products to be stored in the warehouse in a single truckload and spends a total of two hours in the trailer loading and unloading and that the truck is ventilated to produce one air change per hour.

V = 2.9 E^{7} cc (NUREG/CR-0215)

I = 3.1 E^{-2} μCi/hr

λ = 1 air change/hr

$$C = \frac{3.1E^{-2}\mu Ci/hr}{1 air change \times 2.9E^{7} cc} = 1.07E^{-9}\mu Ci/cc$$

Dose Commitment:

H = 1.07 E^{-6} mCi/m^3 x 3 E^{-2} mCi- m^3/mCi-minute x 2 hr x 60 minutes/hr x 6.3 E^{-2} rem/mCi = 2.43 E^{-7} rem

H = 2.43 E^{-4} mrem

d. All other situations during normal use, storage, and transportation involve smaller quantities of H-3 and/or shorter exposure times and, thus, would result in negligible dose commitment.

e. Disposal:

These products are relatively expensive items and are unlikely to be inadvertently discarded. The disposal of an item to normal trash is unlikely. Instructions accompanying the products request return of damaged or defective items to the distributor. Therefore, improper or careless disposal is unlikely to cause any significant radiation dose.

NUREG/CR-0215 estimates the dose commitment to the maximally exposed individual for burial of 500,000 tritium illuminated wrist watches per year in landfills (20,000 in a single location) to be 0.1 mrem/yr. If the sources are burned, a potential maximum dose commitment of 17 mrem/yr was estimated. The total number of items potentially disposed of in a single year would be much lower and the H-3 activity per unit considerably lower than that postulated for the study (NUREG/CR-0215). Therefore, disposal of the items will not present a radiation hazard to the general public.

2. Accident conditions

a. Use

The maximum credible accident involving the use of the sight system is rupture of the source and instantaneous release of the gas during firing. Worst case condition is a rifle, and only the rear sight is of any consequence since it is much closer to the breathing zone of the user than the front sight.

Assume:

Rear sight contains 28 mCi of H-3 gas

Rear sight is located 15 cm from the user's face

Breathing zone can be represented by a cone with apex at the source and base, a 10 cm diameter circle, at the user's face.

All H-3 is converted to tritiated water instantly.

Effective half-life for tritiated water = 10 days.

Total absorption of inhaled tritium in body fluids.

Mass of soft tissue = 63,000 g (ICRP 30)

Fraction of gas released in the direction of the breathing zone:

$$F = \frac{\pi \times r \times r}{4\pi \times R \times R}$$

Where r = radius of the base of the cone
R = distance from source to nose

$$F = \frac{\pi \times 5 \times 5cm^2}{4\pi \times 15 \times 15cm^2} = 0.028$$

Maximum estimated dose commitment to user assuming all H-3 gas is converted to tritiated water:

H = 28 mCi x 0.028 x 6.3 E^{-2} rem/mCi x 1 E^{3} mrem/rem = 49 mrem

For such an accidental instantaneous release, most of the gas would remain as elemental H-3. The dose commitment from H-3 gas would be approximately 1000 times less. The total estimated dose commitment would be 2% of the calculated value since up to 2% of the gas originally in the glass capsule could be in the form of tritiated water.

b. Storage

The maximum credible accident involving storage of the units would involve a fire in the storage area which ruptures some of the borosilicate glass capsules. (A massive fire which would rupture all sources would be likely to result in immediate dispersion of the H-3 gas and dilution with outside air, thus reducing the concentrations of H-3 gas in the storage area.)

Assume:

50% of the sources in a single storage room rupture.

Immediate dispersion of the gas within the storage area.

Conversion of all H-3 gas to tritiated water.

Total rate of absorption of tritiated water into body fluids (mCi/minute) from inhalation and skin absorption is 3.2 E^{-2} C, where C is the concentration of tritiated water in air in mCi/cubic meter (ICRP 30).

$$C = \frac{750Ci}{3.96E^{7}cc} \times 0.50 = 9.47E^{-6}Ci/cc = 9.47E^{3}mCi/meter^{3}$$

Dose commitment:

H = 9.47 E^{3} mCi/cubic meter x 3 E^{-2} mCi-cubic meter/mCi-min x 6.3 E^{-2} rem/mCi

H = 17.9 rem/minute

Dose commitment to occupant remaining in enclosed area for 1 minute = 17.9 rem

Dose commitment to fireman remaining in enclosed area without respiratory protection for 2 minutes for the purpose of rescue = 35.8 rem

This calculation greatly overestimates the true dose commitments in this situation. Air currents would disperse the gas very rapidly in the case of a fire, particularly one of such severity as to rupture 50% of the sources instantaneously. In addition, only a small fraction of the H-3 gas is likely to be converted to tritiated water before venting to the outside.

A more reasonable estimate of the dose commitment would be obtained using the maximum fraction of tritiated water in the source, 0.02. If this value is used, the dose commitments become 3.6 E^{2} mrem for the occupant and 7.2 E^{2} mrem for the fireman.

c. Ingestion or inhalation

Ingestion or inhalation of the entire H-3 content of the ML-100 or ML-115 front sight. (The greatest activity in a single source is 20 mCi.)

H = 20 mCi x 6.3 E^{-2} rem/mCi = 1.3 rem

If we were to consider ingestion or inhalation of the entire H-3 content of the ML-750 sight set (the greatest activity in a set is 54 mCi), the calculation is:

H = 54 mCi x 6.3 E^{-2} rem/mCi = 3.4 rem

These calculations assume that the entire activity of H-3 gas is converted to tritiated water. H-3 gas is not absorbed readily in body fluids and thus produces a negligible dose. These postulated accidents would require that an individual remove one or more of the sources from the product without damaging it (not possible by any known technology), swallow it, and have the source rupture while in the digestive tract. Each of these conditions is highly improbable. The combination of all three occurring is nearly impossible.

SECTION VI. B. Compliance with 10CFR32.23 and 32.24

1. Normal use and storage

   No radiation dose commitment is expected in the normal use of the gun sights. The maximum expected dose commitment to workers in the storage area is less than 0.03 mrem/year. This is within the limit set in Column II, Table O.1 (32.24).

2. Accidental release of the tritium gas

   a. Under maximum credible conditions of use of the equipment, the dose commitment to an individual would not exceed 49 mrem (sights being the worst case), within the limits set in Column III, Table O.1 (32.24). In the highly improbable case where an individual ingested the contents of an entire source (personal marker being the worst case), the estimated dose commitment is 2.5 rem. This is within the limits set in Column IV, Table O.1 (32.24).

   b. Under extreme fire conditions in the storage area, the estimated maximum dose commitment to an occupant of the area is 17.9 rem; to a fireman in the process of rescue, 35.8 rem. More reasonable values, based on 2% of the H-3 gas being oxidized and remaining in the storage room, are 0.36 rem and 0.72 rem respectively. Even under the extreme conditions (extremely low probability), the dose commitment to an occupant of the storage area is only slightly greater than the limits set in Column IV, Table O.1 (32.24). Likewise, the estimated dose to a fireman engaged in rescue in that area is only around twice the limits set in Column IV, Table O.1 (32.24). However, the probability of such an event occurring and an individual entering the storage area without respiratory protection is negligible. The noxious gases that would be produced in such an event would prevent unprotected entrance. Therefore, the requirements of 32.23 are met.

SECTION VI. C. Disposal of units

No significant radiation dose commitment is expected to result from disposal of any of the items listed, since dispersion and dilution with the atmosphere would rapidly reduce tritium concentrations in air to background levels.

NUREG/CR-0215 estimates the dose commitment to the maximally exposed individual for burial of 500,000 tritium illuminated wrist watches, each initially containing 200 mCi, per year in landfills (20,000 in a single location) to be 0.1 mrem/yr. If the sources are burned, a potential maximum dose commitment of 17 mrem/yr was estimated. Anticipated annual sales figures for all MEPROLIGHT products are for around 200,000 per year; and, the tritium activity per product sold (worst case scenario) is only 54 mCi per sight set, 25 mCi for the watch, 40 mCi for the altimeters, and 120 mCi for the 3 light personal marker. The total annual distribution of around 6000 Ci, translated into the yearly disposal activity is only around 6% of that calculated in the study.

Therefore, with a total number of items potentially disposed of in a single year much lower and the H-3 activity per unit considerably lower than that postulated for the study (NUREG/CR-0215), disposal of the items will not present a radiation hazard to the general public.

SECTION VII. A. Quality control procedures

The manufacturer MEPROLIGHT (Scopus Light) is certified to ISO-9002 and maintains a quality system in compliance with the requirements of US Army Military Specification MIL-I-45208 as well. The following quality procedures are followed at that facility.

1. All safety and quality control procedures have been designed to comply with the requirements of the Israel Ministry of Defense and the Israel Atomic Energy Commission (License Number 6004, last renewed 22 October 1999, allowing MEPROLIGHT to manufacture with tritium sources and to have in-house, at any given time, up to 7,000 Ci of H-3).

2. Light sources are purchased only from two producers already qualified by the U.S. Military: mb-microtec and SRB technologies (as a backup alternative source). In addition to dimensional characteristics, the lights are procured with quality requirements for tritium purity, activity, brightness and color; and, they are supplied with a certificate of conformance.

   Receiving inspection of the light sources at MEPROLIGHT Ltd includes the following steps in the order listed:

   - Visual examination of packaging for any signs of external damage
   - Batch swipe test (liquid scintillation counting) to check for leakage problems
   - 100% inspection in dark-room
   - Photometric brightness measurement of dimmest samples
   - Sample subjected to dimensional inspection
   - 100% soak test (liquid scintillation counting) to check for leakage problems

Only after satisfactory completion of receiving inspection can the sources be placed into storage or released for production.

3. All manufacturing is performed in accordance with the safety and health requirements of the Israel Atomic Energy Commission. During manufacture, all work is performed under vented hoods. Work areas are checked at regular frequent intervals for cleanliness with swipe tests counted in a Packard TRICARB Model 2300TR Liquid Scintillation Counter.

   In addition to in-process inspections and final inspections for damage, workmanship, and completeness of assembly, samples are taken at random from each day's overall production (all products) for scintillation counting to assure that there are no health hazards. These soak tests, to determine if there is any leakage, require that the samples be submerged in distilled water for 24 hours at room temperature and the water or an aliquot then counted.

4. Lot acceptance tests on the completed items are performed as stated below:
   - Sampling in accordance with MIL-STD-105E for inspection of dimensional characteristics affecting fit, function or interface; visual defects; workmanship
   - 100% testing in a dark room for comparative brightness, coupled with photometric brightness measurement of the dimmest units (to assure the required useful life of the product).
   - Batch wipe or immersion tests of all products (100%) are performed (counted for beta activity with the Packard TRICARB Model 2300TR Liquid Scintillation Counter) to check for any removable contamination. All scintillation counting results must indicate no detectable activity (less than 1 E^{-5} uCi/sq cm).

5. To afford protection from shipping or handling damage, each of the product lines is packaged according to specific written instructions developed for that product line. Packaging is as follows:

   Sight systems for commercial after-market sales will be individually packaged in a blister pack and then placed in containers of 10 blister packs each. These will then be case-packed in total lots of no more than 1000 sight systems. Sight systems sold directly to weapon manufacturers as OEM will be bulk packed in plastic trays (facilitating inspection and counting), and the trays then layered into containers of up to 500 sights each. These containers will then be case-packed in total lots of no more than 5000 sight systems each.

6. Mandatory quality control procedures for receiving inspection at Scopus Light USA, Inc are:

   Upon receipt, Scopus Light USA, Inc will inspect the packaging for any signs of obvious external damage.

   After unpacking, a random sample will be selected, in accordance with the sampling instructions of MIL-STD-105, Inspection Level S-4, for an AQL of 1.5%, for inspection of proper marking and labeling.

   This inspection will consist of verifying the presence of logo and tritium symbol on the sights and, in addition, verifying that each sight is packaged with instructions for installation and use which carry a notification that they contain tritium in sealed sources, what the activity level is, and that no attempt should be made to disassemble them. In the event that the sights are "bulk-packed" for delivery to a weapons manufacturer (for OEM installation) or to the military, the intermediate bulk-package must contain marking certifying the radioactive content. In addition, the bulk package must be accompanied by safety information for care and temporary storage of the sights, as well as specific installation instructions for mounting the sights on their weapons, as previously discussed.

   Then, after unpacking, and inspecting for marking/labeling information, Scopus Light USA, Inc will inspect 100% of the products in a dark room before release for storage and distribution. This inspection will verify that there has been no degradation in the quality of the product shipped from MEPROLIGHT, LTD (Israel).

   In addition, Scopus Light USA, Inc will assure that each shipment is accompanied by a certificate of conformance attesting to the acceptability of the products.

SECTION VIII. A. Record keeping

All records will be kept in accordance with the requirements of 10CFR32.25 and the New York State (NYCH) "Rules and Regulations for Radioactive Materials".

1. Records will be kept of the number of units of each type, type and the total quantity of by-product material transferred.

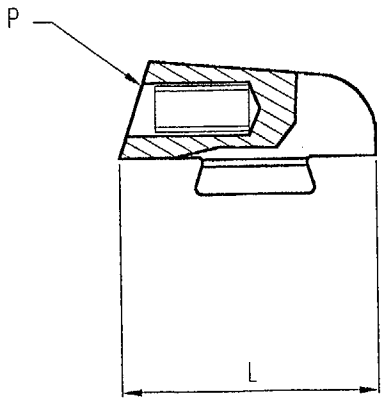
2. Reports will be filed with the U.S. N.R.C. as required by 10CFR32.25(c)(2) and as required by the State of New York.

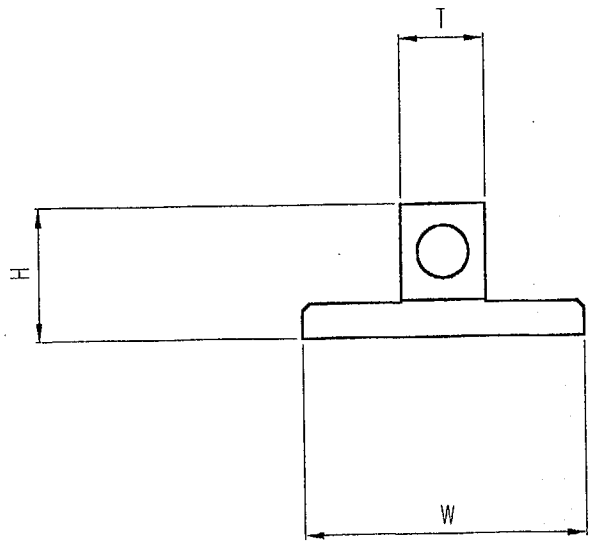
3. The U.S. N.R.C. will be notified if Scopus Light USA, Inc. discontinues the activities covered by this license application.

APPENDIX S-I

SIGHT INFORMATION

	TYPE A1		ML-710
	MIN	MAX	NOMINAL
L	6.5	20.0	10.9
W	3.0	16.0	12.0
H	4.2	13.0	5.6
T	2.8	4.5	3.6
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE 0.50 MM.		





PROTOTYPE TESTED

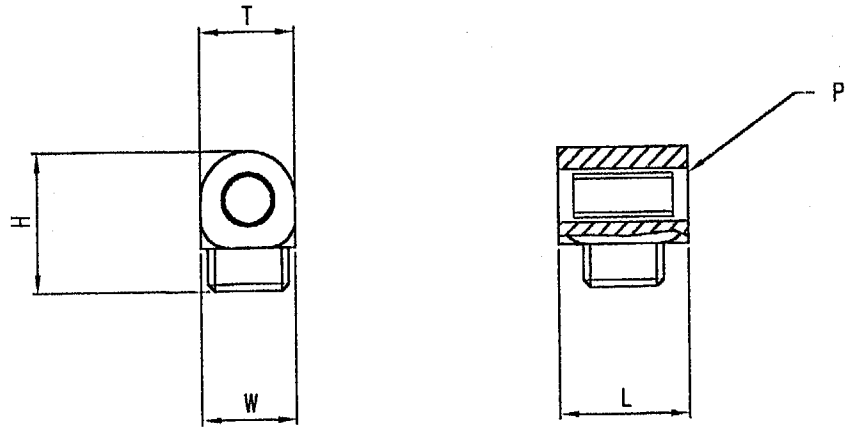
FRONT SIGHT TYPE A1

DATE 13.09.92

SCOPUS
MEPROLIGHT

APP 5-1 1-1

	TYPE A2		ML-405
	MIN	MAX	NOMINAL
L	5.0	17.0	5.5
W	2.5	4.0	3.4
H	5.0	10.0	5.8
T	3.0	4.5	4.0
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE		0.50 MM.



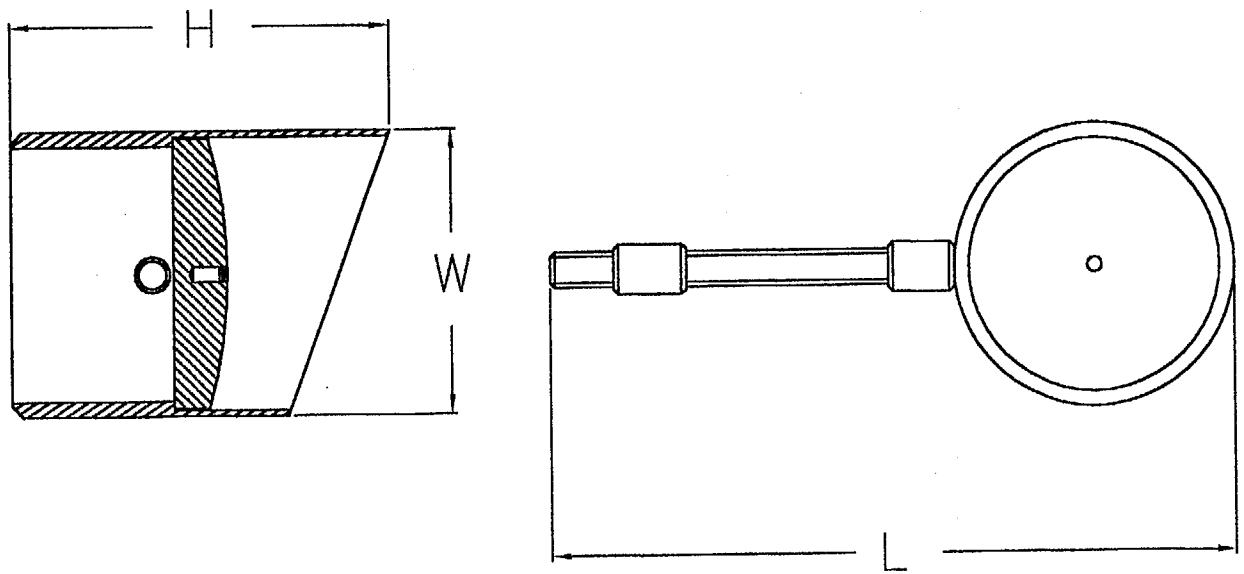
FRONT SIGHT TYPE A2

DATE 13.09.92

SCOPUS
MEPROLIGHT

APP 5-1 - 2

	TYPE A2		ML-51020
	MIN	MAX	NOMINAL
L	15.0	100.0	96.0
W	10.0	50.0	40.0
H	6.0	60.0	54.0
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE 0.50 MM.		

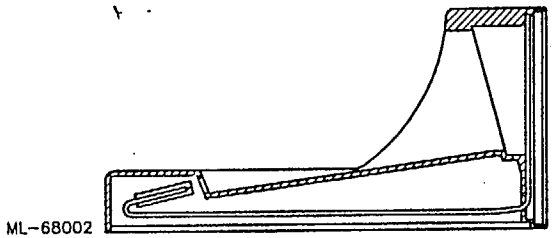


FRONT ARCHERY SIGHT TYPE A2

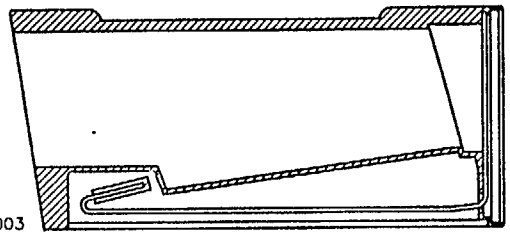
DATE 08.01.96

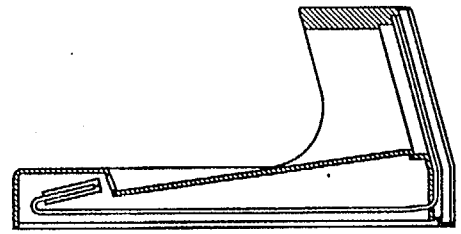
SCOPUS
MEPROLIGHT

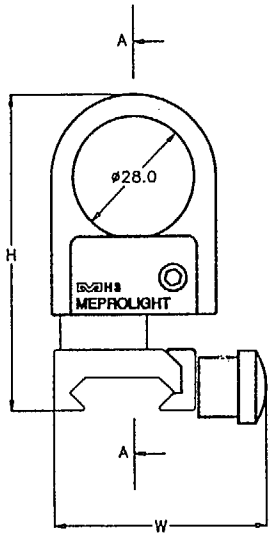
	TYPE A2		680XX
	MIN	MAX	NOMINAL
L	90	120	108
W	28	55	52
H	35	74	66
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE 1mm.		

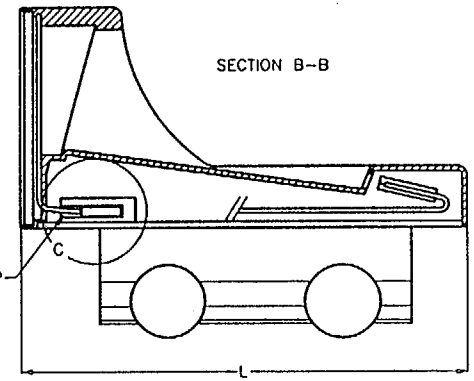


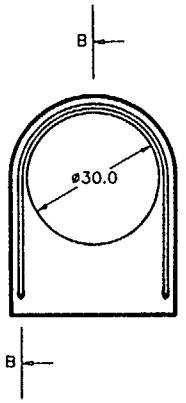
SECTION A-A

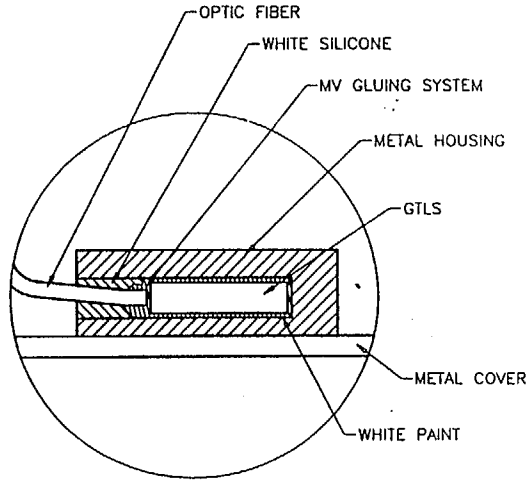












DETAIL C

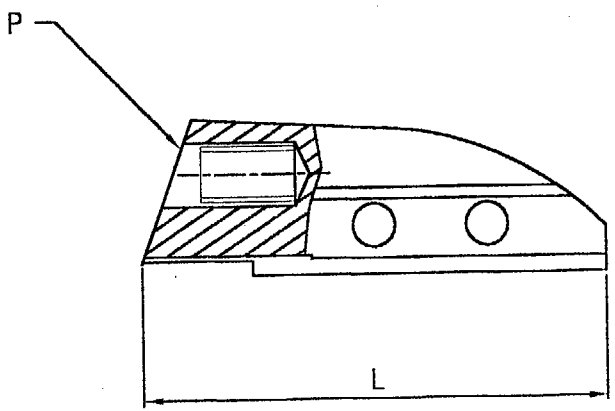
PROTOTYPE TESTED

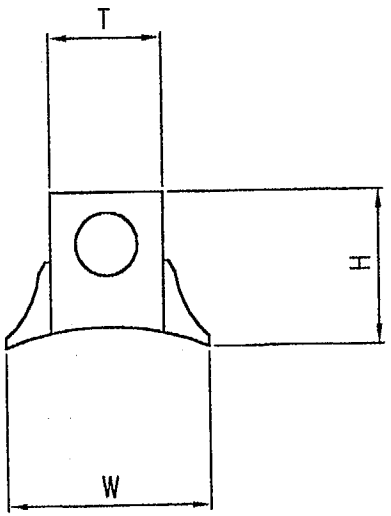
OPTICAL SIGHT TYPE A2

DATE 10.01.98

SCOPUS
MEPROLIGHT

	TYPE A3		ML-762
	MIN	MAX	NOMINAL
L	10.0	20.0	16.4
W	4.5	12.0	7.2
H	5.0	16.0	5.4
T	2.8	4.5	4.0
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE 0.50 MM.		





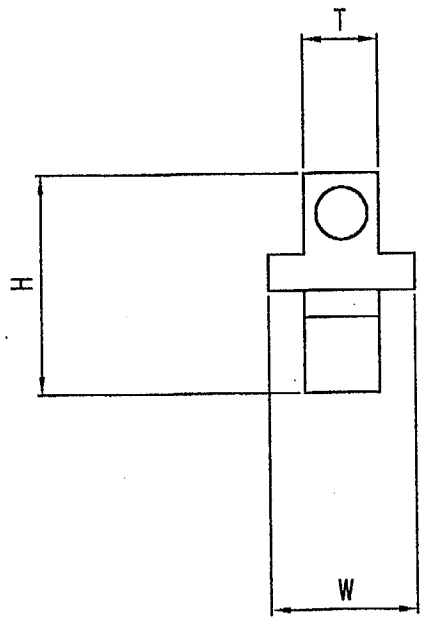
FRONT SIGHT TYPE A3

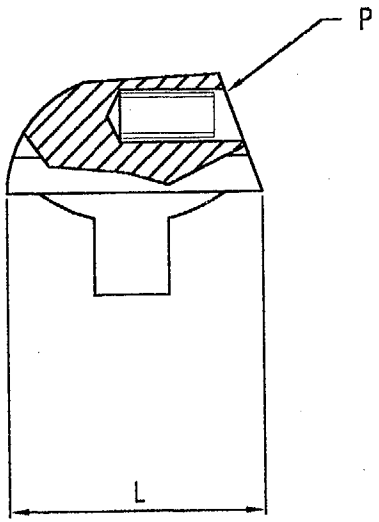
DATE 13.09.92

SCOPUS
MEPROLIGHT

App 5-1 5-

	TYPE A4		ML-776
	MIN	MAX	NOMINAL
L	9.0	17.0	10.5
W	4.0	7.0	6.2
H	5.5	12.0	8.9
T	3.0	4.5	3.2
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE		0.50 MM.





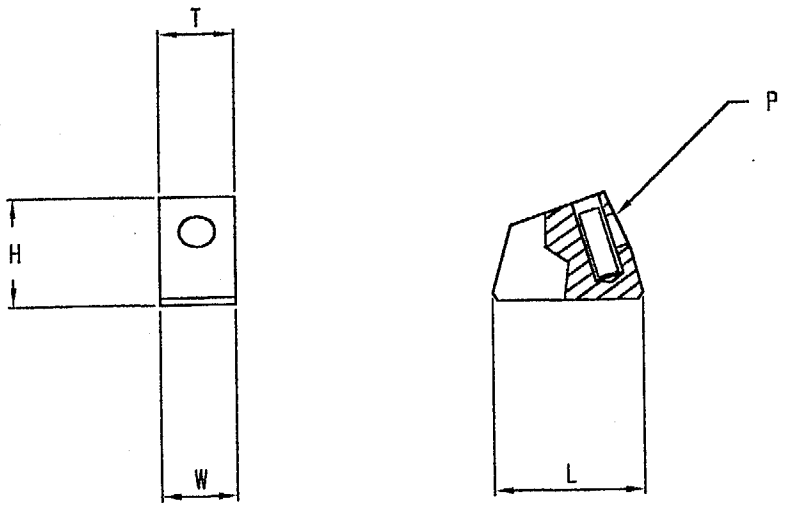
FRONT SIGHT TYPE A4

DATE 13.09.92

SCOPUS
MEPROLIGHT

App 5-1 - 6

	TYPE B1		ML-200A
	MIN	MAX	NOMINAL
L	6.5	7.0	6.6
W	3.0	4.5	3.2
H	4.2	5.0	4.4
T	2.8	3.5	3.2
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE 0.50 MM.		



FRONT SIGHT TYPE B1

DATE 13.09.92

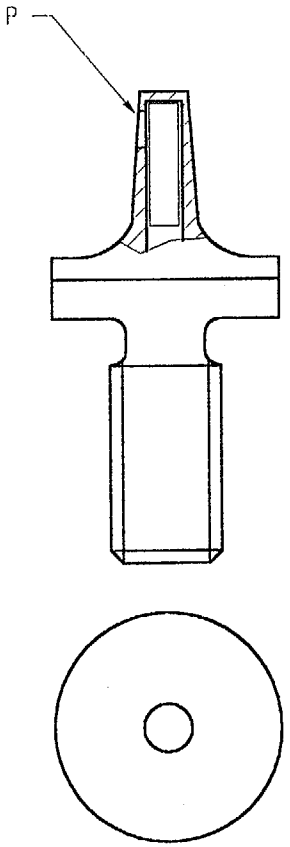
SCOPUS
MEPROLIGHT

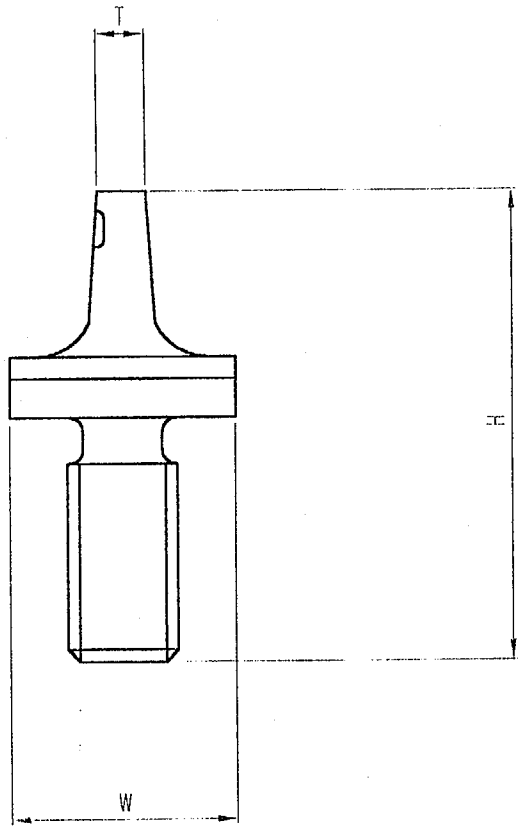
App 5-1 - 7

	TYPE B2		ML-1160
	MIN	MAX	NOMINAL
L	5.0	5.5	—
W	2.5	15.0	ø9.4
H	6.0	62.0	19.5
T	2.0	4.5	ø2.0
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE		0.50 MM.

SIGHT MODELS WITH "P" of 0.30mm MINIMUM

MODEL	DESCRIPTION
ML-1150	AR15/M16 with open rear sight (4-slot front)
ML-115P	AR15/M16 with peep rear sight (4-slot front)
ML-1160	AR15/M16 with open rear sight (5-slot front)
ML-116P	AR15/M16 with peep rear sight (5-slot front)
ML-300A	Mini-Uzi & Carbine with adjustable rear
ML-300N	Uzi Carbine with non-adjustable rear
ML-310	Kalashnikov AK-47 rifle
ML-311	Simonov SKS rifle





PROTOTYPE TESTED

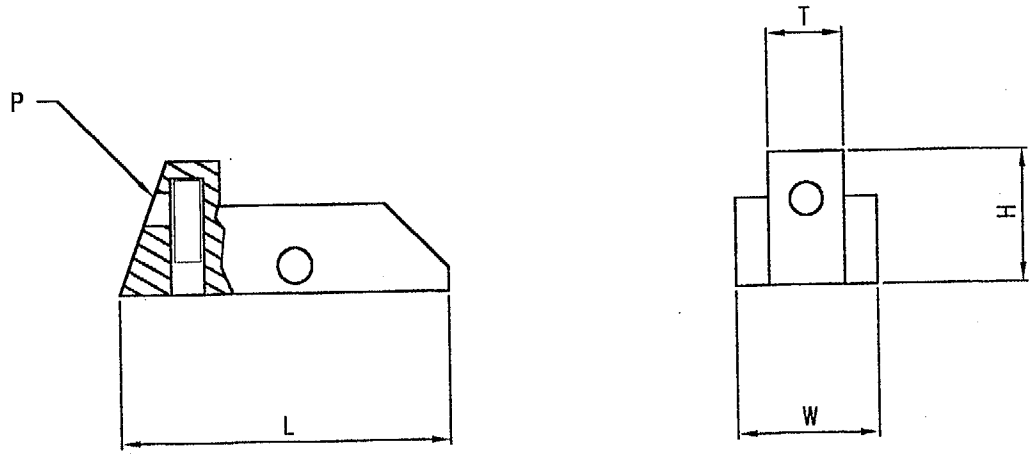
FRONT SIGHT TYPE B2

DATE 13.09.92 – Rev. A

SCOPUS
MEPROLIGHT

APP S-1 - 8

	TYPE B3		ML-260
	MIN	MAX	NOMINAL
L	12.0	20.0	14.0
W	5.0	7.0	6.0
H	5.0	7.0	5.6
T	3.0	3.5	3.2
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE 0.50 MM.		



FRONT SIGHT TYPE B3

DATE 13.09.92

SCOPUS
MEPROLIGHT

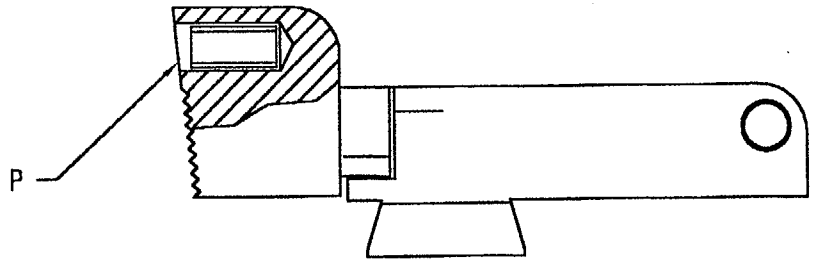
AHP S-1 - 9

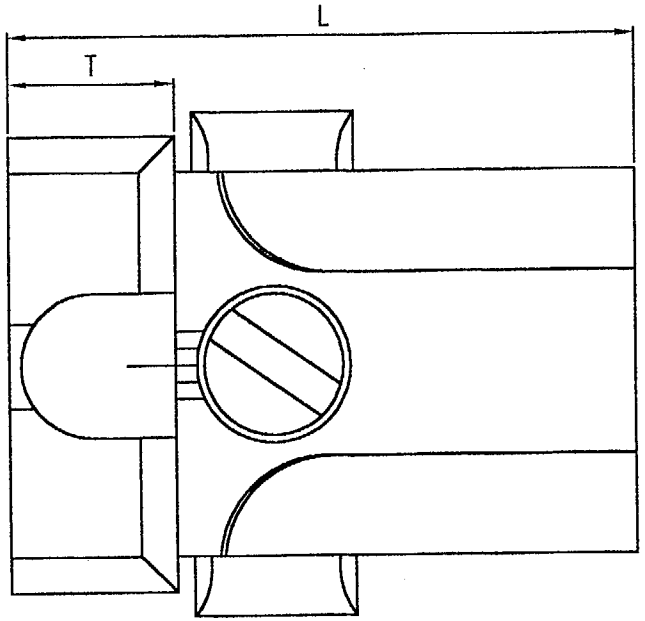
	TYPE A1		ML-2724
	MIN	MAX	NOMINAL
L	5.5	32.0	26.8
W	9.5	23.0	21.0
H	5.5	12.5	10.1
T	4.8	8.0	7.0
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE		0.50 MM.

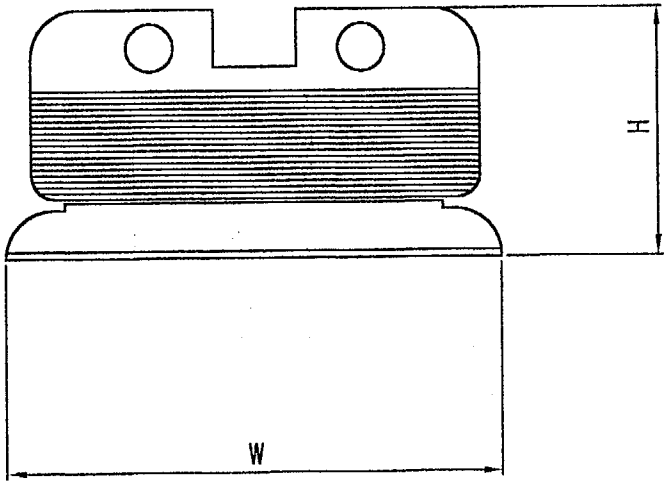
REAR SIGHT TYPE A1

DATE 13.09.92

PROTOTYPE TESTED



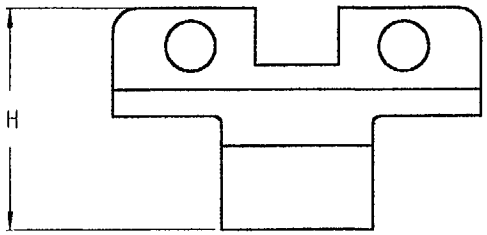


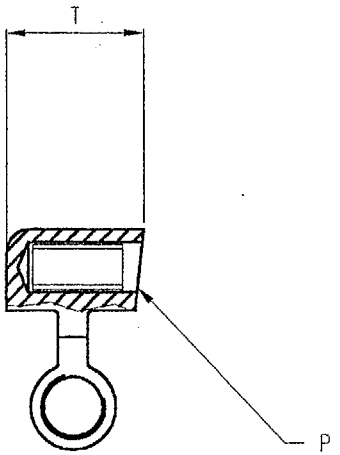


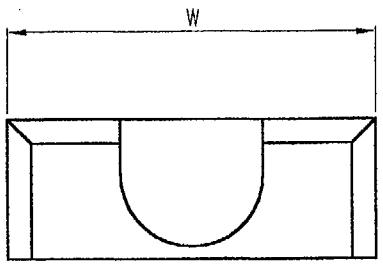
SCOPUS
MEDROLIGHT

APP 5-1 -10

	TYPE A2		ML-2700
	MIN	MAX	NOMINAL
L	—	—	—
W	12.0	18.0	15.5
H	8.0	10.0	9.2
T	5.3	7.0	5.8
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE 0.50 MM.		





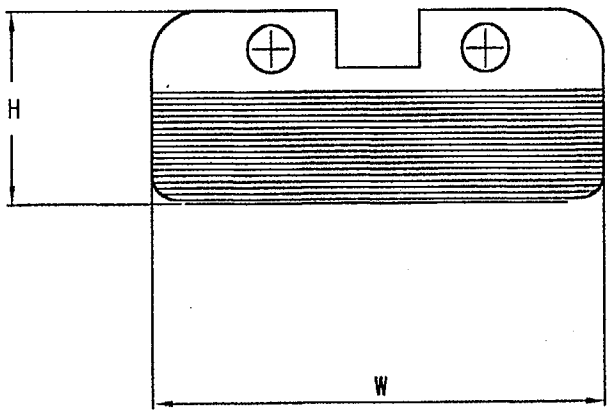


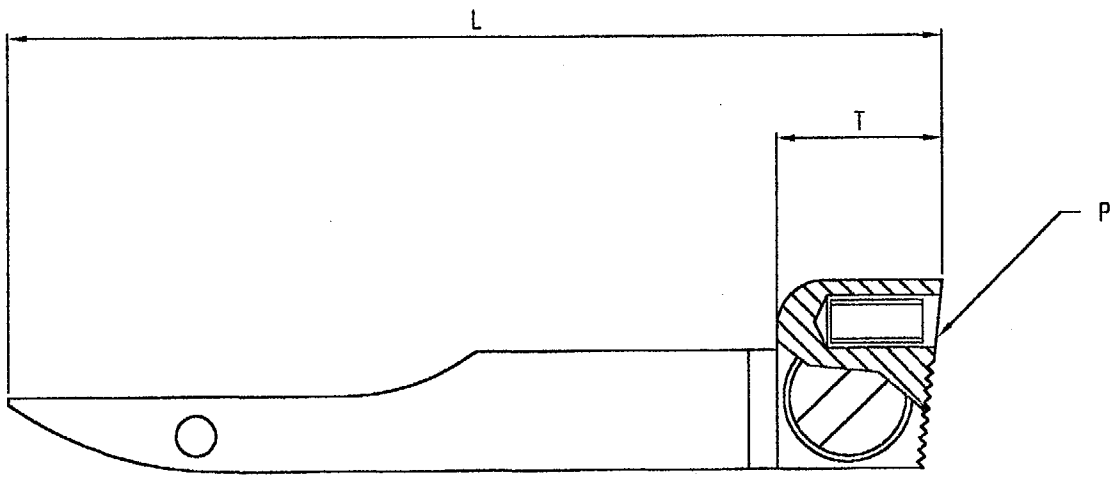
REAR SIGHT TYPE A2

DATE 13.09.92

SCOPUS
MEPROLIGHT

	TYPE A3		ML-2772
	MIN	MAX	NOMINAL
L	8.0	41.0	39.5
W	10.0	21.0	19.0
H	5.0	8.5	7.9
T	4.5	8.0	7.0
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE 0.50 MM.		





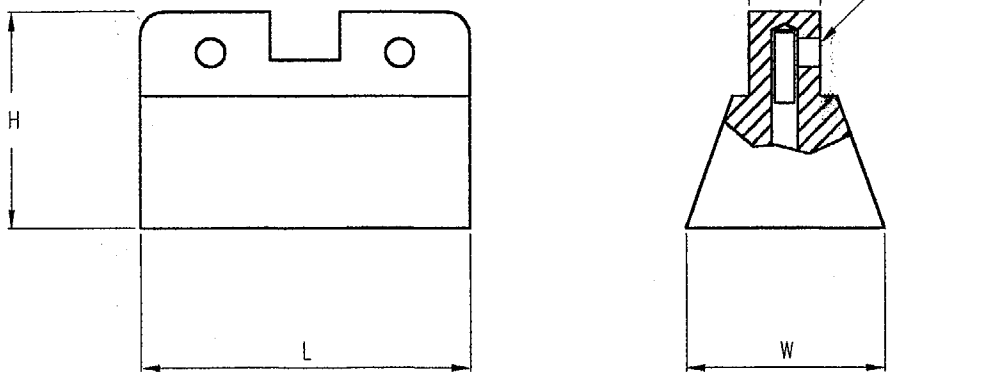
REAR SIGHT TYPE A3

DATE 13.09.92

SCOPUS
MEPROLIGHT

AMS-1-12

	TYPE B1		ML-260
	MIN	MAX	NOMINAL
L	12.0	20.0	14.0
W	7.0	12.5	8.4
H	8.0	13.0	9.0
T	2.3	4.0	3.0
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE 0.50 MM.		



PROTOTYPE TESTED

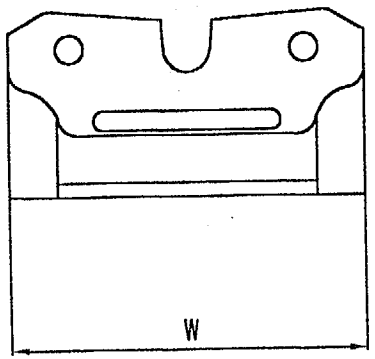
REAR SIGHT TYPE B1

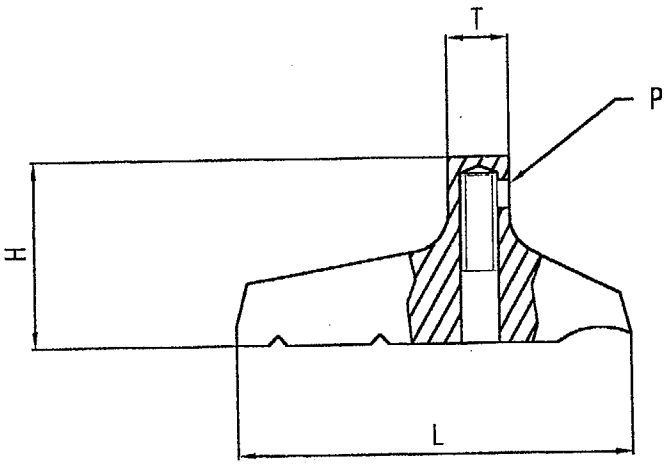
DATE 13.09.92

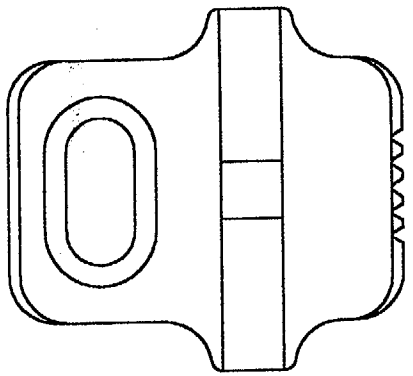
SCOPUS
MEPROLIGHT

AAD 5-1 - 13

	TYPE B2		ML-460
	MIN	MAX	NOMINAL
L	3.5	18.0	16.7
W	8.0	22.0	15.2
H	6.5	13.0	7.1
T	2.2	4.5	2.6
P	MINIMUM PROTECTIVE DISTANCE TO LIGHT SOURCE 0.50 MM.		







REAR SIGHT TYPE B2

DATE 13.09.92

SCOPUS
MEPROLIGHT

41-1-5 ddH

SECTION I. B. Description of intended use

The tritium illuminated watches will be used by the civilian, military and law enforcement communities, giving the wearer a safe means of reading the time without the need to find an external source of light (or to press on a button to activate an internal source of power). Likewise, the altimeters, worn on the wrist (like watches), provide a sure way of reading the correct altitude under any low-light/no-light conditions. This is especially important when considering the fact that conventional models of these devices have no power sources that could be used for illuminating purposes; and, furthermore, because of the temperature extremes under which they are used, they would not be dependable even if based on battery power.

SECTION II. A. Type and quantity of by-product material

All by-product material is tritium H-3 in gaseous form, sealed into borosilicate glass tubes. The sources are purchased from either mb-microtec (source configuration 400/1) or SRB Technologies, Inc (source configuration M-1).

Watches and altimeters are currently listed in HESCO Registration Certificate NR-352-D-102-E. The watches carry model numbers ML-442xx, ML-443xx, ML-444xx and ML-447xx and refer to four configurations of watches in a multitude of colors. The last two positions of each configuration refer to the colors of the housing and faceplate. The total tritium in any watch is 25 mCi maximum; and, no single source exceeds 2 mCi. Each of the configurations is basically identical except that:

- ML-443xx series has an elapsed time ring containing a light source, light sources in each of the hour, minute and second hands, and 13 light sources on the dial.
- ML-442xx series has an elapsed time ring containing a light source, light sources in each of the hour, minute and second hands, and 12 light sources on the dial.
- ML-444xx series has no elapsed time ring, light sources in each of the hour and minute hands, and 13 light sources on the dial.
- ML-447xx series has no elapsed time ring, light sources in each of the hour and minute hands, and 12 light sources on the dial.

The altimeters contain up to seventeen (17) sources of tritium (H-3 gas), located on the altitude hand and the faceplate. The total tritium in any altimeter is 40 mCi maximum; and, no single source exceeds 4 mCi. The altimeters carry model numbers ML-448xx and refer to one basic configuration in several sizes and having different face plates and units of measures. In each case, the number of light sources and the method of mounting is identical.

SECTION II. B. Annual distribution and activity stored in one location

1. Annual Distribution

It is anticipated that 5,940 Ci in the following quantities of each of the products will be distributed yearly:

Sights -	175,000 (5,250 Ci)
Watches -	10,000 (250 Ci)
Altimeters -	1,000 (40 Ci)
Personal Markers (based on 2 sources/marker) -	5,000 (400 Ci)

2. Activity stored in one location

Since, because of economic considerations, large quantities of items are not held in stock, but rather ordered as-needed to fill delivery requirements, an assumption is made that the number of sources stored at one time is one eighth of the yearly amount to be distributed (based on shipments arriving every month to replenish stock and fill orders). Assuming a small residual inventory on hand when a new shipment arrives, we estimate that the maximum activity to be stored at any one time will be 750 Ci.

3. Storage

Storage will be in a room constructed of concrete block, 10 ft x 10 ft x 14 ft, and located within a larger work area of 30,000 sq ft. The room will be vented to the outside and provide a minimum air change of one change per hour. The room will be under lock control and labeled as containing radioactive materials. The larger work area has a continuous air change of once every two minutes.

SECTION III. A. Chemical and physical form

The watches and altimeters contain H-3 gas encapsulated in borosilicate glass.

SECTION III. B. Solubility in water and body fluids

H-3 gas has a low retention in the body subsequent to inhalation; and, the skin absorption intake for H-3 in this form is relatively insignificant (NUREG/CR-0215). However, H-3 gas may be converted to tritiated water, on contact with the atmosphere, if the gas leaks from the tubes over time. Tritiated water is completely soluble in normal water and body fluids. Inhaled tritiated water is assumed to be totally absorbed in body fluids (ICRP 30).

SECTION IV. A. Construction and design (See drawings, Appendix W-I)

1. The watches/altimeters contain H-3 activated light sources - gaseous H-3 encapsulated in borosilicate glass that is internally coated with a phosphor. These light sources are held in place on the dials and hands by epoxy and/or silicon adhesives (depending on the model). For the diving watch, the small source in the elapsed time ring is mounted in a metal housing, covered with a sapphire window, and then glued in place in the metal ring, with an epoxy adhesive. The dial and hands are then mounted on the time (or altitude) movement and hermetically sealed into the outer case - a special tool is required to disassemble or assemble (tamper-proof). In this manner, the sources are protected from accidental damage as well as from unauthorized handling. The sealed unit has a clear glass or high-strength impact resistant plastic window, through which the dials and hands are observed. Assembly methodology is the same as that used by mb microtec (our regular tritium source supplier) for the watches that they market in the U.S.

ML-SERIES	HEIGHT	LENGTH	WIDTH	SOURCE MOUNTING CONFIG
444xx & 447xx	.375 - .875"	1.5 – 2"	1.25 – 1.88"	Notes 1 & 2 (below)
442xx & 443xx	.375 - .875"	1.5 – 2"	1.25 – 1.88"	Notes 1, 2 & 3 (below)
448xx	.8 – 1.3"	2 – 4"	2 – 4"	Note 4 (below)

Drawings for each item within the series are provided in Appendix W-I. Drawings for each source mounting configuration are also provided. There are four basic source mounting configurations, as shown on the drawings, and discussed below.

1) The watch dials have an adhesive backing, and the light sources lay in slots on the dial glued in place by the adhesive backing.

2) All of the watch hands have a light source which is laid in a slot and attached by means of RTV silicon adhesive - which encompasses the bottom half of the light source.

3) The elapsed time ring has a source pre-mounted in a metal insert by means of silicon adhesive and sealed with a hard window. This light assembly is then glued into the elapsed time ring by means of an epoxy glue.

4) Light sources for altimeter hands and faceplates are laid in slots and attached by means of a hard transparent acrylic adhesive.

4. **The complete name and address** of the authorized manufacturer of the items to be distributed and the authorized distributor are:

Manufacturer:
MEPROLIGHT, Ltd – (Scopus Light (1990) Ltd)
Kibbutz Maayan Zvi
30805, Israel

Distributor:
Scopus Light USA, Inc.
1 Lawton Street
Yonkers, NY 10705

SECTION IV. B. External radiation levels

Tritium is a pure beta emitter with a maximum energy of 0.018 MeV, average energy of 0.0057 MeV, and range of approximately 0.55 mg/cm^2. No significant external exposure is expected either from the intact sources encapsulated in borosilicate glass or the free gas. Due to the low energy of the beta, bremsstrahlung is expected to produce no significant dose.

Bremsstrahlung fraction:

$F = 3.5\ E^{-4}\ Ze$ where Z = atomic number (9 for glass)
E = maximum beta energy (0.018 MeV)

$F = 5.67\ E^{-5}$

Total energy flux for each of the two worst cases is presented. (For watches and altimeters, the worst case is the altimeter with 40 mCi.).

Total energy flux from 40 mCi H-3 at 5 cm:

$$\phi = \frac{5.67E^{-5} \times 40mCi \times 2.22E^{9} d/m - mCi \times 0.0057MeV/d}{4\pi(5cm)(5cm)}$$

$$\phi = 92MeV/cm^2$$

Calculated dose rate at 5 cm:

Mass absorption coefficient for 0.018MeV gamma = 0.84 cm^2/g

D = 92 MeV/cm^2 - m x 1.6 E^{-6} erg/MeV x 0.01 g-rad/erg x 0.84 cm^2/g = 1.25 E^{-6} rad/m

H = 1.25 E^{-6} rad/m x 1 rem/rad x 60 m/hr = 0.075 mrem/hr

At 25 cm the dose rate would be 0.003 mrem/hr.

These calculations assume a bare H-3 source. In actuality, any low levels of bremsstrahlung created would be absorbed by the housing and protective MV gluing system layer of the watches and altimeters. (NUREG/CR-0215).

SECTION IV. C. Degree of access

The design of the watches and altimeters assures that the tritium light sources are well protected in the completed assembly and not easily accessible during normal use, storage, handling or routine maintenance. The dial and hands are mounted on the time (or altitude) movement and sealed into the outer case requiring a special tool to disassemble or assemble (tamper-proof). In this manner, the sources are protected from accidental damage as well as from unauthorized handling. Repair and servicing of watches is limited to replacement of the battery - none for the altimeter. Disassembly of the watch or altimeter for other reasons is neither technically nor economically feasible; and, therefore, they would be returned to the manufacturer for replace/repair disposition.

SECTION IV. D. Expected useful life

The expected useful life of the watches and altimeters is 6 to 10 years, depending on the color of the light sources. The length of time in which the brightness decreases to one-half of its initial value is 6 years (Ref: British Defense Standard 62-4 Issue 3).

SECTION IV. E. Proposed method of labeling

Each of the watches and altimeters will be permanently marked with the MEPROLIGHT logo  and the symbol for tritium (H-3). The combined dimensions of the logo and the tritium symbol on the products will be 4 mm x 1 mm. Watches will have the marking stamped/engraved into the metal watch back. Altimeter labeling will be on the protected faceplate with the same epoxy paint used to provide the other markings. This protected faceplate is similar in design and location to that of a watch. It is an internal part of the device, covered by the glass crown through which it is read - and is not exposed to any extreme environments nor to direct contact of any type. Under these conditions, the life of the marking will easily exceed the useful life of the altimeter itself.

In addition, each product will be packaged with instructions for use which carry a notification that they contain tritium in sealed sources, what the activity level is, and that no attempt should be made to disassemble them. The notification will also state that the items should be returned to the authorized dealer for any corrective measures or disposal (See Appendix W-I for example). The intent is to influence the user to return the unwanted product rather than simply discarding it. However, the warning does not imply that there is a regulatory requirement for returning these items.

SECTION V. A. Prototype testing

The assembled watches and altimeters have been successfully tested (Prototype testing) by MEPROLIGHT to the environmental and mechanical requirements of U.S. Military Specification (for tritium watches) MIL-W-46374F. Design qualification and safety testing of the watches and altimeters were accomplished under the auspices of MEPROLIGHT (partly in house and partly in contracted test laboratory facilities). In addition, design of the dials and hands, and their assembly methodology have been taken directly from mb-microtec and, therefore, are considered acceptable by direct comparison.

1. Testing performed is summarized below for the test parameters that are important to safety.
   a. Vibration (para 3.3.1) – 3 planes (20 minutes each) at a frequency of 30 – 60 – 30 Hz, and an amplitude of.030 ± .005"
   b. Shock (para 3.3.2) – Drop from a height of ½ meter
   c. Storage (para. 3.3.3) - 24 hours each at -50°F, room temp, 140°F (min 50% RH)
   d. Water Resistance (par 3.3.4) 5 minutes at 1 atmosphere, then 5 minutes at 3 atmospheres
   e. Radiological Contamination (para 3.3.12.1) - 100 dpm
   f. Radiological Contamination - long term (para 3.3.12.2) - total contamination for 10 watches packaged and stored for 90 days, not to exceed 100 dpm (swipe test)
   g. Diffusion (para 3.3.12.3) - soak test for 50 nCi/24 hour period
   h. Altitude (para 3.3.14) - 35,000 feet for 60 minutes
2. Evaluation criteria used to demonstrate that the products passed the testing.

   The watch remains mechanically sound with no signs of damage, no loose, missing or damaged components. In addition, all light sources must appear functional, and there must be no external radiation beyond that allowed by Paragraph 3.3.12.
3. Drawings for the design that was prototype tested (ML-443xx watch and Alt 2 altimeter) are provided in Appendix W-I. It is claimed that those models not subjected to the prototype testing would pass such testing based on the following: The materials, light sources and adhesives are identical for all models. The method of attaching the light sources and the method of mounting the parts containing the sources to the entire assembly are also identical for all models. The methods of assembling the watch and altimeter and of closing the assembly (at final assembly) are the same for all models.

SECTION VI. A. Estimated radiation dose commitments

1. Normal conditions

a. Normal use

Because of similarity in construction and use, data for the following sections has been extrapolated from NUREG/CR-0215 "Estimates of Potential Radiation Doses from Wristwatches Containing Tritium Gas". However, since the maximum activity per watch/altimeter to be licensed is 40 mCi as compared to the 200 mCi used in the report, the figures cited herein have been adjusted downward accordingly.

No radiation dose commitment is anticipated during normal use of these products. Watch wearers are estimated to receive annual total-body doses of 0.0006 -0.004 mrem, depending on "wearing" habits. Since altimeters are worn for much shorter periods of time, the total-body dose would be significantly less than these figures. The tritium gas is sealed in borosilicate glass; therefore, no inhalation or ingestion of the radioactive material is expected in normal use.

b. Storage

Storage is based on the total number of sources and not on the specific product, and therefore the calculations are shown for the total anticipated to be stored at any one time. Distilled water immersion tests on the sights and the other products indicated a leakage rate no greater than 1 E^{-5} uCi/sight in 24 hours. Based on the anticipated annual sales and monthly shipments to replenish the inventory on-hand, an assumption is made that the number of sources stored at one time is one eighth of the yearly amount to be distributed. Therefore, the expected number of sources in storage at any given time will not exceed the following:

Product and Sources Per Product	Quantity of Product	Quantity of Sources	Sources in Storage at any given time
Sight Sets (3 sources each)	109,000	327,000	40,875
Single sights (archery pins, fronts or optical – one source each)	66,000	66,000	8,250
Watches (17 sources each)	10,000	170,000	21,250
Altimeters (17 sources each)	1,000	17,000	2,125
Personal Markers (2 sources each)	5,000	10,000	1,250
Total Sources in Storage	-	-	**73,750**

Assuming that these 73,750 sources are stored in a 14 ft x 10 ft x 10 ft room in a 30,000 sq ft work area with an air exchange rate of 1 air change per hour, the calculated equilibrium concentration of tritium is as follows:

$$C = \frac{I}{\lambda V}$$

Where: I = rate of influx of H-3 gas
V = volume of the room
λ = air exchange rate
C = equilibrium H-3 gas concentration

I = 73,750 sources x 1 E^{-5} μCi/source-24 hr = 3.1 E^{-2} μCi/hr

V = 1400 cubic ft x 2.83 E^{4} cc/cubic ft = 3.96 E^{7} cc

$$C = \frac{3.1E^{-2}\,\mu Ci/hr}{1 airchange \times 3.96E^{7} cc} = 7.8E^{-10}\,\mu Ci/cc$$

C = 7.8 E^{-7} mCi/m^3

The concentration limit set in 10CFR20 Appendix B, Table II, Column 1 for H-3 in air is 2 E^{-7} μCi/ml. Therefore, the calculated equilibrium concentration in the storage area is less than 1% of the 10CFR20 concentration limit for a controlled area.

The annual dose commitment to a warehouse worker, working in the area for 1 hour/day, 250 days/year is as follows:

Assume:

All H-3 gas is converted to tritiated water

Total rate of absorption of tritiated water into body fluids (mCi/minute) from inhalation and skin absorption is 3 E^{-2} C, where C is the concentration of tritiated water in air in mCi/ m^3 (ICRP 30)

Committed dose equivalent per unit intake of tritiated water is 1.7 E^{-11} Sv/Bq (6.3 E^{-2} rem/mCi)

Annual committed dose:

H = 7.8 E^{-7} mCi/m^3 x 3 E^{-2} mCi- m^3/mCi-minute x 60 minutes/hr x 250 hr/yr x 6.3 E^{-2} rem/mCi = 2.21 E^{-5} rem/year

H = 0.022 mrem/year

A similar type calculation in NUREG/CR-0215 "Estimates of Potential Radiation Doses from Wristwatches Containing Tritium Gas" yields a committed dose of 50 mrem from exposure to 2.5 E^{-5} μCi/cc for 24 hours or 8.3 E^{4} mrem-cc/μCi-hr. Using that factor, the annual committed dose to a warehouse worker would be:

H = 8.3 E^{4} mrem-cc/μCi-hr x 250 hr/yr x 7.8 E^{-10} μCi/cc = 0.016 mrem/yr

c. Transportation

As was the case for storage, the transportation calculation is based on the total number of sources and not on the specific product, and therefore the calculations are shown for the total number of sources to be transported. Assume a truck driver transports all products to be stored in the warehouse in a single truckload and spends a total of two hours in the trailer loading and unloading and that the truck is ventilated to produce one air change per hour.

V = 2.9 E^{7} cc (NUREG/CR-0215)

I = 3.1 E^{-2} μCi/hr

λ = 1 air change/hr

$$C = \frac{3.1E^{-2}\,\mu Ci/hr}{1 air change \times 2.9E^{7}\,cc} = 1.07E^{-9}\,\mu Ci/cc$$

Dose Commitment:

H = 1.07 E^{-6} mCi/m^3 x 3 E^{-2} mCi- m^3/mCi-minute x 2 hr x 60 minutes/hr x 6.3 E^{-2} rem/mCi = 2.43 E^{-7} rem

H = 2.43 E^{-4} mrem

d. All other situations during normal use, storage, and transportation involve smaller quantities of H-3 and/or shorter exposure times and, thus, would result in negligible dose commitment.

e. Disposal:

These products are relatively expensive items and are unlikely to be inadvertently discarded. The disposal of an item to normal trash is unlikely. Instructions accompanying the products request return of damaged or defective items to the distributor. Therefore, improper or careless disposal is unlikely to cause any significant radiation dose.

NUREG/CR-0215 estimates the dose commitment to the maximally exposed individual for burial of 500,000 tritium illuminated wrist watches per year in landfills (20,000 in a single location) to be 0.1 mrem/yr. If the sources are burned, a potential maximum dose commitment of 17 mrem/yr was estimated. The total number of items potentially disposed of in a single year would be much lower and the H-3 activity per unit considerably lower than that postulated for the study (NUREG/CR-0215). Therefore, disposal of the items will not present a radiation hazard to the general public.

2. Accident conditions

a. Use

The maximum credible accident involving the use of these items is rupture of the sources and instantaneous release of the gas while being worn. The watch or altimeter is approximately 50 cm from the user's breathing zone when being worn.

Assume:

Total activity of the watch/altimeter is 40 mCi of H-3 gas. (watches are less, only 25 mCi)

Location - 50 cm from the user's face.

Breathing zone can be represented by a cone with apex at the source and base, a 10 cm diameter circle, at the user's face.

All H-3 is converted to tritiated water instantly.

Effective half-life for tritiated water = 10 days.

Total absorption of inhaled tritium in body fluids.

Mass of soft tissue = 63,000 g (ICRP 30)

Fraction of gas released in the direction of the breathing zone:

$$F = \frac{\pi \times r \times r}{4\pi \times R \times R}$$ Where r = radius of the base of the cone
R = distance from source to nose

$$F = \frac{\pi \times 5 \times 5cm^2}{4\pi \times 50 \times 50cm^2} = 0.0025$$

Maximum estimated dose commitment to user assuming all H-3 gas is converted to tritiated water:

H = 40 mCi x 0.0025 x 6.3 E^{-2} rem/mCi x 1 E^{3} mrem/rem = 6.3 mrem

For such an accidental instantaneous release, most of the gas would remain as elemental H-3. The dose commitment from H-3 gas would be approximately 1000 times less. The total estimated dose commitment would be 2% of the calculated value since up to 2% of the gas originally in the glass capsule could be in the form of tritiated water.

b. Storage

The maximum credible accident involving storage of the units would involve a fire in the storage area which ruptures some of the borosilicate glass capsules. (A massive fire which would rupture all sources would be likely to result in immediate dispersion of the H-3 gas and dilution with outside air, thus reducing the concentrations of H-3 gas in the storage area.)

Assume:

50% of the sources in a single storage room rupture.

Immediate dispersion of the gas within the storage area.

Conversion of all H-3 gas to tritiated water.

Total rate of absorption of tritiated water into body fluids (mCi/minute) from inhalation and skin absorption is 3.2 E^{-2} C, where C is the concentration of tritiated water in air in mCi/cubic meter (ICRP 30).

$$C = \frac{750Ci}{3.96E^{7}cc} \times 0.50 = 9.47E^{-6}Ci/cc = 9.47E^{3}mCi/meter^{3}$$

Dose commitment:

H = 9.47 E^{3} mCi/cubic meter x 3 E^{-2} mCi-cubic meter/mCi-min x 6.3 E^{-2} rem/mCi

H = 17.9 rem/minute

Dose commitment to occupant remaining in enclosed area for 1 minute = 17.9 rem

Dose commitment to fireman remaining in enclosed area without respiratory protection for 2 minutes for the purpose of rescue = 35.8 rem

This calculation greatly overestimates the true dose commitments in this situation. Air currents would disperse the gas very rapidly in the case of a fire, particularly one of such severity as to rupture 50% of the sources instantaneously. In addition, only a small fraction of the H-3 gas is likely to be converted to tritiated water before venting to the outside.

A more reasonable estimate of the dose commitment would be obtained using the maximum fraction of tritiated water in the source, 0.02. If this value is used, the dose commitments become 3.6 E^2 mrem for the occupant and 7.2 E^2 mrem for the fireman.

c. Ingestion or inhalation

Ingestion or inhalation of the entire H-3 content of the largest source in either product (4 mCi).

$H = 4\ mCi \times 6.3\ E^{-2}\ rem/mCi = 0.25\ rem$

Ingestion or inhalation of the entire H-3 content of all the sources on the watch or altimeter. (The greatest activity is that of the altimeter - 40 mCi.)

$H = 40\ mCi \times 6.3\ E^{-2}\ rem/mCi = 2.5\ rem$

These calculations assume that the entire activity of H-3 gas is converted to tritiated water. H-3 gas is not absorbed readily in body fluids and thus produces a negligible dose. These postulated accidents would require that an individual remove one or more of the sources from the product without damaging it (not possible by any known technology), swallow it, and have the source rupture while in the digestive tract. Each of these conditions is highly improbable. The combination of all three occurring is nearly impossible.

SECTION VI. B. Compliance with 10CFR32.23 and 32.24

1. Normal use and storage

No radiation dose commitment is expected in the normal use of the watches or altimeters. The maximum expected dose commitment to workers in the storage area is less than 0.03 mrem/year. This is within the limit set in Column II, Table O.1 (32.24).

2. Accidental release of the tritium gas

a. Under maximum credible conditions of use of the equipment, the dose commitment to an individual would not exceed 49 mrem (sights being the worst case), within the limits set in Column III, Table O.1 (32.24). In the highly improbable case where an individual ingested the contents of an entire source (personal marker being the worst case), the estimated dose commitment is 2.5 rem. This is within the limits set in Column IV, Table O.1 (32.24).

b. Under extreme fire conditions in the storage area, the estimated maximum dose commitment to an occupant of the area is 17.9 rem; to a fireman in the process of rescue, 35.8 rem. More reasonable values, based on 2% of the H-3 gas being oxidized and remaining in the storage room, are 0.36 rem and 0.72 rem respectively. Even under the extreme conditions (extremely low probability), the dose commitment to an occupant of the storage area is only slightly greater than the limits set in Column IV, Table O.1 (32.24). Likewise, the estimated dose to a fireman engaged in rescue in that area is only around twice the limits set in Column IV, Table O.1 (32.24). However, the probability of such an event occurring and an individual entering the storage area without respiratory protection is negligible. The noxious gases that would be produced in such an event would prevent unprotected entrance. Therefore, the requirements of 32.23 are met.

SECTION VI. C. Disposal of units

No significant radiation dose commitment is expected to result from disposal of any of the items listed, since dispersion and dilution with the atmosphere would rapidly reduce tritium concentrations in air to background levels.

NUREG/CR-0215 estimates the dose commitment to the maximally exposed individual for burial of 500,000 tritium illuminated wrist watches, each initially containing 200 mCi, per year in landfills (20,000 in a single location) to be 0.1 mrem/yr. If the sources are burned, a potential maximum dose commitment of 17 mrem/yr was estimated. Anticipated annual sales figures for all MEPROLIGHT products are for around 200,000 per year; and, the tritium activity per product sold (worst case scenario) is only 54 mCi per sight set, 25 mCi for the watch, 40 mCi for the altimeters, and 120 mCi for the 3 light personal marker. The total annual distribution of around 6000 Ci, translated into the yearly disposal activity is only around 6% of that calculated in the study.

Therefore, with a total number of items potentially disposed of in a single year much lower and the H-3 activity per unit considerably lower than that postulated for the study (NUREG/CR-0215), disposal of the items will not present a radiation hazard to the general public.

SECTION VII. A. Quality control procedures

The manufacturer MEPROLIGHT (Scopus Light) is certified to ISO-9002 and maintains a quality system in compliance with the requirements of US Army Military Specification MIL-I-45208 as well. The following quality procedures are followed at that facility.

1. All safety and quality control procedures have been designed to comply with the requirements of the Israel Ministry of Defense and the Israel Atomic Energy Commission (License Number 6004, last renewed 22 October 1999, allowing MEPROLIGHT to manufacture with tritium sources and to have in-house, at any given time, up to 7,000 Ci of H-3).

2. Light sources are purchased only from two producers already qualified by the U.S. Military: mb-microtec and SRB technologies (as a backup alternative source). In addition to dimensional characteristics, the lights are procured with quality requirements for tritium purity, activity, brightness and color; and, they are supplied with a certificate of conformance.

   Receiving inspection of the light sources at MEPROLIGHT Ltd includes the following steps in the order listed:

   - Visual examination of packaging for any signs of external damage
   - Batch swipe test (liquid scintillation counting) to check for leakage problems
   - 100% inspection in dark-room
   - Photometric brightness measurement of dimmest samples
   - Sample subjected to dimensional inspection
   - 100% soak test (liquid scintillation counting) to check for leakage problems

   Only after satisfactory completion of receiving inspection can the sources be placed into storage or released for production.

3. All manufacturing is performed in accordance with the safety and health requirements of the Israel Atomic Energy Commission. During manufacture, all work is performed under vented hoods. Work areas are checked at regular frequent intervals for cleanliness with swipe tests counted in a Packard TRICARB Model 2300TR Liquid Scintillation Counter.

   In addition to in-process inspections and final inspections for damage, workmanship, and completeness of assembly, samples are taken at random from each day's overall production (all products) for scintillation counting to assure that there are no health hazards. These soak tests, to determine if there is any leakage, require that the samples be submerged in distilled water for 24 hours at room temperature and the water or an aliquot then counted.

4. Lot acceptance tests on the completed items are performed as stated below:
   - Sampling in accordance with MIL-STD-105E for inspection of dimensional characteristics affecting fit, function or interface; visual defects; workmanship
   - 100% testing in a dark room for comparative brightness, coupled with photometric brightness measurement of the dimmest units (to assure the required useful life of the product).
   - Batch wipe or immersion tests of all products (100%) are performed (counted for beta activity with the Packard TRICARB Model 2300TR Liquid Scintillation Counter) to check for any removable contamination. All scintillation counting results must indicate no detectable activity (less than 1 E^{-5} uCi/sq cm).

5. To afford protection from shipping or handling damage, each of the product lines is packaged according to specific written instructions developed for that product line. Packaging is as follows:

   Watches and altimeters will be individually packaged with protective cushioning (bubble pack or equivalent) and, then the items will be placed in intermediate packs for added security. These will then be case-packed for added protection and ease of shipping.

6. Mandatory quality control procedures for receiving inspection at Scopus Light USA, Inc are:

   Upon receipt, Scopus Light USA, Inc will inspect the packaging for any signs of obvious external damage.

   After unpacking, a random sample will be selected, in accordance with the sampling instructions of MIL-STD-105, Inspection Level S-4, for an AQL of 1.5%, for inspection of proper marking and labeling.

   This inspection will consist of verifying the presence of logo and tritium symbol on the products and, in addition, verifying that each product is packaged with instructions for use which carry a notification that they contain tritium in sealed sources, what the activity level is, and that no attempt should be made to disassemble them. In the event that the products are "bulk-packed", the intermediate bulk-package must contain marking certifying the radioactive content. In addition, the bulk package must be accompanied by safety information for care and temporary storage of the items.

   Then, after unpacking, and inspecting for marking/labeling information, Scopus Light USA, Inc will inspect 100% of the products in a dark room before release for storage and distribution. This inspection will verify that there has been no degradation in the quality of the product shipped from MEPROLIGHT, LTD (Israel).

   In addition, Scopus Light USA, Inc will assure that each shipment is accompanied by a certificate of conformance attesting to the acceptability of the products.

SECTION VIII. A. Record keeping

All records will be kept in accordance with the requirements of 10CFR32.25 and the New York State (NYCH) "Rules and Regulations for Radioactive Materials".

1. Records will be kept of the number of units of each type, type and the total quantity of by-product material transferred.

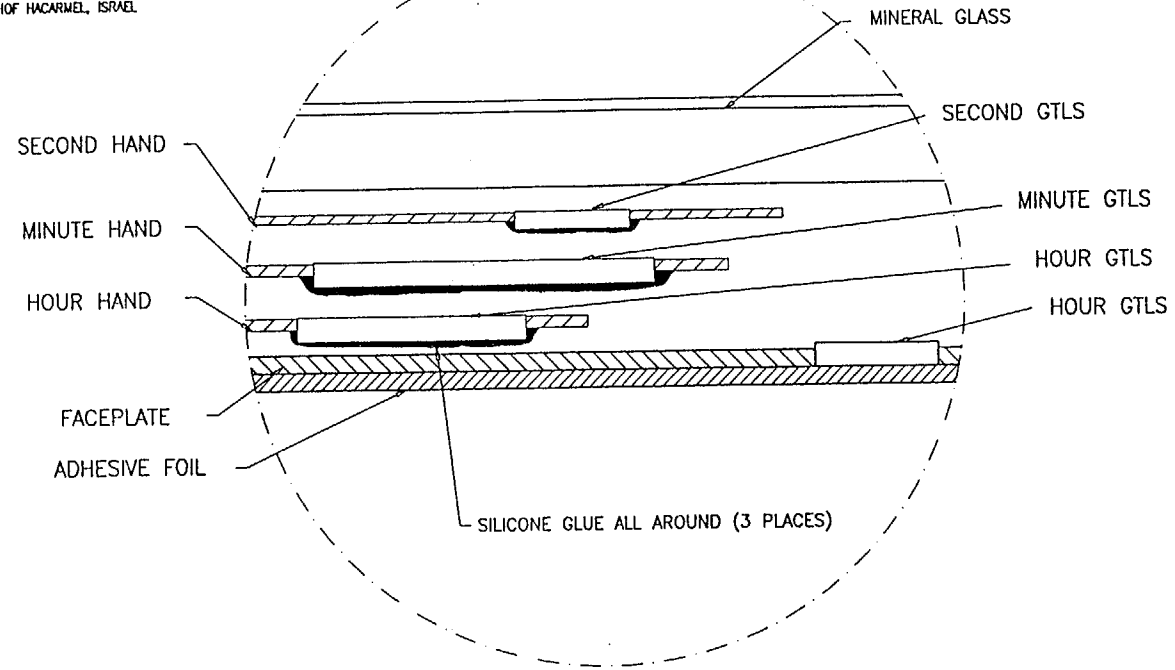
2. Reports will be filed with the U.S. N.R.C. as required by 10CFR32.25(c)(2) and as required by the State of New York.

3. The U.S. N.R.C. will be notified if Scopus Light USA, Inc. discontinues the activities covered by this license application.

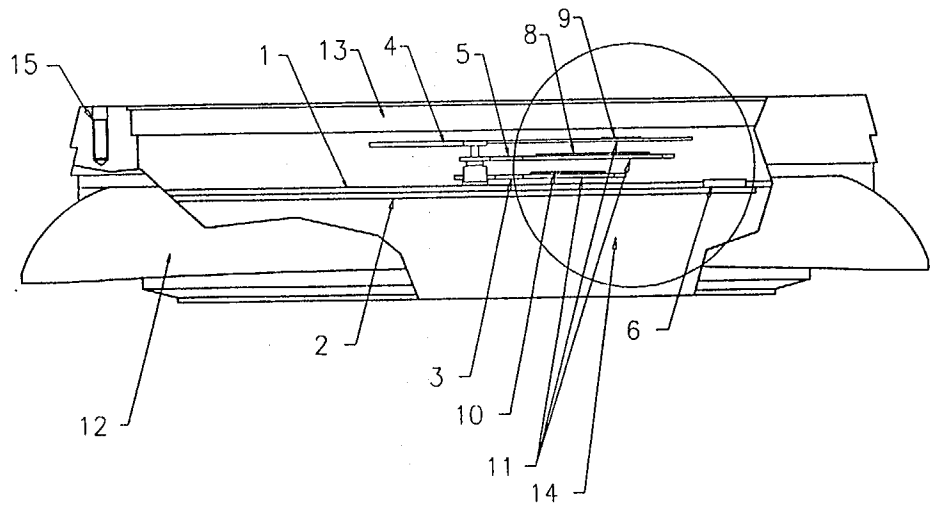
APPENDIX W-I

WATCH & ALTIMETER INFORMATION

DETAIL



NOTE:
APPLIES TO MODELS 44225/6/8/9 AND MODELS 44325/6/8/9. PROTOTYPE TESTED
NO RING INSERT AND SECOND GTLS IN MODELS 44725/6/8/9 AND MODELS 44425/6/8/9.



ITEM	QTY	DESCRIPTION	DWG N°	P/N	MANUF./NOTE
15	1	RING INSERT		T5162-1/I	MB
14	1	MOVEMENT		715-L	RONDA
13	1	MINERAL GLASS			STINGMARS
12	1	STEEL CASE			STINGMARS
11		SILICONE GLUE		RTV 112-Q	GE
10	1	HOUR GTLS		T5318-1	MB
9	1	SECOND GTLS		T5319-1	MB
8	1	MINUTE GTLS		T5324-1	MB
	2	12 O'CLOCK GTLS		T5255-1/IIIa	MB
6	10	HOUR GTLS		T5317-1	MB
5	1	MINUTE HAND	71442204		ESTIMA
4	1	SECOND HAND	71442203		ESTIMA
3	1	HOUR HAND	71442205		ESTIMA
2	1	ADHESIVE FOIL	71442202	WHITE VINYL	3M
			71443202	WHITE VINYL	3M
1	1	FACEPLATE	DATE-3		ADI
			DATE-4:30		ADI

DATABASE: ..\ADI\ML-44220\SIDEASSY

UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.2
Angular tolerance: ±1°
Break sharp corners-0.2

Material: N/A
Heat tratment: N/A
Finish: N/A

Design 20.09.96
Aprvd AES 20.09.96
Drawing N°: 044220
Cat N°: 044220

Used on: ML-44220
Rev: A 20.09.96
Sheet 1 of 1

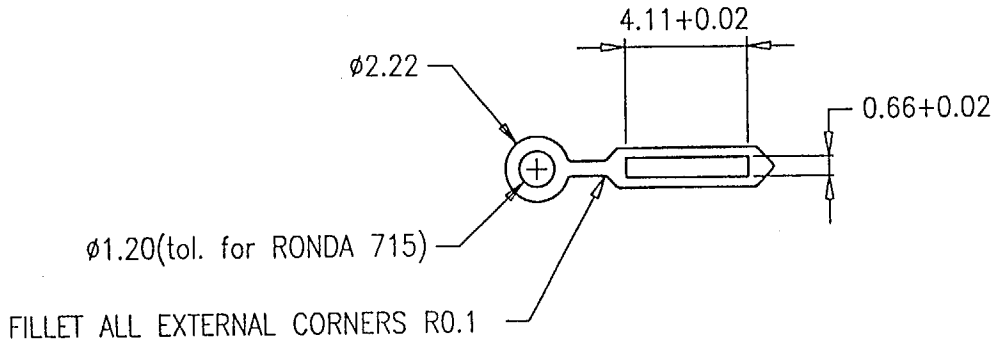
N7

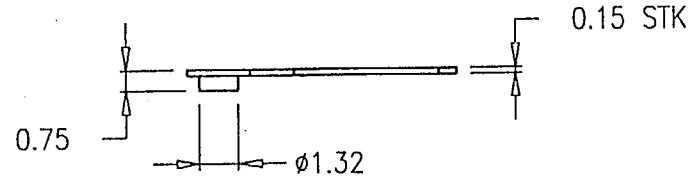
Name: ASSEMBLY
Next Assy: N/A

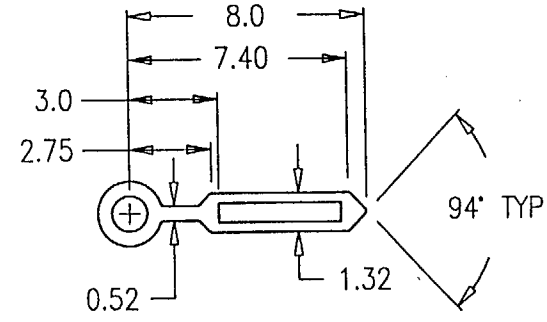
MEPROLIGHT

App n-1 - 1

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED







DATABASE: ..\ADI\ML-44220\HOURHAND

UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.05
Angular tolerance: ±1°
Break sharp corners-0.1

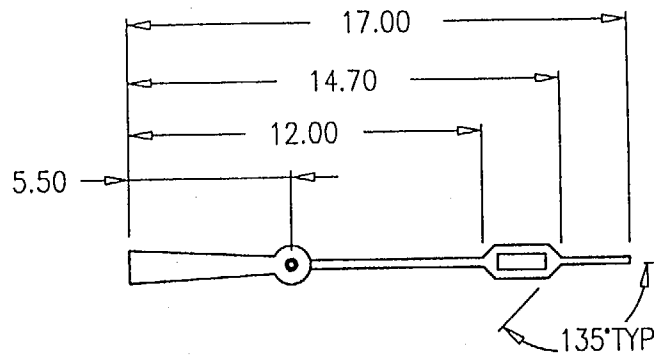
Design	20.09.96	Used on:	ML-44220 ML-44720	N7	
Aprvd	20.09.96				
Drawing N°: 72442205		Rev: A	20.09.96	Name: HOUR HAND	
Cat N°: 72442205		Sheet 1	of 1	Next Assy: 044220	

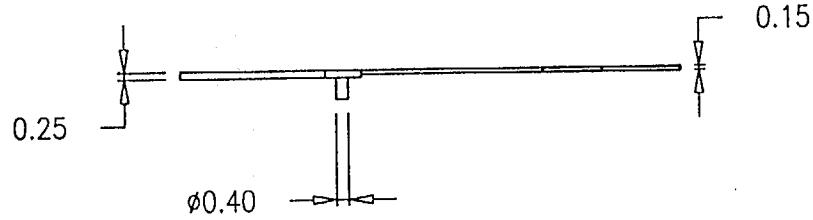
Material: N/A
Heat tratment: N/A
Finish: N/A

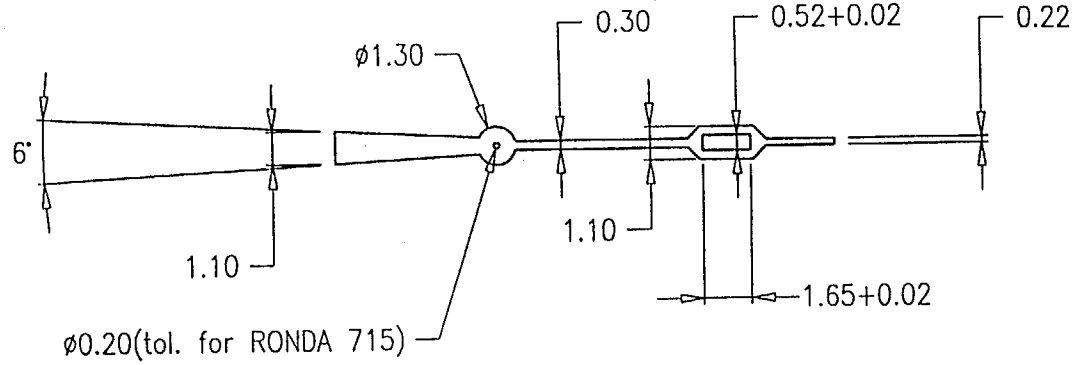
MEPROLIGHT

App w-1 -2

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED





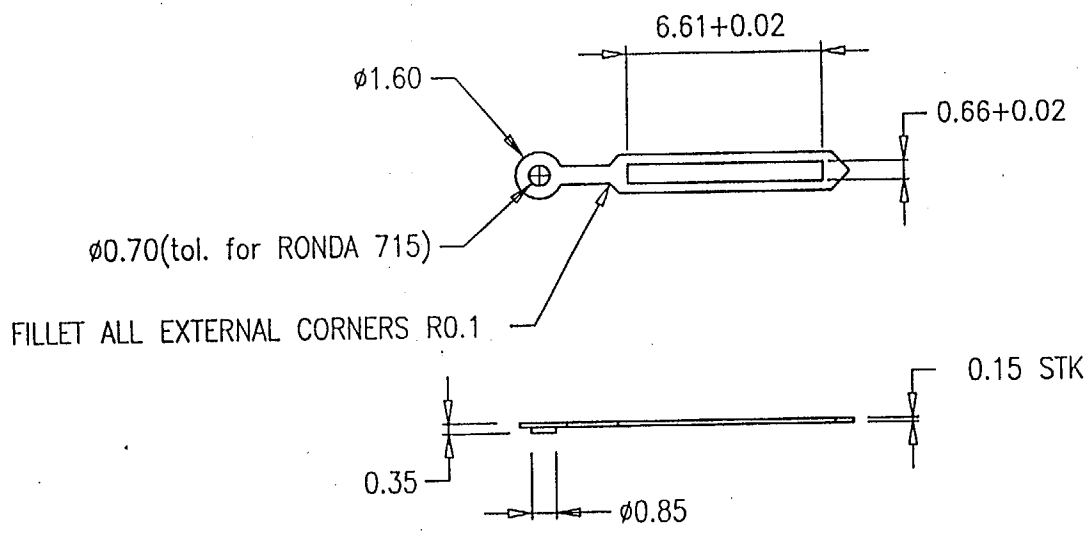


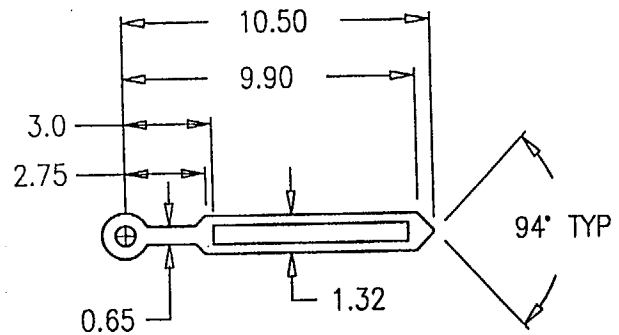
DATABASE: ..\ADI\ML-44220\SECOHAND				
UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.2 Angular tolerance: ±1° Break sharp corners-0.2	Design	20.09.96	Used on: ML-44220	N7
	Aprvd ZES	20.09.96		Name: SECOND HAND
	Drawing N°: 72442203		Rev: A 20.09.96	
	Cat N°: 72442203		Sheet 1 of 1	Next Assy: 044220
Material: N/A				
Heat tratment: N/A				
Finish: N/A				

MEPROLIGHT

APP W-1 -3

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED





DATABASE: ..\ADI\ML-44220\MINUHAND

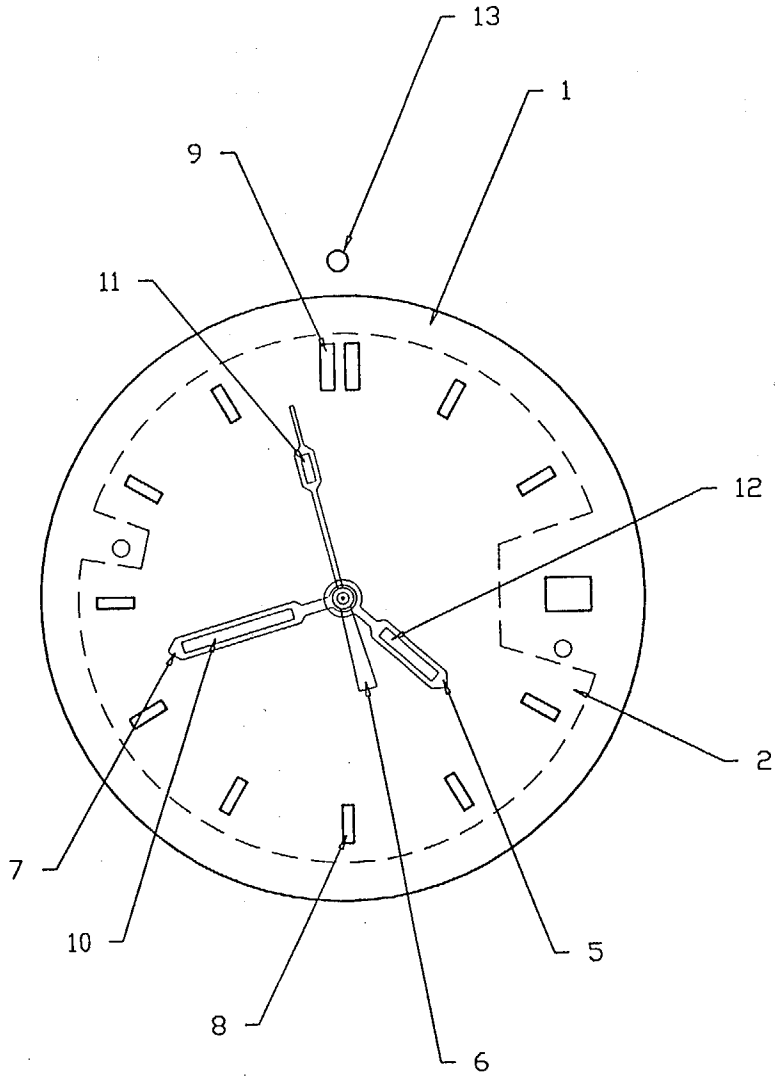
UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.05
Angular tolerance: ±1°
Break sharp corners-0.1

Material: N/A
Heat tratment: N/A
Finish: N/A

Design	20.09.96	Used on: ML-44220 ML-44720	N7
Aprvd	20.09.96		
Drawing N°: 72442204		Rev: A 20.09.96	Name: MINUTE HAND
Cat N°: 72442204		Sheet 1 of 1	Next Assy: 044220

MEPROLIGHT

Add-1-4



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

ITEM	QTY	DESCRIPTION	DWG N°	P/N	MANUF./NOTE
13	1	RING INSERT		T5162-1/I	MB
12	1	HOUR GTLS		T5318-1	MB
11	1	SECOND GTLS		T5319-1	MB
10	1	MINUTE GTLS		T5324-1	MB
9	2	12 O'CLOCK GTLS		T5255-1/IIIa	MB
8	10	HOUR GTLS		T5317-1	MB
7	1	MINUTE HAND	72442204		ADI
6	1	SECOND HAND	72442203		ADI
5	1	HOUR HAND	72442205		ADI
2	1	ADHESIVE FOIL	72442202		DL
1	1	BLUE FACEPLATE	72442250		ADI
1	1	WHITE FACEPLATE	72442260		ADI
1	1	BLACK FACEPLATE	72442280		ADI
1	1	METAL FACEPLATE	72442290		ADI

DATABASE: ..\ADI\ML-44220\ASSY

UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.2
Angular tolerance: ±1°
Break sharp corners-0.2

Material: N/A
Heat tratment: N/A
Finish: N/A

Design 20.09.96
Aprvd 20.09.96
Drawing N°: 044220
Cat N°: 044220

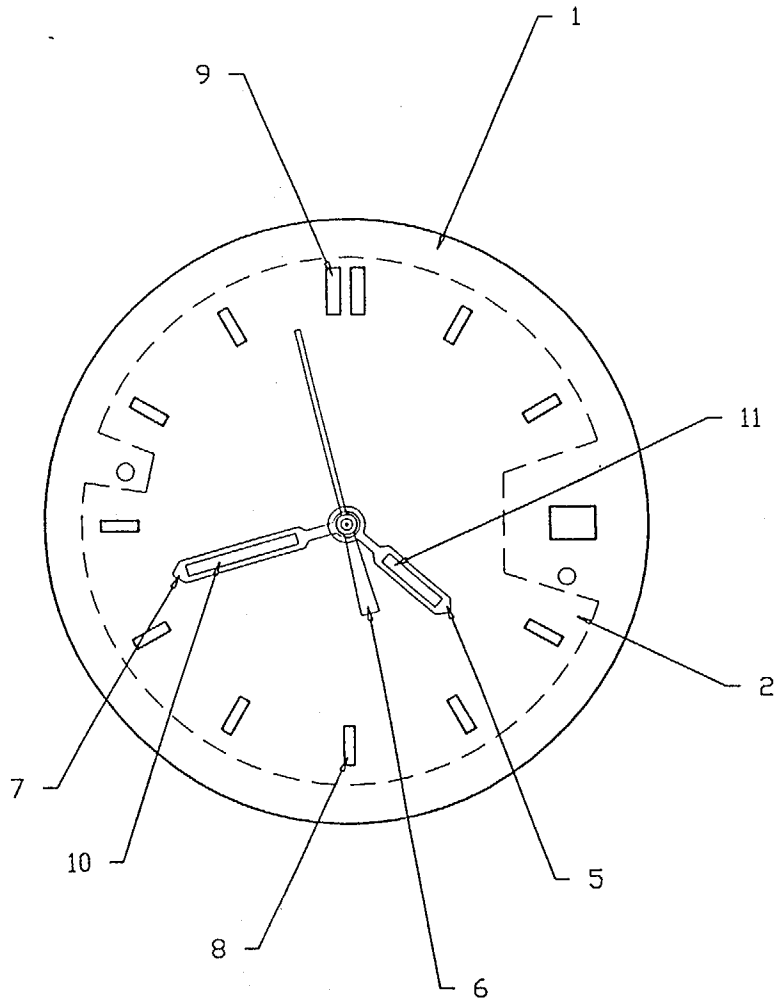
Used on: ML-44225/6/8/9
Rev: A 20.09.96
Sheet 1 of 1

N7

Name: ASSEMBLY
Next Assy: N/A

MEPROLIGHT

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



ITEM	QTY	DESCRIPTION	DWG N°	P/N	MANUF./NOTE
11	1	HOUR GTLS		T5318-1	MB
10	1	MINUTE GTLS		T5324-1	MB
9	2	12 O'CLOCK GTLS		T5255-1/IIIa	MB
8	10	HOUR GTLS		T5317-1	MB
7	1	MINUTE HAND	72442204		ADI
6	1	SECOND HAND	72442201		ADI
5	1	HOUR HAND	72442205		ADI
2	1	ADHESIVE FOIL	72442202		DL
1	1	BLUE FACEPLATE	72447250		ADI
1	1	WHITE FACEPLATE	72447260		ADI
1	1	BLACK FACEPLATE	72447280		ADI
1	1	METAL FACEPLATE	72447290		ADI

DATABASE: ..\ADI\ML-44220\720-ASSY

UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.2
Angular tolerance: ±1°
Break sharp corners-0.2

Material: N/A
Heat tratment: N/A
Finish: N/A

Design	20.09.96	Used on: ML-44725/6/8/9	N7
Aprvd PES	20.09.96		
Drawing N°: 044720	Rev: A 20.09.96	Name: ASSEMBLY	
Cat N°: 044720	Sheet 1 of 1	Next Assy: N/A	

MEPROLIGHT

APP W-1 - b

REVISIONS				
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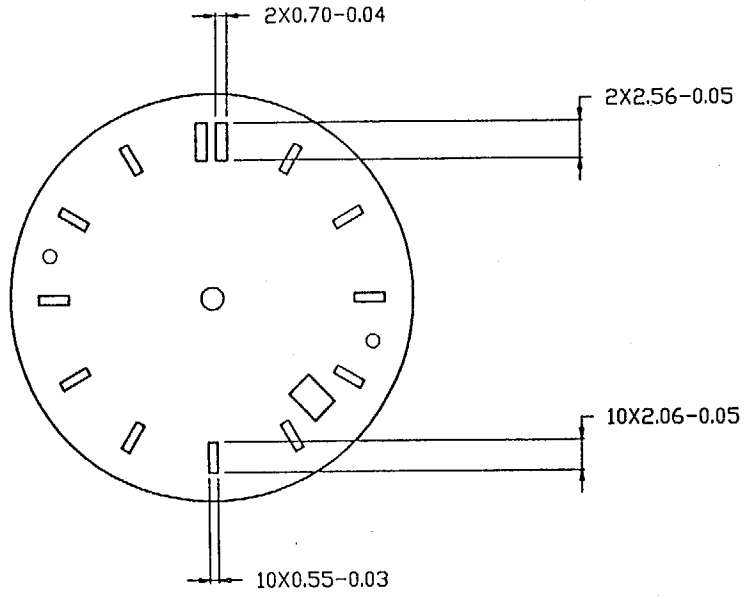
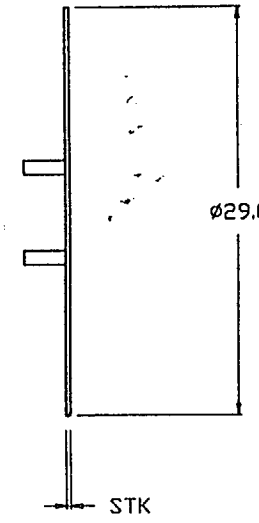




BLUE	CAT N°	71443250	71444250
	ML-N°	ML-44325	ML-44425
WHITE	CAT N°	71443260	71444260
	ML-N°	ML-44326	ML-44426
BLACK	CAT N°	71443280	71444280
	ML-N°	ML-44328	ML-44428
METALLIC	CAT N°	71443290	71444290
	ML-N°	ML-44329	ML-44429

DATABASE: ..\ADI\ML-44220\DIAL443

UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.2
Angular tolerance: ±1°
Break sharp corners-0.2

Material: N/A
Heat tratment: N/A
Finish: N/A

Design 20.09.96
Aprvd 20.09.96
Drawing N°: SEE TABLE
Cat N°: SEE TABLE

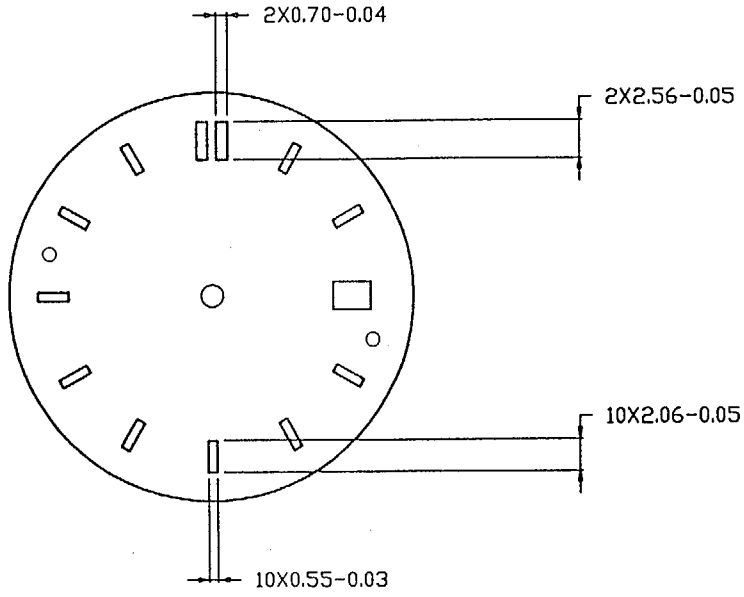
Used on: ML-44320
ML-44420

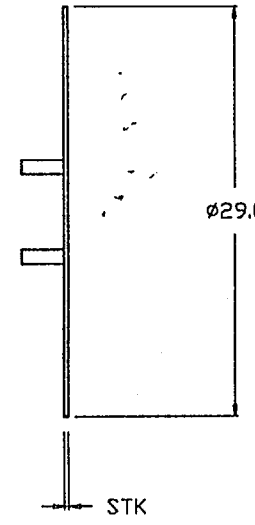
Rev: A 20.09.96
Sheet 1 of 1

Name: DIAL
Next Assy: 044320

MEPROLIGHT

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED





BLUE	CAT N°	71442250	71447250
	ML-N°	ML-44225	ML-44725
WHITE	CAT N°	71442260	71447260
	ML-N°	ML-44226	ML-44726
BLACK	CAT N°	71442280	71447280
	ML-N°	ML-44228	ML-44728
METALLIC	CAT N°	71442290	71447290
	ML-N°	ML-44229	ML-44729

DATABASE: ..\ADI\ML-44220\DIAL442

UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.2
Angular tolerance: ±1°
Break sharp corners-0.2

Material: N/A
Heat tratment: N/A
Finish: N/A

Design 20.09.96
Aprvd PES 20.09.96
Drawing N°: SEE TABLE
Cat N°: SEE TABLE

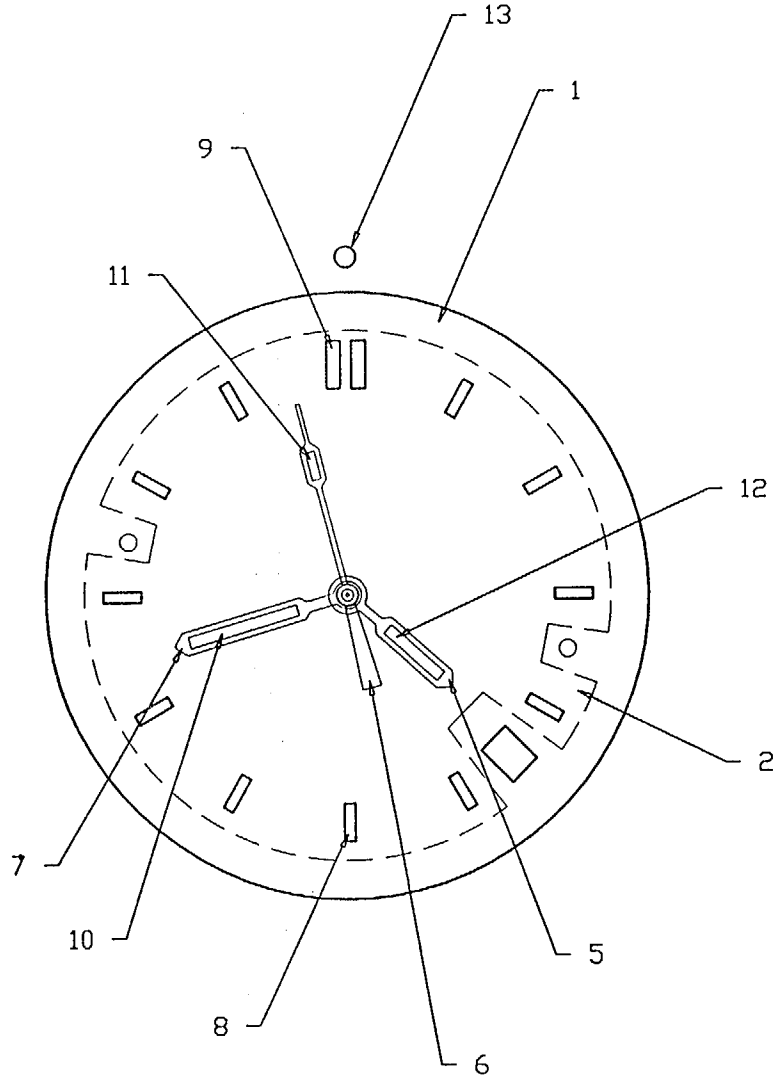
Used on: ML-44220
ML-44720

N7

Rev: A 20.09.96
Sheet 1 of 1

Name: DIAL
Next Assy: 044220

MEPROLIGHT



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

ITEM	QTY	DESCRIPTION	DWG N°	P/N	MANUF./NOTE
13	1	RING INSERT		T5162-1/I	MB
12	1	HOUR GTLS		T5318-1	MB
11	1	SECOND GTLS		T5319-1	MB
10	1	MINUTE GTLS		T5324-1	MB
9	2	12 O'CLOCK GTLS		T5255-1/IIIa	MB
8	11	HOUR GTLS		T5317-1	MB
7	1	MINUTE HAND	72442204		ADI
6	1	SECOND HAND	72443203		ADI
5	1	HOUR HAND	72442205		ADI
2	1	ADHESIVE FOIL	72443202		DL
1	1	BLUE FACEPLATE	72443250		ADI
1	1	WHITE FACEPLATE	72443260		ADI
1	1	BLACK FACEPLATE	72443280		ADI
1	1	METAL FACEPLATE	72443290		ADI

DATABASE: ..\ADI\ML-44320\ASSY

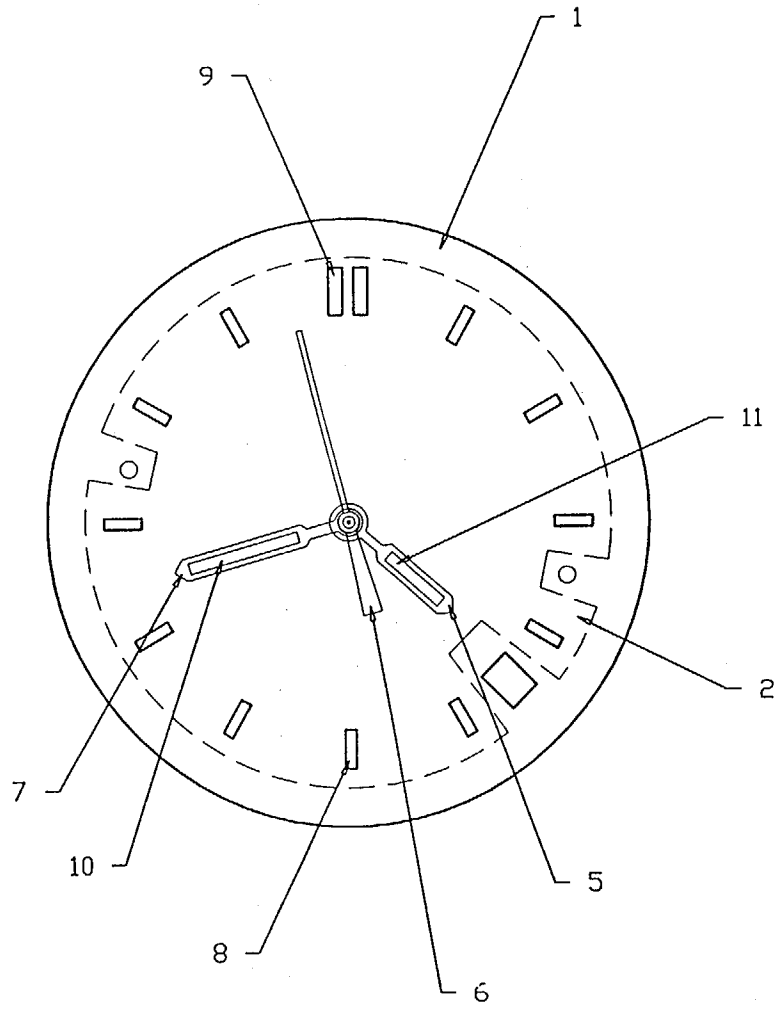
UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.2
Angular tolerance: ±1°
Break sharp corners-0.2

Material: N/A
Heat tratment: N/A
Finish: N/A

Design 20.09.96
Aprvd 20.09.96
Used on: ML-44325/6/8/9
Drawing N°: 044320
Rev: A 20.09.96
Cat N°: 044320
Sheet 1 of 1
Name: ASSEMBLY
Next Assy: N/A

MEPROLIGHT

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



ITEM	QTY	DESCRIPTION	DWG N°	P/N	MANUF./NOTE
11	1	HOUR GTLS		T5318-1	MB
10	1	MINUTE GTLS		T5324-1	MB
9	2	12 O'CLOCK GTLS		T5255-1/IIIa	MB
8	11	HOUR GTLS		T5317-1	MB
7	1	MINUTE HAND	72442204		ADI
6	1	SECOND HAND	72442201		ADI
5	1	HOUR HAND	72442205		ADI
2	1	ADHESIVE FOIL	72443202		DL
1	1	BLUE FACEPLATE	72444250		ADI
1	1	WHITE FACEPLATE	72444260		ADI
1	1	BLACK FACEPLATE	72444280		ADI
1	1	METAL FACEPLATE	72444290		ADI

DATABASE: ..\ADI\ML-44220\420-ASSY

UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.2
Angular tolerance: ±1°
Break sharp corners-0.2

Material: N/A
Heat tratment: N/A
Finish: N/A

Design 20.09.96
Aprvd 20.09.96
Drawing N°: 044420
Cat N°: 044420

Used on: ML-44425/6/8/9
Rev: A 20.09.96
Sheet 1 of 1

N7

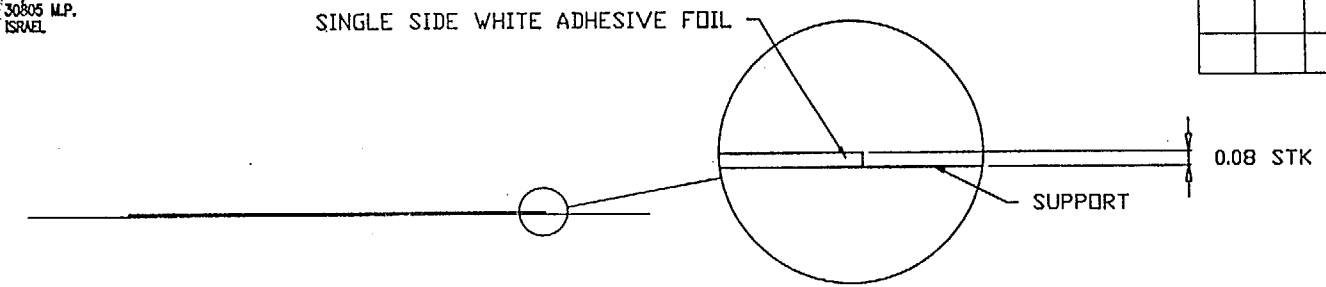
Name: ASSEMBLY
Next Assy: N/A

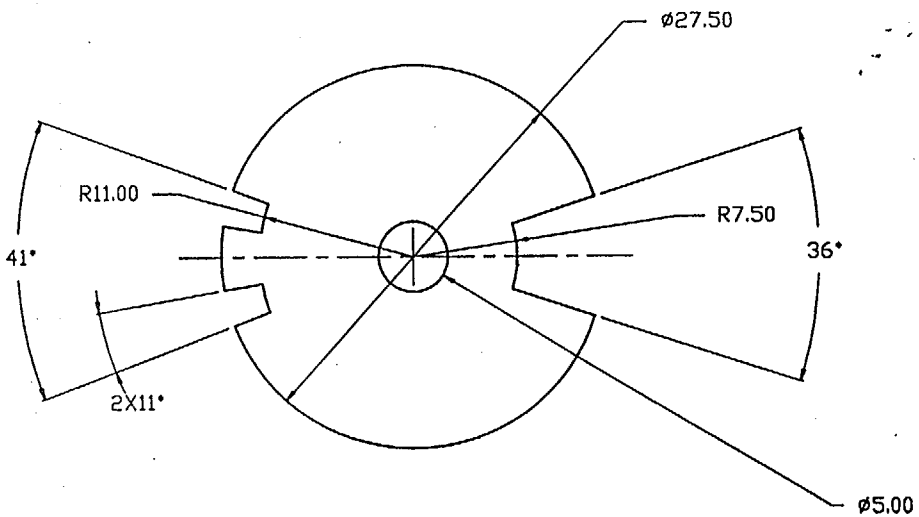
MEPROLIGHT

App W-1 -10

SCOPUS LIGHT (1990) LTD.
KIBUTZ MAAYAN ZVI, 30805 M.P.
HOF HACARMEL, ISRAEL

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



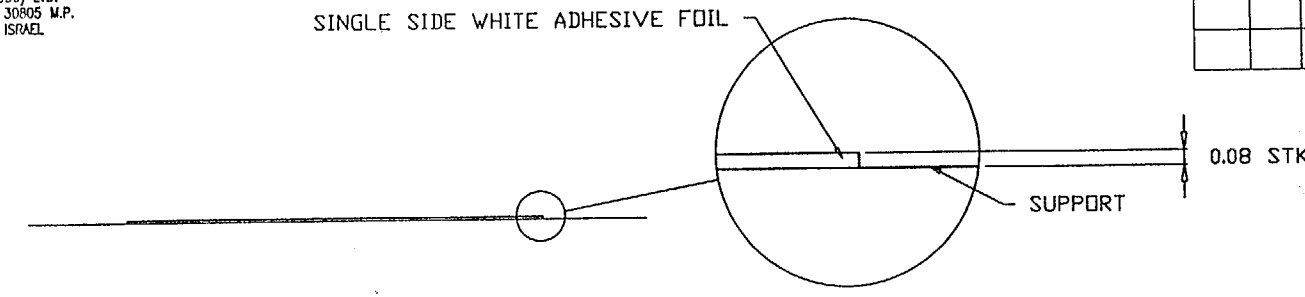


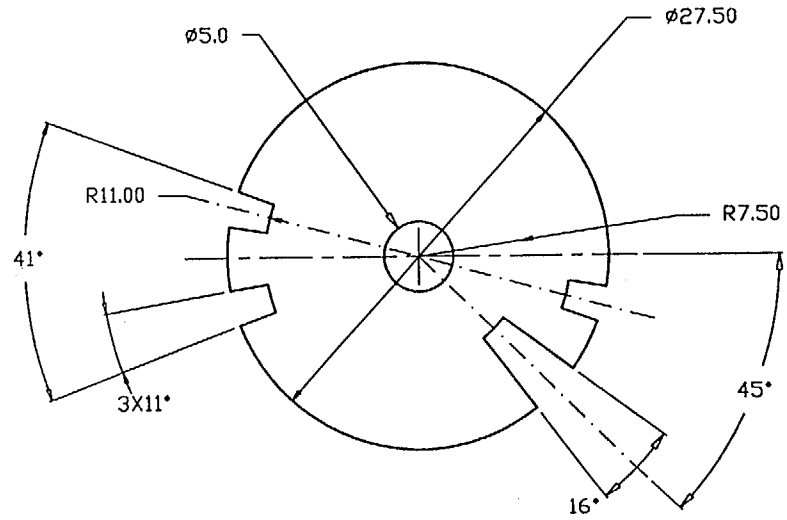
DATABASE: ..\ADI\ML-44220\MADBEKOT					
UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.2 Angular tolerance: ±1° Break sharp corners-0.2	Design	20.09.96	Used on: ML-44220 ML-44720	N7	
	Aprvd	20.09.96			
	Drawing N°: 72442202		Rev: A 20.09.96	Name: MADBEKOT	
	Cat N°: 72442202		Sheet 1 of 1	Next Assy: 044220	
Material: 3M ADHESIVE FOIL	MEPROLIGHT				
Heat tratment: N/A					
Finish: WHITE					

PROPRIETARY

SCOPUS LIGHT (1990) LTD.
KIBUTZ MAAYAN ZVI, 30805 M.P.
HOF HACARMEL, ISRAEL

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED





DATABASE: ..\ADI\ML-44220\72443202

UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.2
Angular tolerance: ±1°
Break sharp corners-0.2

Material: 3M ADHESIVE FOIL
Heat tratment: N/A
Finish: WHITE

Design	20.09.96	Used on: ML-44320 ML-44420	N7
Aprvd	20.09.96		
Drawing N°: 72443202		Rev: A 20.09.96	Name: MADBEKOT
Cat N°: 72443202		Sheet 1 of 1	Next Assy: 044320

MEPROLIGHT

App M-1-12-

Amend 2
10 June 1994
superseding
Amend 1
4 Sept 1992

INCH-POUND
MIL-W-46374F
14 OCTOBER 1991
SUPERSEDING
SEE 6.11

MILITARY SPECIFICATION

WATCH, WRIST: GENERAL PURPOSE

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

1. SCOPE.

1.1 Scope. This specification covers mechanical and mechanical/quartz wrist watches intended for general use.

1.2 Classification. Watches shall be of the following types and colors, as specified (see 6.1 and 6.3).

Types

1 – Mechanical analog, fifteen jewel, maintainable
2 – Mechanical analog
3 – Quartz analog with battery installed
4 – Quartz analog; battery out of watch but packed with watch
5 – Quartz analog; battery not included with watch
6 – Navigators

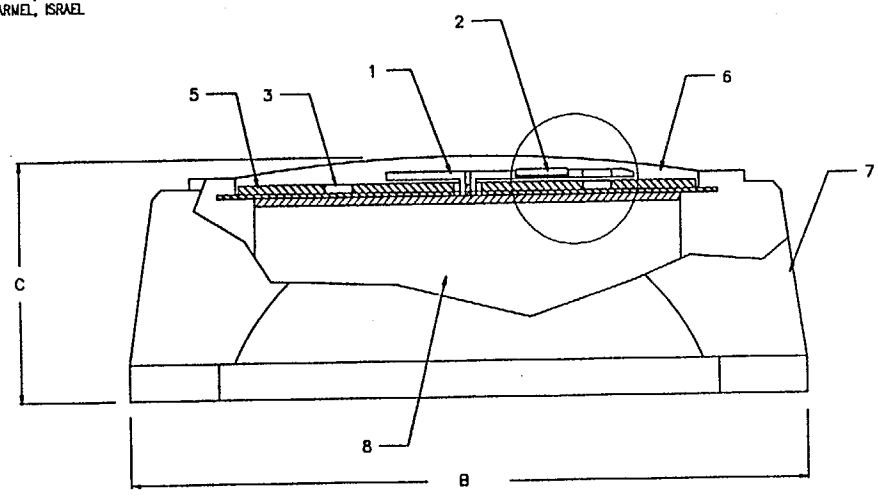
Colors

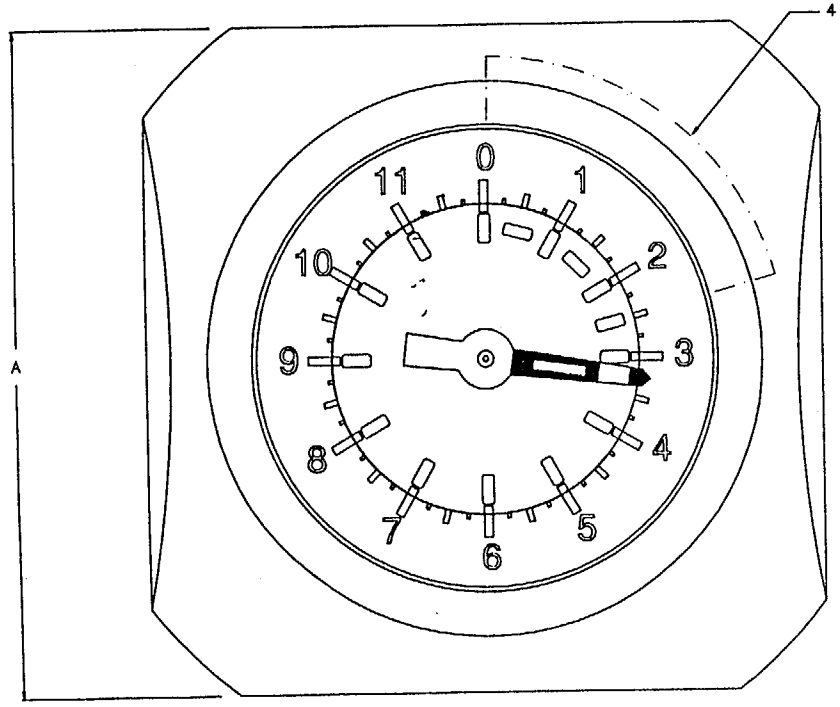
M – Silvery metallic
B – Black

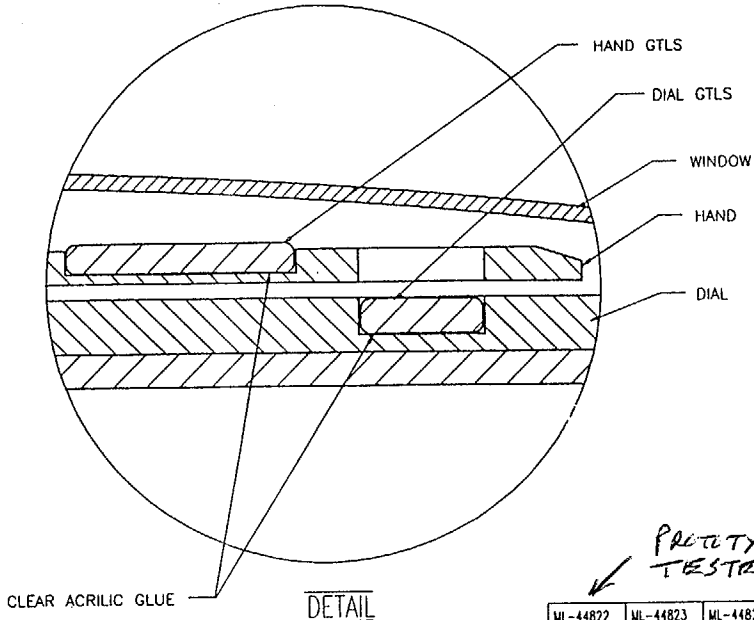
Bennificial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document, should be addressed to : Commander, U. S. Army ARDEC, ATTN: SMCAR-BAC-S, Picatinny Arsenal, New Jersey 07806-5000 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6645

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED







DETAIL

PROTOTYPE TESTED

	ML-44822	ML-44823	ML-44825	ML-4482B
A	90	64	82	90
B	90	64	82	90
C	28	30	25	28

ITEM	QTY	DESCRIPTION	DWG N°	DWG N°	DWG N°	DWG N°
8	1	PRESSURE GAUGE	PS2	PS3	PS5	PS2
7	1	POLYAMIDE HOUSING	PH2	PH3	PH5	PH2
6	1	POLYCARBONATE WINDOW	PW2	PW3	PW5	PW2
5	1	DIAL	448221	448231	448251	448221
4	6	ORANGE GTLS (12 TO 2:30)	T5255-1/IIIa	T5255-1/IIIa	T5255-1/IIIa	T5255-1/IIIa
3	9	GREEN GTLS (3 TO 11)	T5255-1/Ia	T5255-1/Ia	T5255-1/Ia	T5255-1/Ia
2	1	HAND GTLS	T5256-1a	T5274-1	T5256-1a	T5256-1a
1	1	ACRILIC HAND	448220	448230	448250	448220

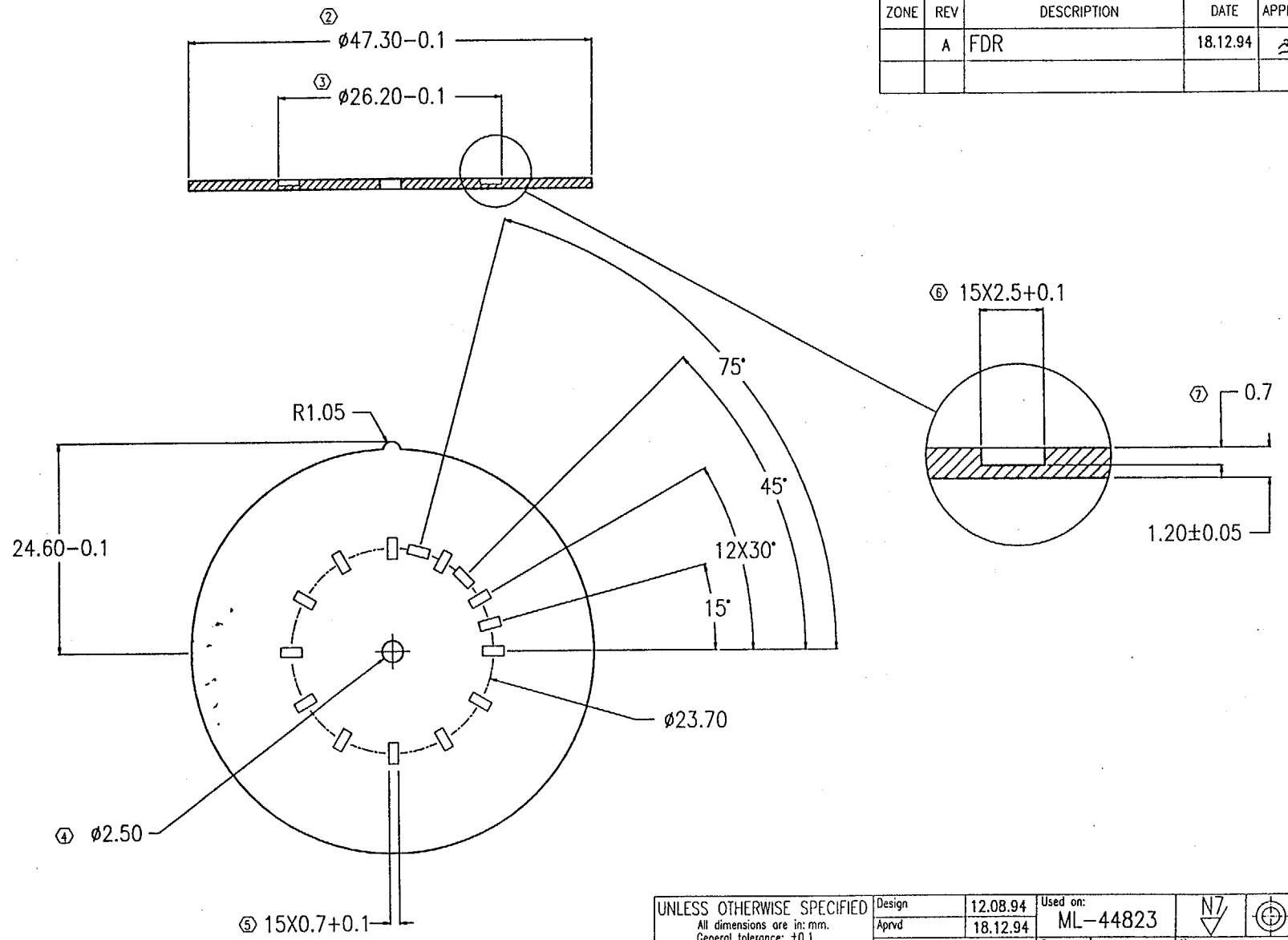
UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.1
Angular tolerance: ±1°
Break sharp corners-0.2

Material:
Heat tratment:
Finish:

Design	12.08.94	Used on: ALTIMETER	N7
Aprvd	18.12.94		
Drawing N°:		Rev:	Name:
Cat N°:		Sheet of	Next Assy:

MEPROLIGHT

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	FDR	18.12.94	ak3

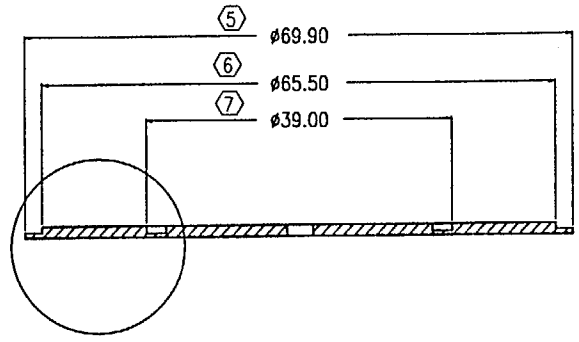


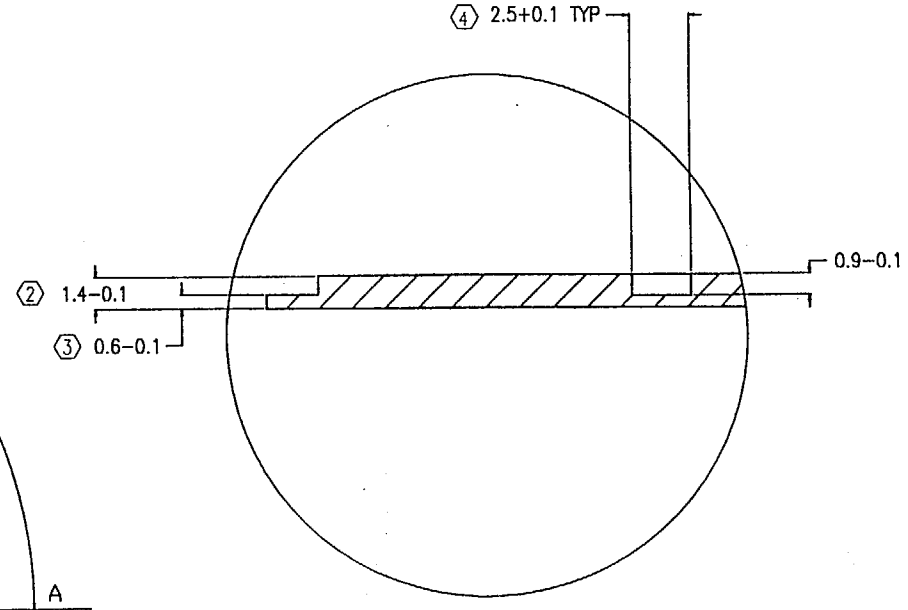
UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.1 Angular tolerance: ±1° Break sharp corners−0.2	Design	12.08.94	Used on: ML−44823	N7
	Aprvd	18.12.94		
	Drawing N°: 448231		Rev: B 29.01.97	Name: DIAL
	Cat N°: 448231		Sheet 1 of 1	Next Assy:
Material: NORYL/DELRIN WHITE				
Heat tratment:				
Finish:				

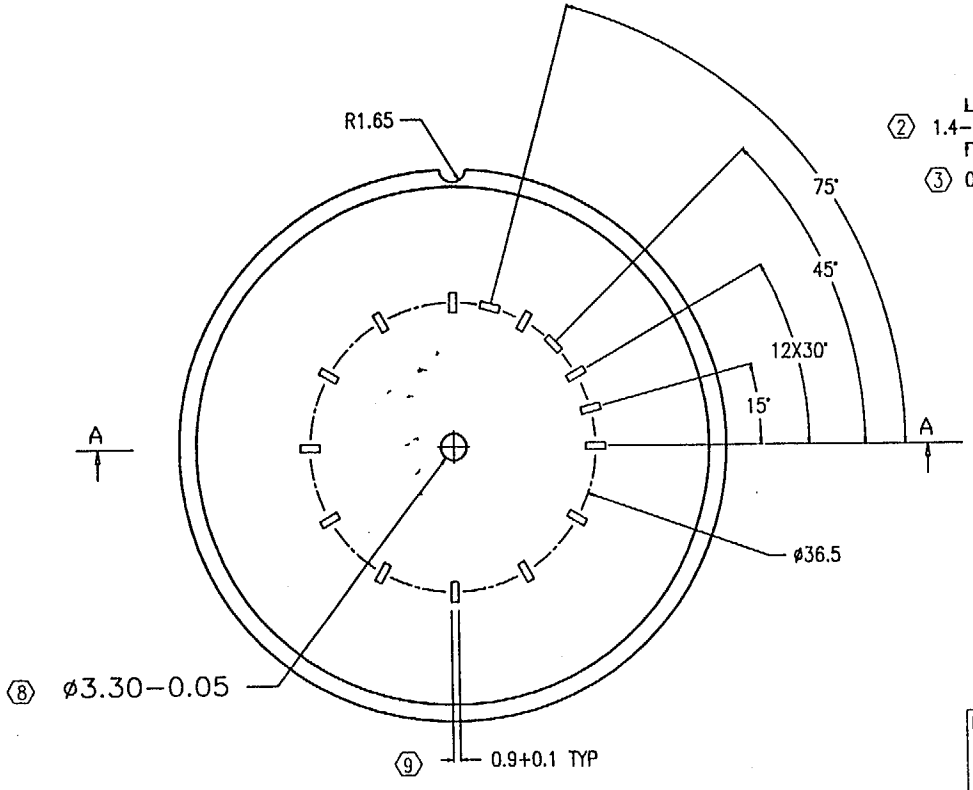
MEPROLIGHT

AHP W-1-15

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	FDR	18.12.94	



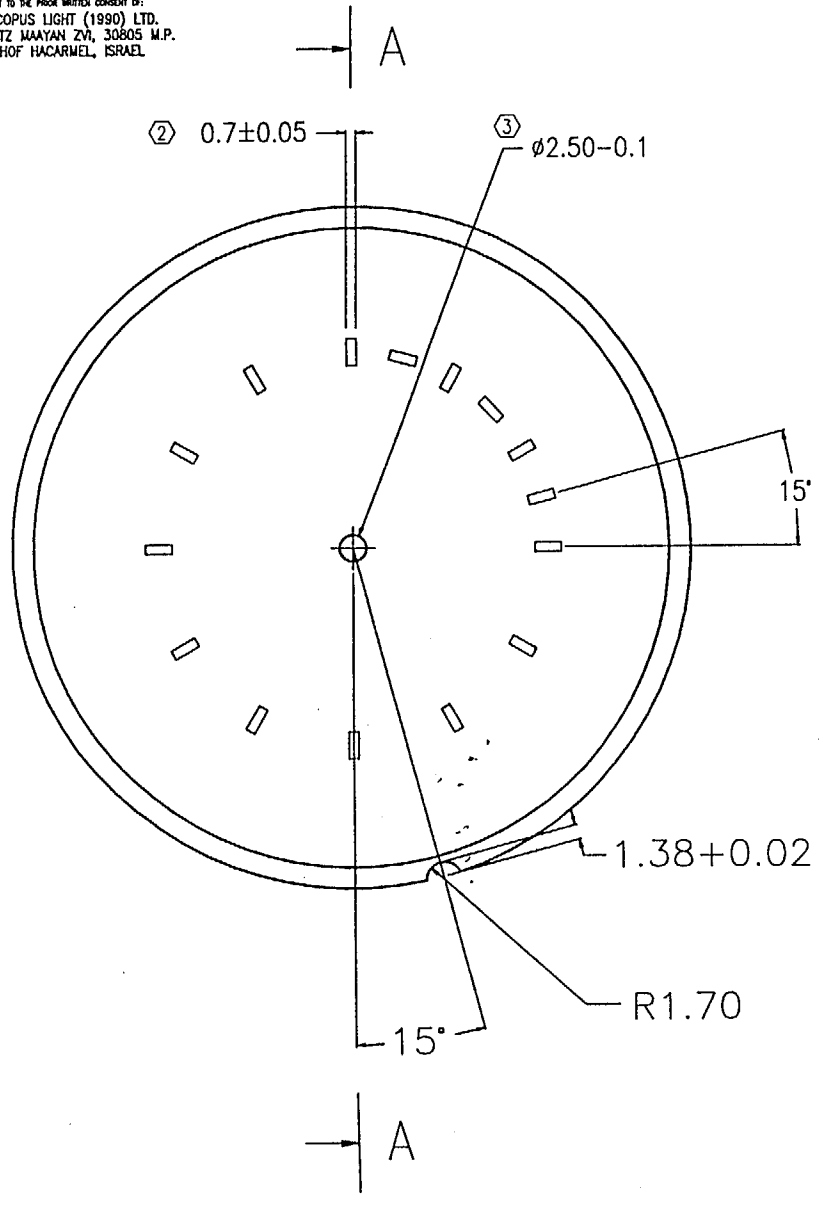


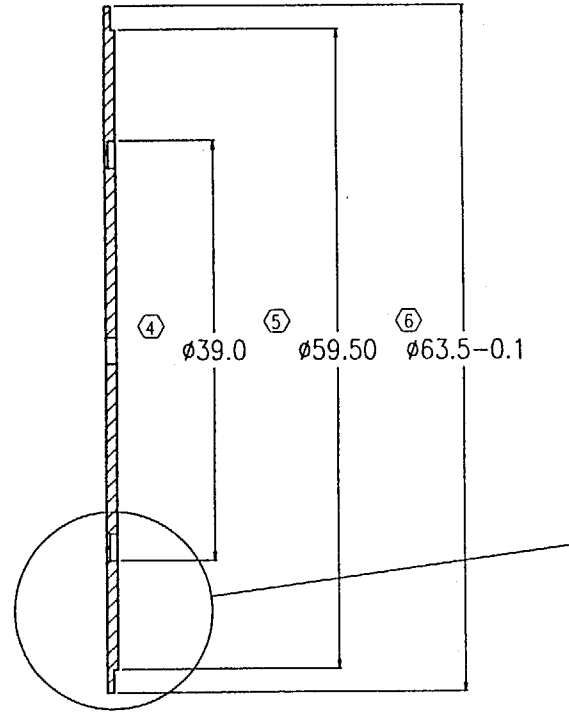


UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.1 Angular tolerance: ±1° Break sharp corners–0.2	Design	12.08.94	Used on: ML–44822/4482B	N7
	Aprvd	18.12.94		
	Drawing N°: 448221		Rev: B 29.01.97	Name: DIAL
	Cat N°: 448221		Sheet 1 of 1	Next Assy:
Material: NORYL/DELRIN/ABS WHITE	MEPROLIGHT			
Heat tratment:				
Finish:				

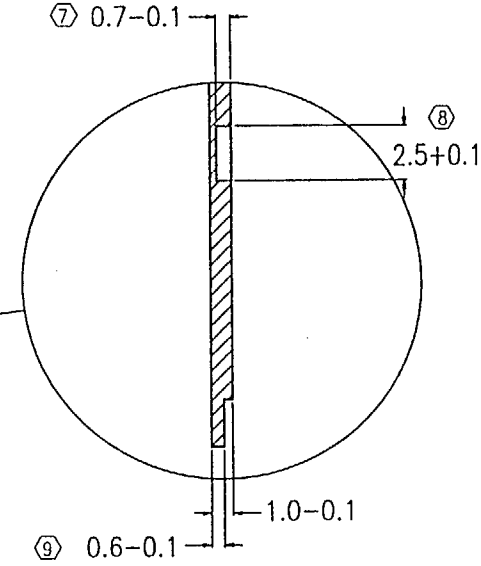
App No. 16

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED





SECTION A-A

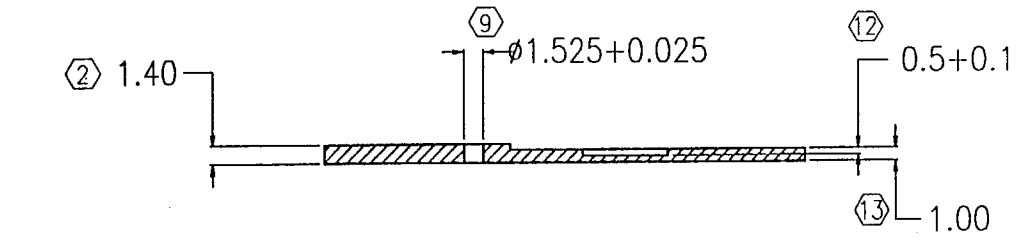


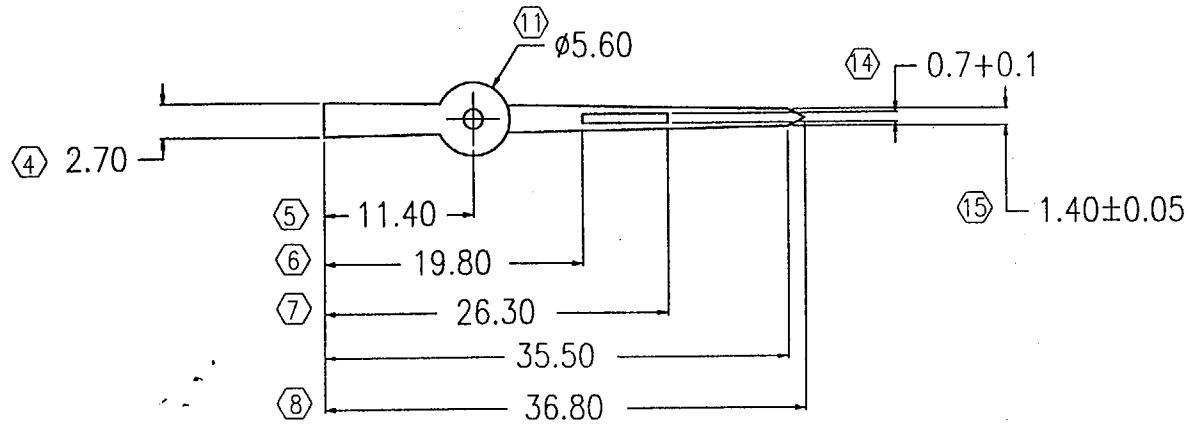
UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.1 Angular tolerance: ±1° Break sharp corners-0.2	Design	12.08.94	Used on: ML-44825	N7
	Aprvd RKS	18.12.94		
	Drawing N°: 448251		Rev: A 18.12.94	Name: DIAL
	Cat N°: 448251		Sheet 1 of 1	Next Assy:
Material: NORYL/DELRIN WHITE				
Heat tratment:				
Finish:				

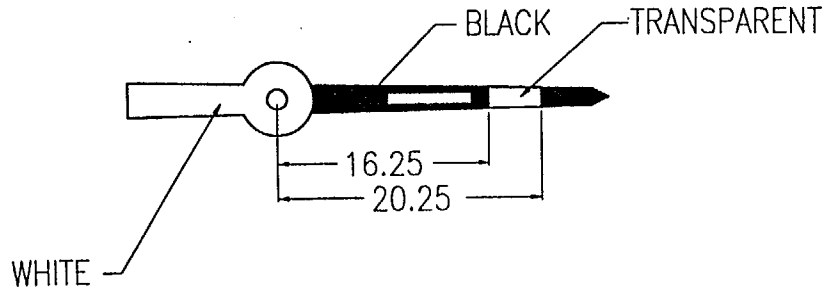
MEPROLIGHT

App no. 1-17

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	FDR	29.3.95	
	B	HOLE TO ø1.525	25.01.97	?K5





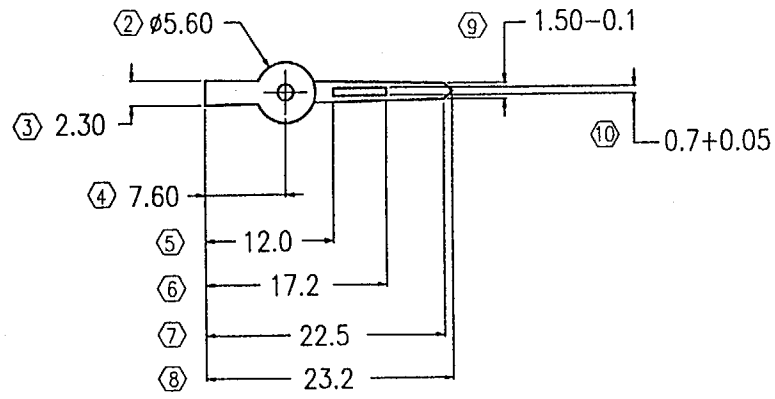


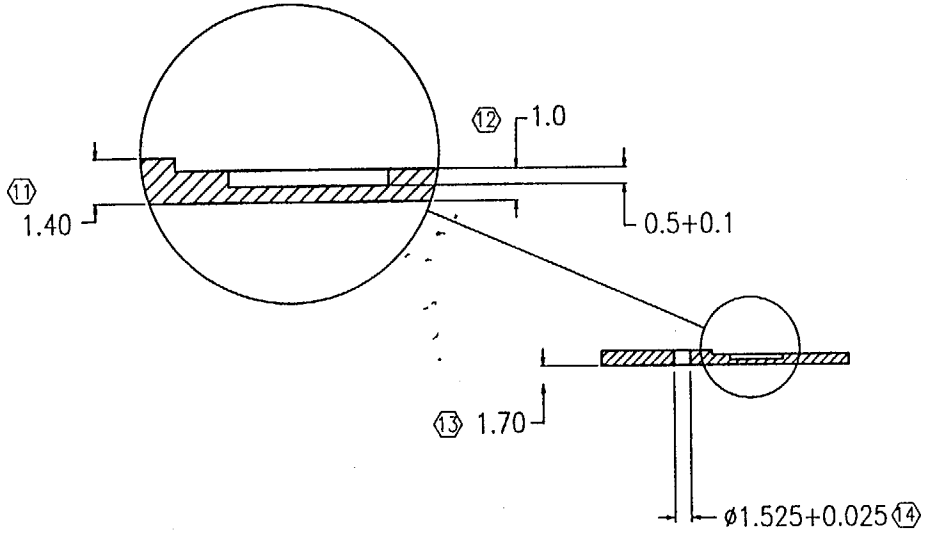
UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.1 Angular tolerance: ±1° Break sharp corners-0.2	Design	12.08.94	Used on: ML-44822/4482B	N7
	Aprvd ?K5	18.12.94		
	Drawing N°: 448220		Rev: B 25.01.97	Name: NEEDLE
	Cat N°: 448220		Sheet 1 of 1	Next Assy: N/A
Material: TRANSPARENT ACRILIC				
Heat tratment: ANNEALING				
Finish: B&W PAINT				

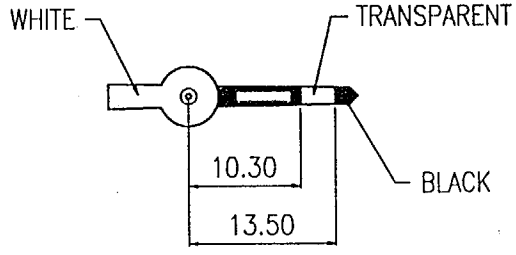
MEPROLIGHT

Appn-1-18

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	FDR	29.03.95	
	B	HOLE TO ø1.525	25.01.97	



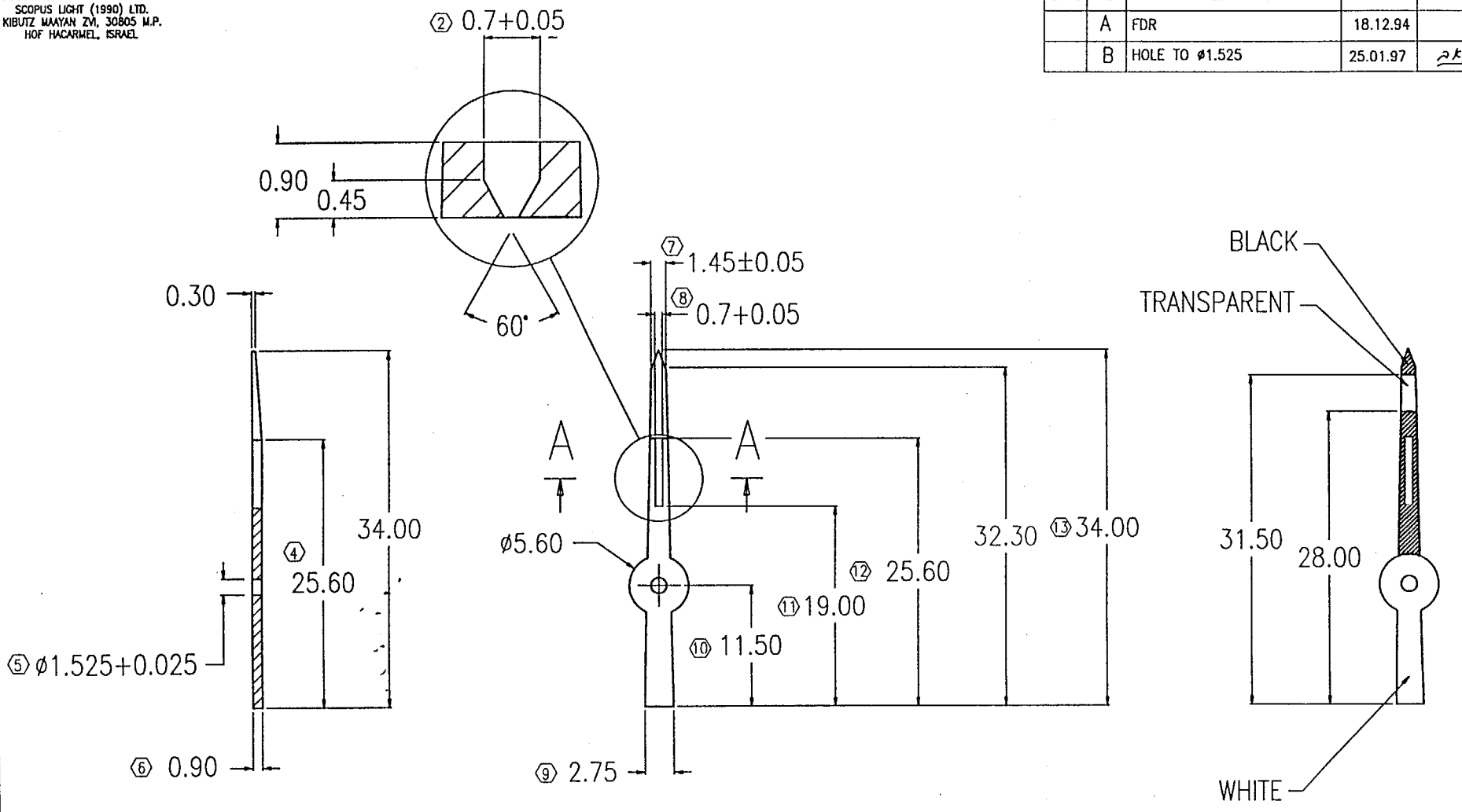




UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.1 Angular tolerance: ±1° Break sharp corners−0.2	Design	12.08.94	Used on: ML−44823	N7	
	Aprvd	18.12.94			
	Drawing N°: 448230		Rev: B 25.01.97	Name: NEEDLE	
	Cat N°: 448230		Sheet 1 of 1	Next Assy: N/A	
Material: TRANSPARENT ACRILIC Heat tratment: ANNEALING Finish: B&W PAINT	MEPROLIGHT				

App No. 14

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	FDR	18.12.94	
	B	HOLE TO ø1.525	25.01.97	



UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.1 Angular tolerance: ±1° Break sharp corners-0.2	Design	12.08.94	Used on: ML-44825	NZ
	Aprvd ZKS	18.12.94		
	Drawing N°: 448250		Rev: B 18.12.94	Name: HAND
	Cat N°: 448250		Sheet 1 of 1	Next Assy:
Material: TRANSPARENT ACRILIC				
Heat tratment: ANNEALING				
Finish: B&W PAINT				

MEPROLIGHT

App No. 1-20

SECTION I. B. Description of intended use

In personal markers, the luminous elements provide a reliable and effective means for marking and identifying an individual when he is stationary or moving on foot in the darkness. The personal marker was originally developed to help eliminate accidents caused by "Friendly Fire" in combat situations, while minimizing the risk of discovery by enemy forces. In addition, the use of the personal marker during "live fire" training exercises provides an added measure of safety to the participants. Over the past couple of years, SWAT teams and special forces units have expressed a need for these markers, as well. Both civilian and military communities benefit from this personal marker. In the case of hunters, climbers, and hikers, it is desirable and often necessary to maintain visual contact with each other while, in many cases, for law enforcement and military personnel, it is imperative to maintain this visual contact.

Since it is logistically difficult, if not impossible, to guarantee a supply of fresh batteries, and even when available they do not work well for any prolonged period of time under extreme weather conditions, the use of a tritium light source is the only reasonable solution.

SECTION II. A. Type and quantity of by-product material

All by-product material is tritium H-3 in gaseous form, sealed into borosilicate glass tubes. The sources are purchased from either mb-microtec (source configuration 400/1) or SRB Technologies, Inc (source configuration M-1).

The Personal Markers are currently listed in HESCO Registration Certificate NR-352-D-103-E. The personal markers are available in 5 configurations (1 or 2 dots, and 1, 2 or 3 bars), in a variety of colors and carry model numbers ML-417xx. Each dot is a 35 mCi source of tritium (H-3 gas); and, each bar is a 40 mCi source of tritium. Experience has shown, however, that the most widely used configuration (accounting for over 85% of the sales) is that having two bars. Therefore, distribution and storage figures are based on a marker with two sources.

SECTION II. B. Annual distribution and activity stored in one location

1. Annual Distribution

It is anticipated that 5,940 Ci in the following quantities of each of the products will be distributed yearly:

Sights -	175,000 (5,250 Ci)
Watches -	10,000 (250 Ci)
Altimeters -	1,000 (40 Ci)
Personal Markers (based on 2 sources/marker) -	5,000 (400 Ci)

2. Activity stored in one location

   Since, because of economic considerations, large quantities of items are not held in stock, but rather ordered as-needed to fill delivery requirements, an assumption is made that the number of sources stored at one time is one eighth of the yearly amount to be distributed (based on shipments arriving every month to replenish stock and fill orders). Assuming a small residual inventory on hand when a new shipment arrives, we estimate that the maximum activity to be stored at any one time will be 750 Ci.

3. Storage

   Storage will be in a room constructed of concrete block, 10 ft x 10 ft x 14 ft, and located within a larger work area of 30,000 sq ft. The room will be vented to the outside and provide a minimum air change of one change per hour. The room will be under lock control and labeled as containing radioactive materials. The larger work area has a continuous air change of once every two minutes.

SECTION III. A. Chemical and physical form

The personal markers contain H-3 gas encapsulated in borosilicate glass.

SECTION III. B. Solubility in water and body fluids

H-3 gas has a low retention in the body subsequent to inhalation; and, the skin absorption intake for H-3 in this form is relatively insignificant (NUREG/CR-0215). However, H-3 gas may be converted to tritiated water, on contact with the atmosphere, if the gas leaks from the tubes over time. Tritiated water is completely soluble in normal water and body fluids. Inhaled tritiated water is assumed to be totally absorbed in body fluids (ICRP 30).

SECTION IV. A. Construction and design (See drawings, Appendix M-I)

1. The personal marker consists of three plastic pieces and an appropriate number of tritium light sources. All 3 plastic pieces are injection molded from a polycarbonate material. They are then glued together with appropriate adhesive. The gaseous tritium light sources (GTLS), used to provide the illumination, are firmly and totally located within specially designed wells which provide protection against any possible damage. In the "dot" configuration, each source is encased in a white flexible plastic sleeve before being glued into the well. The GTLSs are totally covered, sealed and glued in place using our MV glueing system, qualified and used on all of our illuminated night sight systems.

A discussion of the model series is presented below together with a table showing maximum and minimum dimensions and source mounting configuration for each series.

The ML-417xx series covers a range of Personal Markers - 5 configurations, each in a variety of colors. They are identical in external configuration, materials and dimensions. The difference is the number of light sources (from 1 to 3) and their orientation and location within the molded polycarbonate body. Drawings for each item within the series are provided in Appendix M-1.

ML-SERIES	LENGTH	WIDTH	SOURCE MOUNTING CONFIG
4175x & 4176x	1.5 – 2"	1.25 – 1.88"	Note 1 (below)
4171x, 4172x & 4173x	1.5 – 2"	1.25 – 1.88"	Note 2 (below)

Drawings for each source mounting configuration are also provided. There are two mounting configurations. In both cases, there is a minimum of 0.5mm of hard acrylic surface protecting the visible part of the light source, with the remainder of the light source completely protected by the polycarbonate housing.

a. One configuration (ML-4175x and ML-4176x) is very similar to the TRU-DOT sights, in that the light source is inserted into a polyolefin sleeve and then inserted "on end" into a hole in the polycarbonate body, held in place by an acrylic adhesive which totally encompasses the light source.

b. The other configuration has the light sources laying flat in cavities and completely engulfed by the same acrylic adhesive.

2. <u>The complete name and address</u> of the authorized manufacturer of the items to be distributed and the authorized distributor are:

<u>Manufacturer:</u>
MEPROLIGHT, Ltd – (Scopus Light (1990) Ltd)
Kibbutz Maayan Zvi
30805, Israel

<u>Distributor:</u>
Scopus Light USA, Inc.
1 Lawton Street
Yonkers, NY 10705

SECTION IV. B. <u>External radiation levels</u>

Tritium is a pure beta emitter with a maximum energy of 0.018 MeV, average energy of 0.0057 MeV, and range of approximately 0.55 mg/cm^2. No significant external exposure is expected either from the intact sources encapsulated in borosilicate glass or the free gas. Due to the low energy of the beta, bremsstrahlung is expected to produce no significant dose.

Bremsstrahlung fraction:

$F = 3.5\ E^{-4}\ Ze$ where Z = atomic number (9 for glass)
E = maximum beta energy (0.018 MeV)

$F = 5.67\ E^{-5}$

Total energy flux for the worst cases is presented. (the three-light personal marker with 120 mCi).

Total energy flux from 120 mCi H-3 at 5 cm:

$$\phi = \frac{5.67E^{-5} \times 120mCi \times 2.22E^{9} d/m - mCi \times 0.0057MeV/d}{4\pi(5cm)(5cm)}$$

$$\phi = 275MeV/cm^{2}$$

Calculated dose rate at 5 cm:

Mass absorption coefficient for 0.018MeV gamma = 0.84 cm^2/g

D = 275 MeV/cm^2 - m x 1.6 E^{-6} erg/MeV x 0.01 g-rad/erg x 0.84 cm^2/g = 3.75 E^{-6} rad/m

H = 3.75 E^{-6} rad/m x 1 rem/rad x 60 m/hr = 0.225 mrem/hr

At 25 cm the dose rate would be 0.009 mrem/hr.

These calculations assume a bare H-3 source. In actuality, any low levels of bremsstrahlung created would be absorbed by the housing and protective MV gluing system layer of the personal markers. (NUREG/CR-0215).

SECTION IV. C. Degree of access

The design of the personal marker is similar to the gun sights with regard to protection of the sources. The sources are held in place and sealed into the polycarbonate housing with a gluing/sealing system which protects against damage and unauthorized handling of the light sources. In the "dot" configuration, each source is encased in a white flexible plastic sleeve before being glued into the well. The illuminated viewing area is covered by a clear, hard material ("MV" gluing system) of minimum thickness 0.5mm. The personal marker is designed with inherent combat safety features, the body, cover, and light blocking shield are made of polycarbonate - a rigid plastic capable of withstanding impacts. Full protection is afforded by both this outer housing assembly and the hardened glue system which encompasses the source.

SECTION IV. D. Expected useful life

The expected useful life of the personal markers is 6 years. This is the length of time in which the brightness decreases to one-half of its initial value (Reference: British Defense Standard 62-4 Issue 3).

SECTION IV. E. Proposed method of labeling

Each of the personal markers will be permanently marked with the MEPROLIGHT logo and the symbol for tritium (H-3). The combined dimensions of the logo and the tritium symbol on the marker will be 4 mm x 1 mm. The personal marker has this information integrally embossed into the rear surface of the housing as part of the molding process of the polycarbonate material.

In addition, each product has instructions for use which carry a notification that they contain tritium in sealed sources, what the activity level is, and that no attempt should be made to disassemble them. The notification will also state that the items should be returned to the authorized dealer for any corrective measures or disposal (See Appendix M-I for sight instruction sheet as example). The intent is to influence the user to return the unwanted product rather than simply discarding it. However, the warning does not imply that there is a regulatory requirement for returning these items.

SECTION V. A. Prototype testing

1. The Personal Marker was developed and underwent qualification testing in accordance with Israel Defense Forces (IDF) Development Specification (7-41040630-90/04). Design qualification and safety testing were accomplished for the IDF under the auspices of MEPROLIGHT. In addition, the Personal Marker is inspected/tested and accepted according to IDF document 118912981/101. These documents, written in Hebrew, are the property of the Israeli Military and not available for general distribution. The program included the following testing:
   a. Temperature Shock - three cycles from +80°C to -30°C, 5°C/minute temperature change with the Personnel Markers held at each of these temperatures for 1 hour.
   b. Pressure, Hi-Low - (4 half hour cycles) at two pressure settings, each 15 minutes, at -0.25 and +2.0 atmospheres.
   c. Vibration – 3 planes (10 minutes each sweep) 25 - 500 - 25 Hz at 5g, with a 30 minute dwell on any harmonic frequency found.
   d. Mechanical Shock – 6 shocks, 3 – axes, 30g, 11 milliseconds
   e. Drop – three drops from height of 2 meters - Personal Marker mounted on helmet

The program for the IDF started over 10 years ago, with the development and qualification programs being completed over a period of 3 years. Since that time, tens of thousands of these have been produced and delivered to the IDF, NATO forces, U.S. Special Forces and other military and law enforcement agencies in Europe and the Far East. . More recent sales of several thousands of pieces have been made to the British Army, French Army and U.S. Special Forces. Our Personal Marker has been assigned NATO Stock Number NSN: 8470-99-978-9972.

Drawings for the design(s) that were prototype tested are provided in Appendix M-I. It is claimed that those models not subjected to the prototype testing would pass such testing based on the following: The materials and adhesives are of identical for all models. The difference between the light sources is only in their length (and tritium activity in direct proportion). The method of attaching the light sources is different for dots (mounted in holes with only their end facing outward) and stripes (mounted in troughs with their length facing outward) but each type has been subject to the testing. Both types have the light sources mounted "below flush" and covered by a protective layer of clear optical adhesive.

The assembly has identical added built in protection, regardless of the type, by means of the polycarbonate body and a protective polycarbonate window which covers the light source area and limits accessibility to the surface under which they are located. Since the only other differences relate to the number of sources (1 or 2 for dots, 1,2 or 3 for stripes) there is no doubt that they would all pass the testing.

2. In addition to the prototype testing, First Article Testing and Inspection has been performed on several of the above Personal Markers. Details of the testing are provided below.

   a. First Article Inspection was performed on a sample taken from the first production lot, after it was subjected to and successfully completed its Factory Acceptance Testing. Inspections and tests were performed to verify manufacturing capability, proper use of materials and components, process controls, compliance of the product to specified requirements, and the validity of applicable documentation. The inspections and tests include relevant environmental tests, designed to verify that the production has been carried out in such a way as to assure the integrity of the product. A strong emphasis was placed on the continual verification that no functional degradation or safety related hazard developed during the various testing.

      1) Documentation must be furnished showing proof that all in-process and Factory Acceptance Testing has been performed successfully, that sample components of each configuration have been inspected, and that the tritium light sources have completed First Article before the Personnel Markers are presented for their First Article Inspections and Tests.

2) Contamination shall be measured on 100% of the Personnel Markers by means of a liquid scintillation system, to assure that there is no unacceptable leakage or removable radioactive contamination. The contamination test is repeated after conducting each of the environmental tests listed herein.

3) Visual/Functional shall be conducted, including geometric configuration, dimensions, cosmetics and verification that the tritium light sources are functional and that the slidable window operates correctly.

4) Brightness inspection shall be performed in a darkroom for the entire quantity to assure that they meet minimum brightness requirements. Initial brightness is allowed to fall by 10% after completion of any environmental test, but with a maximum total decrease of 15% after completion of all tests. NOTE: For the purpose of this test, brightness is defined as the photometric term meaning luminance. The brightness test is repeated after conducting each of the environmental tests listed herein.

5) Temperature Shock - The Personnel Marker shall be placed in the temperature chamber, heated in air to +80°C within 5 minutes, kept at this temperature for 1 hour, then cooled to -30°C within 15 minutes and kept at this temperature for 1 hour. This cycle shall be repeated three times.

6) Pressure, Hi-Low - The Personnel Marker shall be put into the test chamber and exposed to pressures of 0.25 and 2.0 bars (15 minutes each) for four cycles - the pressure being returned to atmospheric pressure between each period.

7) Light Leakage of the Personnel Markers shall be inspected in a dark room to assure that no light is visible with the slidable window closed.

SECTION VI. A. <u>Estimated radiation dose commitments</u>

1. Normal conditions

   a. Normal use

   Data has been extrapolated from NUREG/CR-0215 "Estimates of Potential Radiation Doses from Wristwatches Containing Tritium Gas". However, since the maximum activity per personal marker to be licensed is 120 mCi as compared to the 200 mCi used in the report, the figures cited below have been adjusted downward accordingly.

No radiation dose commitment is anticipated during normal use of the personal markers. Typically, these markers are worn on the back of a helmet (for military applications) or on the rear of a hat, or on the sleeve of a garment (for civilian applications) during night use only, such as training exercises, night emergencies or hikes. Current applications of the Personal Markers, primarily military and law enforcement personnel, places the average use at less than 10 hours per week. It is possible that the markers are not removed from the helmet, hat or item of clothing when not in use. Therefore, a more reasonable estimate of the number of hours the marker is worn should be made. Assuming that hats are worn no more than 4 hours per day (average daily time spent out doors) and that a specific piece of clothing is not worn for more than 2-3 full days during a week, it would be reasonable to assume that the personal marker is worn for around 30 hours per week. Based on this factor, the users are estimated to receive annual total-body doses of 0.006 mrem. This is well within the amount allowed by Column I, Table O.1 (32.24). The tritium gas is sealed in borosilicate glass; therefore, no inhalation or ingestion of the radioactive material is expected in normal use.

b. Storage

Storage is based on the total number of sources and not on the specific product, and therefore the calculations are shown for the total anticipated to be stored at any one time. Distilled water immersion tests on the sights and the other products indicated a leakage rate no greater than 1 E^{-5} uCi/sight in 24 hours. Based on the anticipated annual sales and monthly shipments to replenish the inventory on-hand, an assumption is made that the number of sources stored at one time is one eighth of the yearly amount to be distributed. Therefore, the expected number of sources in storage at any given time will not exceed the following:

Product and Sources Per Product	**Quantity of Product**	**Quantity of Sources**	**Sources in Storage at any given time**
Sight Sets (3 sources each)	109,000	327,000	40,875
Single sights (archery pins, fronts or optical – one source each)	66,000	66,000	8,250
Watches (17 sources each)	10,000	170,000	21,250
Altimeters (17 sources each)	1,000	17,000	2,125
Personal Markers (2 sources each)	5,000	10,000	1,250
Total Sources in Storage	-	-	**73,750**

Assuming that these 73,750 sources are stored in a 14 ft x 10 ft x 10 ft room in a 30,000 sq ft work area with an air exchange rate of 1 air change per hour, the calculated equilibrium concentration of tritium is as follows:

$$C = \frac{I}{\lambda V}$$

Where: I = rate of influx of H-3 gas
V = volume of the room
λ = air exchange rate
C = equilibrium H-3 gas concentration

I = 73,750 sources x 1 E^{-5} µCi/source-24 hr = 3.1 E^{-2} µCi/hr

V = 1400 cubic ft x 2.83 E^{4} cc/cubic ft = 3.96 E^{7} cc

$$C = \frac{3.1E^{-2}\,\mu Ci/hr}{1 air change \times 3.96E^{7} cc} = 7.8E^{-10}\,\mu Ci/cc$$

C = 7.8 E^{-7} mCi/m^3

The concentration limit set in 10CFR20 Appendix B, Table II, Column 1 for H-3 in air is 2 E^{-7} µCi/ml. Therefore, the calculated equilibrium concentration in the storage area is less than 1% of the 10CFR20 concentration limit for a controlled area.

The annual dose commitment to a warehouse worker, working in the area for 1 hour/day, 250 days/year is as follows:

Assume:

All H-3 gas is converted to tritiated water

Total rate of absorption of tritiated water into body fluids (mCi/minute) from inhalation and skin absorption is 3 E^{-2} C, where C is the concentration of tritiated water in air in mCi/ m^3 (ICRP 30)

Committed dose equivalent per unit intake of tritiated water is 1.7 E^{-11} Sv/Bq (6.3 E^{-2} rem/mCi)

Annual committed dose:

H = 7.8 E^{-7} mCi/m^3 x 3 E^{-2} mCi- m^3/mCi-minute x 60 minutes/hr x 250 hr/yr x 6.3 E^{-2} rem/mCi = 2.21 E^{-5} rem/year

H = 0.022 mrem/year

A similar type calculation in NUREG/CR-0215 "Estimates of Potential Radiation Doses from Wristwatches Containing Tritium Gas" yields a committed dose of 50 mrem from exposure to 2.5 E^{-5} μCi/cc for 24 hours or 8.3 E^{4} mrem-cc/μCi-hr. Using that factor, the annual committed dose to a warehouse worker would be:

$$H = 8.3\ E^{4}\ \text{mrem-cc/}\mu\text{Ci-hr} \times 250\ \text{hr/yr} \times 7.8\ E^{-10}\ \mu\text{Ci/cc} = 0.016\ \text{mrem/yr}$$

c. Transportation

As was the case for storage, the transportation calculation is based on the total number of sources and not on the specific product, and therefore the calculations are shown for the total number of sources to be transported. Assume a truck driver transports all products to be stored in the warehouse in a single truckload and spends a total of two hours in the trailer loading and unloading and that the truck is ventilated to produce one air change per hour.

$V = 2.9\ E^{7}$ cc (NUREG/CR-0215)

$I = 3.1\ E^{-2}$ μCi/hr

λ = 1 air change/hr

$$C = \frac{3.1E^{-2}\,\mu Ci/hr}{1 air change \times 2.9E^{7}\,cc} = 1.07E^{-9}\,\mu Ci/cc$$

Dose Commitment:

$H = 1.07\ E^{-6}$ mCi/m^3 x 3 E^{-2} mCi- m^3/mCi-minute x 2 hr x 60 minutes/hr x 6.3 E^{-2} rem/mCi $= 2.43\ E^{-7}$ rem

$H = 2.43\ E^{-4}$ mrem

d. All other situations during normal use, storage, and transportation involve smaller quantities of H-3 and/or shorter exposure times and, thus, would result in negligible dose commitment.

e. Disposal:

These products are relatively expensive items and are unlikely to be inadvertently discarded. The disposal of an item to normal trash is unlikely. Instructions accompanying the products request return of damaged or defective items to the distributor. Therefore, improper or careless disposal is unlikely to cause any significant radiation dose.

NUREG/CR-0215 estimates the dose commitment to the maximally exposed individual for burial of 500,000 tritium illuminated wrist watches per year in landfills (20,000 in a single location) to be 0.1 mrem/yr. If the sources are burned, a potential maximum dose commitment of 17 mrem/yr was estimated. The total number of items potentially disposed of in a single year would be much lower and the H-3 activity per unit considerably lower than that postulated for the study (NUREG/CR-0215). Therefore, disposal of the items will not present a radiation hazard to the general public.

2. Accident conditions

a. Use

The maximum credible accident involving the use of the personal markers is rupture of the sources and instantaneous release of the gas while being worn. Assuming that the personal marker is worn on the rear of a helmet or hat, allowing for its location, we can assume that it is approximately 40 cm from the user's breathing zone when being worn. Other locations where the marker could be worn would yield greater distances to the breathing zone.

Assume:

Total activity of the personal marker is 120 mCi of H-3 gas.
Location - 40 cm from the user's face.
Breathing zone can be represented by a cone with apex at the source and base, a 10 cm diameter circle, at the user's face.
All H-3 is converted to tritiated water instantly.
Effective half-life for tritiated water = 10 days.
Total absorption of inhaled tritium in body fluids.
Mass of soft tissue = 63,000 g (ICRP 30)

Fraction of gas released in the direction of the breathing zone:

$$F = \frac{\pi \times r \times r}{4\pi \times R \times R}$$

Where r = radius of the base of the cone
R = distance from source to nose

Maximum estimated dose commitment to user assuming all H-3 gas is converted to tritiated water:

H = 120 mCi x 0.0039 x 6.3 E^{-2} rem/mCi x 1 E^{3} mrem/rem = 29.5 mrem

For such an accidental instantaneous release, most of the gas would remain as elemental H-3. The dose commitment from H-3 gas would be approximately 1000 times less. The total estimated dose commitment would be 2% of the calculated value since up to 2% of the gas originally in the glass capsule could be in the form of tritiated water. Furthermore, a direct blow to the personal marker having enough force to break one or more of the sources in their protective housing, when mounted on the rear of a helmet or hat, being worn, would either knock the helmet/hat off of the wearer's head or (in the case of a hat) cause severe if not fatal damage to him.

b. Storage

The maximum credible accident involving storage of the units would involve a fire in the storage area which ruptures some of the borosilicate glass capsules. (A massive fire which would rupture all sources would be likely to result in immediate dispersion of the H-3 gas and dilution with outside air, thus reducing the concentrations of H-3 gas in the storage area.)

Assume:

50% of the sources in a single storage room rupture.

Immediate dispersion of the gas within the storage area.

Conversion of all H-3 gas to tritiated water.

Total rate of absorption of tritiated water into body fluids (mCi/minute) from inhalation and skin absorption is 3.2 E^{-2} C, where C is the concentration of tritiated water in air in mCi/cubic meter (ICRP 30).

$$C = \frac{750Ci}{3.96E^{7}cc} \times 0.50 = 9.47E^{-6}Ci/cc = 9.47E^{3}mCi/meter^{3}$$

Dose commitment:

H = 9.47 E^{3} mCi/cubic meter x 3 E^{-2} mCi-cubic meter/mCi-min x 6.3 E^{-2} rem/mCi
H = 17.9 rem/minute

Dose commitment to occupant remaining in enclosed area for 1 minute = 17.9 rem

Dose commitment to fireman remaining in enclosed area without respiratory protection for 2 minutes for the purpose of rescue = 35.8 rem

This calculation greatly overestimates the true dose commitments in this situation. Air currents would disperse the gas very rapidly in the case of a fire, particularly one of such severity as to rupture 50% of the sources instantaneously. In addition, only a small fraction of the H-3 gas is likely to be converted to tritiated water before venting to the outside.

A more reasonable estimate of the dose commitment would be obtained using the maximum fraction of tritiated water in the source, 0.02. If this value is used, the dose commitments become 3.6 E^2 mrem for the occupant and 7.2 E^2 mrem for the fireman.

c. Ingestion or inhalation

Ingestion or inhalation of the entire H-3 content of the largest source in a marker (40 mCi)

$H = 40 \text{ mCi} \times 6.3 E^{-2} \text{ rem/mCi} = 2.5 \text{ rem}$

Ingestion or inhalation of the entire H-3 content of all sources on the personal marker. (The greatest activity is that of the three bar model - 120 mCi.)

$H = 120 \text{ mCi} \times 6.3 E^{-2} \text{ rem/mCi} = 7.6 \text{ rem}$

These calculations assume that the entire activity of H-3 gas is converted to tritiated water. H-3 gas is not absorbed readily in body fluids and thus produces a negligible dose. These postulated accidents would require that an individual remove one or more of the sources from the product without damaging it (not possible by any known technology), swallow it, and have the source rupture while in the digestive tract. Each of these conditions is highly improbable. The combination of all three occurring is nearly impossible.

SECTION VI. B. Compliance with 10CFR32.23 and 32.24

1. Normal use and storage

No radiation dose commitment is expected in the normal use of the personal markers. The maximum expected dose commitment to workers in the storage area is less than 0.03 mrem/year. This is within the limit set in Column II, Table O.1 (32.24).

2. Accidental release of the tritium gas

   a. Under maximum credible conditions of use of the equipment, the dose commitment to an individual would not exceed 49 mrem (sights being the worst case), within the limits set in Column III, Table O.1 (32.24). In the highly improbable case where an individual ingested the contents of an entire source (personal marker being the worst case), the estimated dose commitment is 2.5 rem. This is within the limits set in Column IV, Table O.1 (32.24).

   b. Under extreme fire conditions in the storage area, the estimated maximum dose commitment to an occupant of the area is 17.9 rem; to a fireman in the process of rescue, 35.8 rem. More reasonable values, based on 2% of the H-3 gas being oxidized and remaining in the storage room, are 0.36 rem and 0.72 rem respectively. Even under the extreme conditions (extremely low probability), the dose commitment to an occupant of the storage area is only slightly greater than the limits set in Column IV, Table O.1 (32.24). Likewise, the estimated dose to a fireman engaged in rescue in that area is only around twice the limits set in Column IV, Table O.1 (32.24). However, the probability of such an event occurring and an individual entering the storage area without respiratory protection is negligible. The noxious gases that would be produced in such an event would prevent unprotected entrance. Therefore, the requirements of 32.23 are met.

SECTION VI. C. <u>Disposal of units</u>

No significant radiation dose commitment is expected to result from disposal of any of the items listed, since dispersion and dilution with the atmosphere would rapidly reduce tritium concentrations in air to background levels.

NUREG/CR-0215 estimates the dose commitment to the maximally exposed individual for burial of 500,000 tritium illuminated wrist watches, each initially containing 200 mCi, per year in landfills (20,000 in a single location) to be 0.1 mrem/yr. If the sources are burned, a potential maximum dose commitment of 17 mrem/yr was estimated. Anticipated annual sales figures for all MEPROLIGHT products are for around 200,000 per year; and, the tritium activity per product sold (worst case scenario) is only 54 mCi per sight set, 25 mCi for the watch, 40 mCi for the altimeters, and 120 mCi for the 3 light personal marker. The total annual distribution of around 6000 Ci, translated into the yearly disposal activity is only around 6% of that calculated in the study.

Therefore, with a total number of items potentially disposed of in a single year much lower and the H-3 activity per unit considerably lower than that postulated for the study (NUREG/CR-0215), disposal of the items will not present a radiation hazard to the general public.

SECTION VII. A. Quality control procedures

The manufacturer MEPROLIGHT (Scopus Light) is certified to ISO-9002 and maintains a quality system in compliance with the requirements of US Army Military Specification MIL-I-45208 as well. The following quality procedures are followed at that facility.

1. All safety and quality control procedures have been designed to comply with the requirements of the Israel Ministry of Defense and the Israel Atomic Energy Commission (License Number 6004, last renewed 22 October 1999, allowing MEPROLIGHT to manufacture with tritium sources and to have in-house, at any given time, up to 7,000 Ci of H-3).
2. Light sources are purchased only from two producers already qualified by the U.S. Military: mb-microtec and SRB technologies (as a backup alternative source). In addition to dimensional characteristics, the lights are procured with quality requirements for tritium purity, activity, brightness and color; and, they are supplied with a certificate of conformance.

   Receiving inspection of the light sources at MEPROLIGHT Ltd includes the following steps in the order listed:

   - Visual examination of packaging for any signs of external damage
   - Batch swipe test (liquid scintillation counting) to check for leakage problems
   - 100% inspection in dark-room
   - Photometric brightness measurement of dimmest samples
   - Sample subjected to dimensional inspection
   - 100% soak test (liquid scintillation counting) to check for leakage problems

   Only after satisfactory completion of receiving inspection can the sources be placed into storage or released for production.
3. All manufacturing is performed in accordance with the safety and health requirements of the Israel Atomic Energy Commission. During manufacture, all work is performed under vented hoods. Work areas are checked at regular frequent intervals for cleanliness with swipe tests counted in a Packard TRICARB Model 2300TR Liquid Scintillation Counter.

   In addition to in-process inspections and final inspections for damage, workmanship, and completeness of assembly, samples are taken at random from each day's overall production (all products) for scintillation counting to assure that there are no health hazards. These soak tests, to determine if there is any leakage, require that the samples be submerged in distilled water for 24 hours at room temperature and the water or an aliquot then counted.

4. Lot acceptance tests on the completed items are performed as stated below:
   - Sampling in accordance with MIL-STD-105E for inspection of dimensional characteristics affecting fit, function or interface; visual defects; workmanship
   - 100% testing in a dark room for comparative brightness, coupled with photometric brightness measurement of the dimmest units (to assure the required useful life of the product).
   - Batch wipe or immersion tests of all products (100%) are performed (counted for beta activity with the Packard TRICARB Model 2300TR Liquid Scintillation Counter) to check for any removable contamination. All scintillation counting results must indicate no detectable activity (less than 1 E^{-5} uCi/sq cm).
5. To afford protection from shipping or handling damage, the personal markers are packaged according to specific written instructions developed for them. Packaging is as follows:

   Personal markers will be individually packaged in heat sealed bags; and, then the items will be placed in intermediate packs for added security. These will then be case-packed for added protection and ease of shipping.
6. Mandatory quality control procedures for receiving inspection at Scopus Light USA, Inc are:

   Upon receipt, Scopus Light USA, Inc will inspect the packaging for any signs of obvious external damage.

   After unpacking, a random sample will be selected, in accordance with the sampling instructions of MIL-STD-105, Inspection Level S-4, for an AQL of 1.5%, for inspection of proper marking and labeling.

   This inspection will consist of verifying the presence of logo and tritium symbol on the markers and, in addition, verifying that they are packaged with instructions for use that carry a notification that they contain tritium in sealed sources, what the activity level is, and that no attempt should be made to disassemble them. In the event that the markers are "bulk-packed" for delivery to the military, the intermediate bulk-package must contain marking certifying the radioactive content. In addition, the bulk package must be accompanied by safety information for care and temporary storage of the markers.

   Then, after unpacking, and inspecting for marking/labeling information, Scopus Light USA, Inc will inspect 100% of the products in a dark room before release for storage and distribution. This inspection will verify that there has been no degradation in the quality of the product shipped from MEPROLIGHT, LTD (Israel).

   In addition, Scopus Light USA, Inc will assure that each shipment is accompanied by a certificate of conformance attesting to the acceptability of the products.

SECTION VIII. A. Record keeping

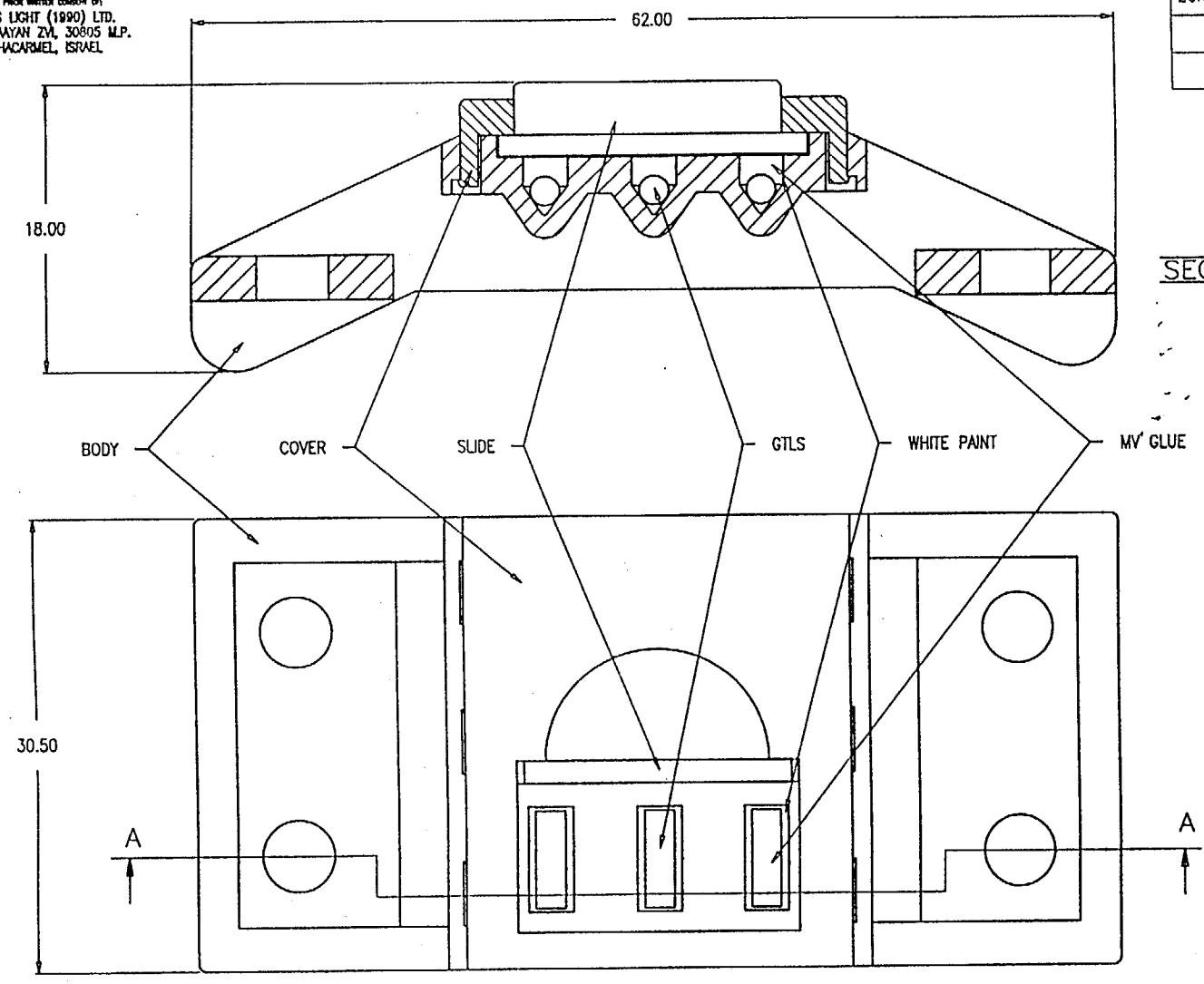
All records will be kept in accordance with the requirements of 10CFR32.25 and the New York State (NYCH) "Rules and Regulations for Radioactive Materials".

1. Records will be kept of the number of units of each type, type and the total quantity of by-product material transferred.
2. Reports will be filed with the U.S. N.R.C. as required by 10CFR32.25(c)(2) and as required by the State of New York.
3. The U.S. N.R.C. will be notified if Scopus Light USA, Inc. discontinues the activities covered by this license application.

APPENDIX M-I

PERSONAL MARKER INFORMATION

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



SECTION A–A

* ML-41720 ORIGINAL Z-BAR MODEL USED FOR IDF QUALIFICATION AND PROTOTYPE TESTING

** ML-41730 PROTOTYPE TESTED FOR FAR EAST CUSTOMER

MATERIALS	
BODY COVER SLIDE	SAND BLASTED POLYCARBONATE REINFORCED WITH 30% FIBER GLASS COLOR OLIVE GREEN
GTLS (LIGHT SOURCE)	BOROSILICATE GLASS
WHITE PAINT	EPOXY TPC-250
MV GLUE	TRANSPARENT ACRYLIC

CONFIGURATION TABLE

	GREEN	BLUE	ORANGE	WHITE	
**	ML-41730	ML-41734	ML-41733	ML-41735	3 BARS
*	ML-41720	ML-41724	ML-41723	ML-41725	2 BARS
	ML-41710	ML-41714	ML-41713	ML-41715	1 BAR

UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.1
Angular tolerance: ±1°
Break sharp corners-0.2
Material:
Heat tratment:
Finish:

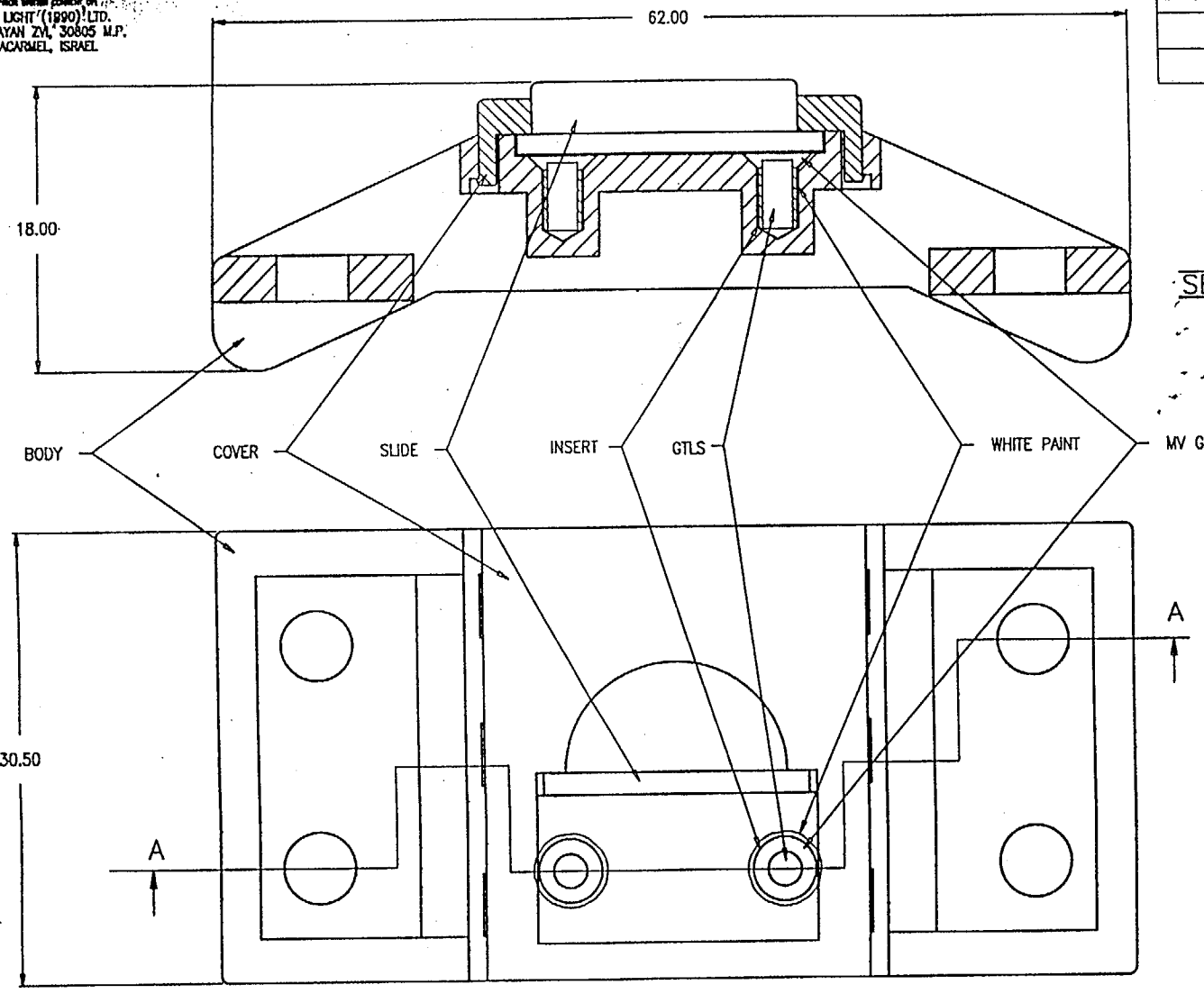
Design	03.04.86	Used on:	
Aprvd	05.04.86	ML-4170X/4173X	
Drawing N°: 603ASSY		Rev: A 05.08.94	Name: ASSEMBLY
Cat N°: 417510/417535		Sheet of	Next Assy:

MEPROLIGHT

1-W-004

SCOPUS LIGHT (1990) LTD.
KIBUTZ MAAYAN ZVI, 30805 M.P.
HOF HACARMEL, ISRAEL

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



SECTION A–A

MATERIALS	
BODY COVER SLIDE	SAND BLASTED POLYCARBONATE REINFORCED WITH 30% FIBER GLASS COLOR OLIVE GREEN
GTLS (LIGHT SOURCE)	BOROSILICATE GLASS
INSERT	POLYOLEPHIN
WHITE PAINT	EPOXY TPC–250
MV GLUE	TRANSPARENT ACRYLIC

CONFIGURATION TABLE

GREEN	BLUE	ORANGE	WHITE	
ML–41760	ML–41764	ML–41763	ML–41765	2 DOTS
ML–41750	ML–41754	ML–41753	ML–41755	1 DOT

UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.1
Angular tolerance: ±1°
Break sharp corners–0.2
Material:
Heat tratment:
Finish:

Design	03.04.86	Used on: ML–4175X/4176X	N7
Aprvd	05.04.86		
Drawing N°: 653ASSY		Rev: A 05.08.94	Name: ASSEMBLY
Cat N°: 417550/417565		Sheet 1 of 1	Next Assy:

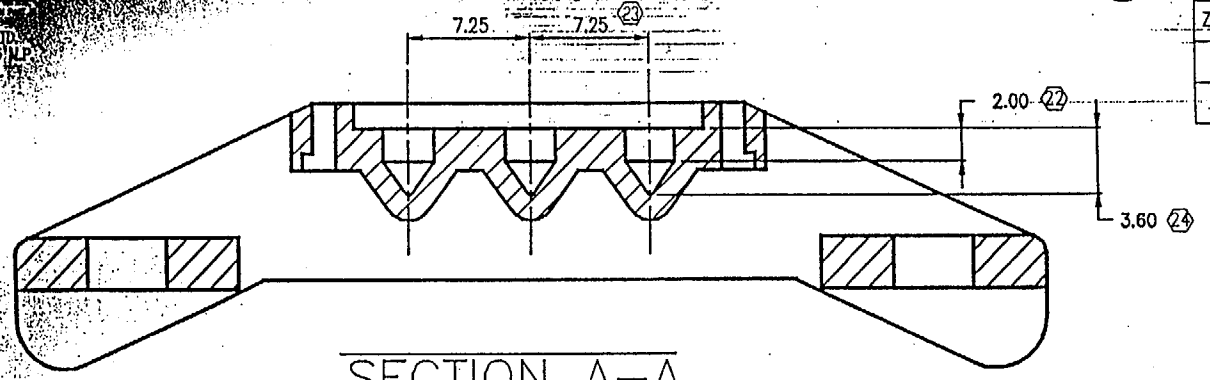
MEPROLIGHT

HAP M-1-2

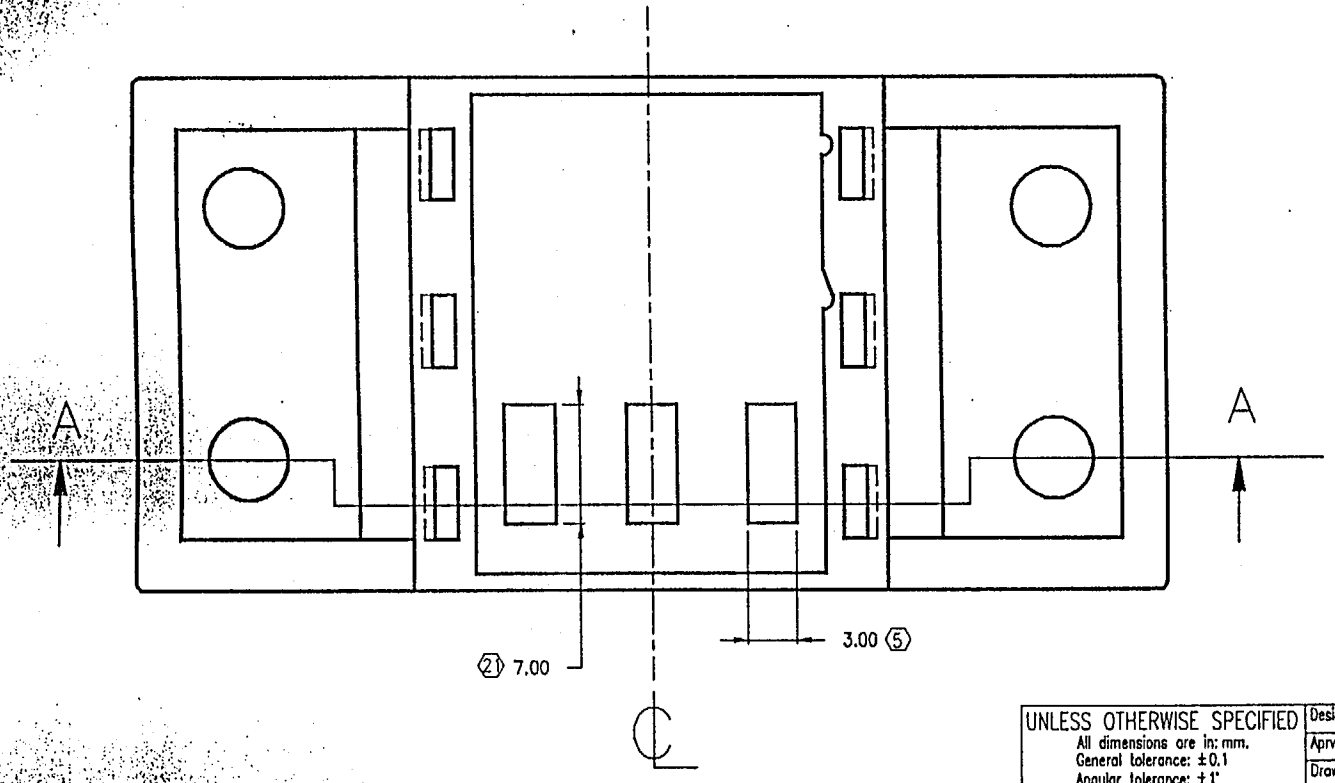
PROPRIETARY

MEPROLIGHT (1990) LTD.
KIBUTZ NAHSHOLIM 30805 ISRAEL
HOFIT HACARMEL ISRAEL

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED



SECTION A–A



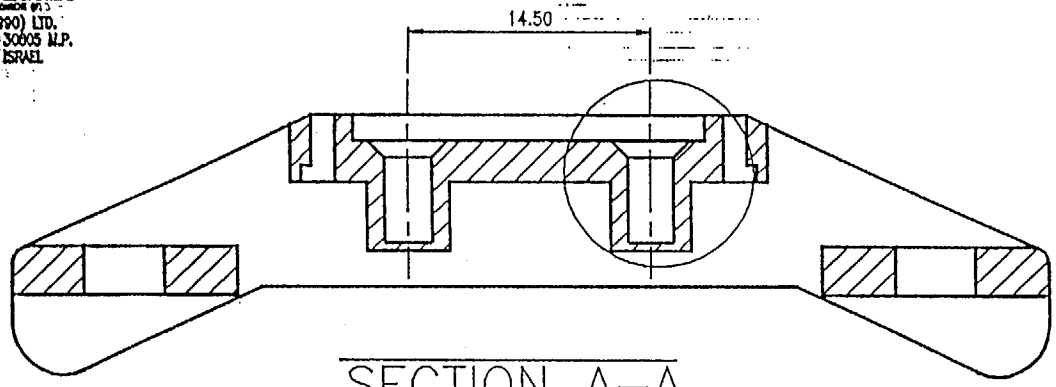
NOTE:
ALL OTHER DIMENSIONS AS PER DRAWING 716001 REV. A DATE 27.09.93
CATALOGUE NUMBER OF BODY WITH TWO (2) BARS: 714162
CATALOGUE NUMBER OF BODY WITH ONE (1) BARS: 714161

UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.1 Angular tolerance: ±1° Break sharp corners-0.2	Design	03.04.86	Used on: ML-4160XX	N7	
	Aprvd AE3	05.04.86			
	Drawing N°: 714163		Rev: A 05.08.94	Name: BODY	
	Cat N°: 714163		Sheet of	Next Assy: 603ASSY	
Material: GE LEXAN 503R 33252					
Heat tratment:					
Finish: BLAST–OLIVE GREEN					

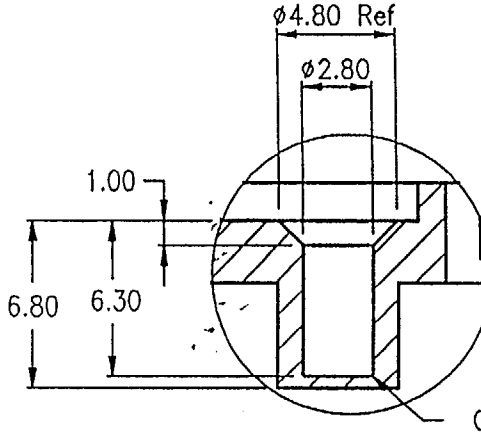
MEPROLIGHT

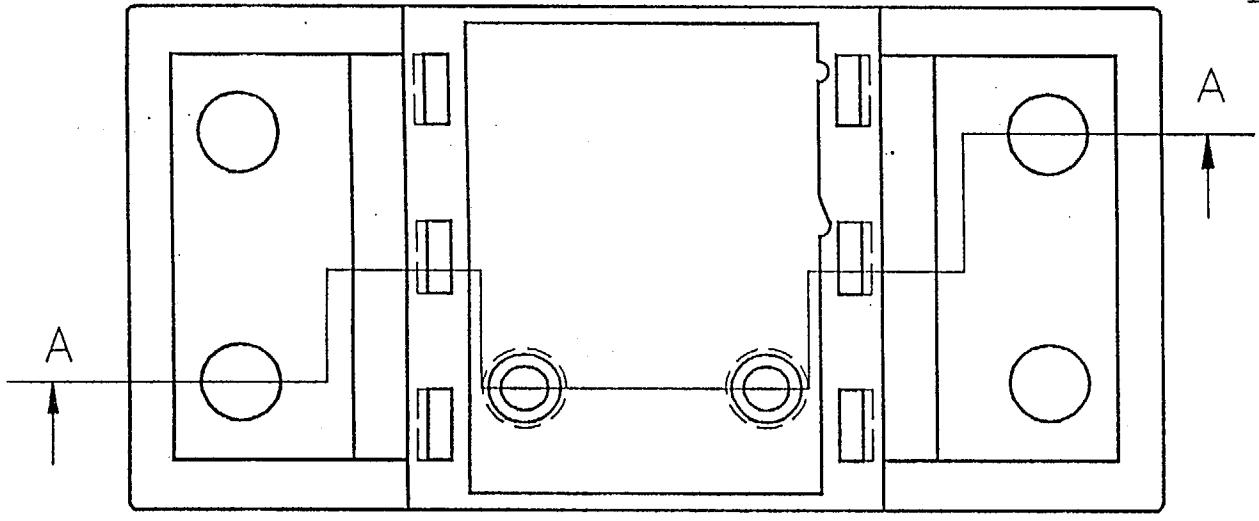
A00 n-1 -3

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



SECTION A–A



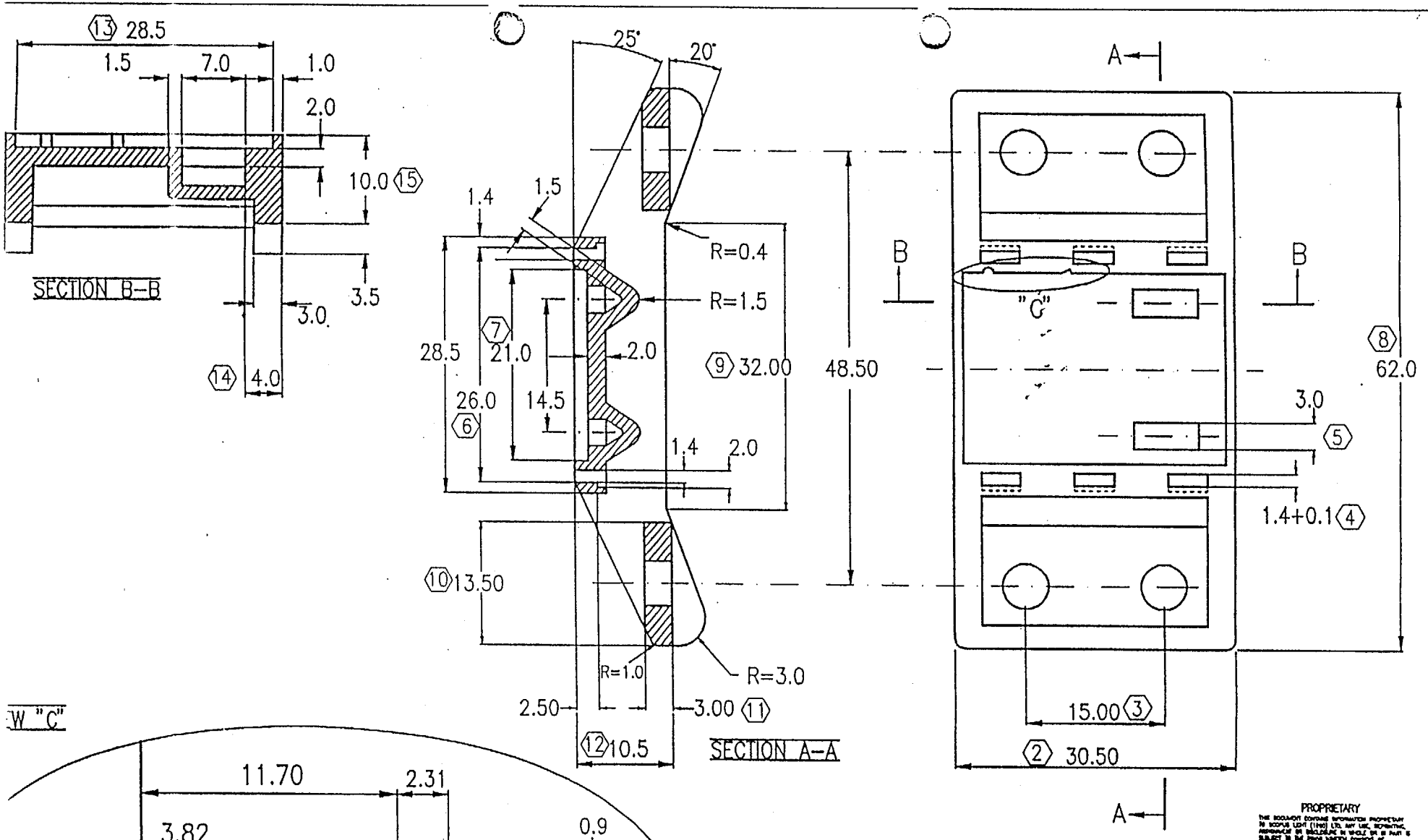


NOTE:
ALL OTHER DIMENSIONS AS PER DRAWING 716001 REV. A DATE 27.09.93
CATALOGUE NUMBER OF BODY WITH ONE (1) HOLE IS: 714165

UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.1 Angular tolerance: ±1° Break sharp corners-0.2	Design	03.04.86	Used on: ML-4165XX	N7	
	Aprvd	05.04.86			
	Drawing N°: 714167		Rev: A 05.08.94	Name: BODY	
	Cat N°: 714167		Sheet of	Next Assy: 653ASSY	
Material: GE LEXAN 503R 33252					
Heat tratment:					
Finish: BLAST – OLIVE GREEN					

MEPROLIGHT

ADD M-1-4



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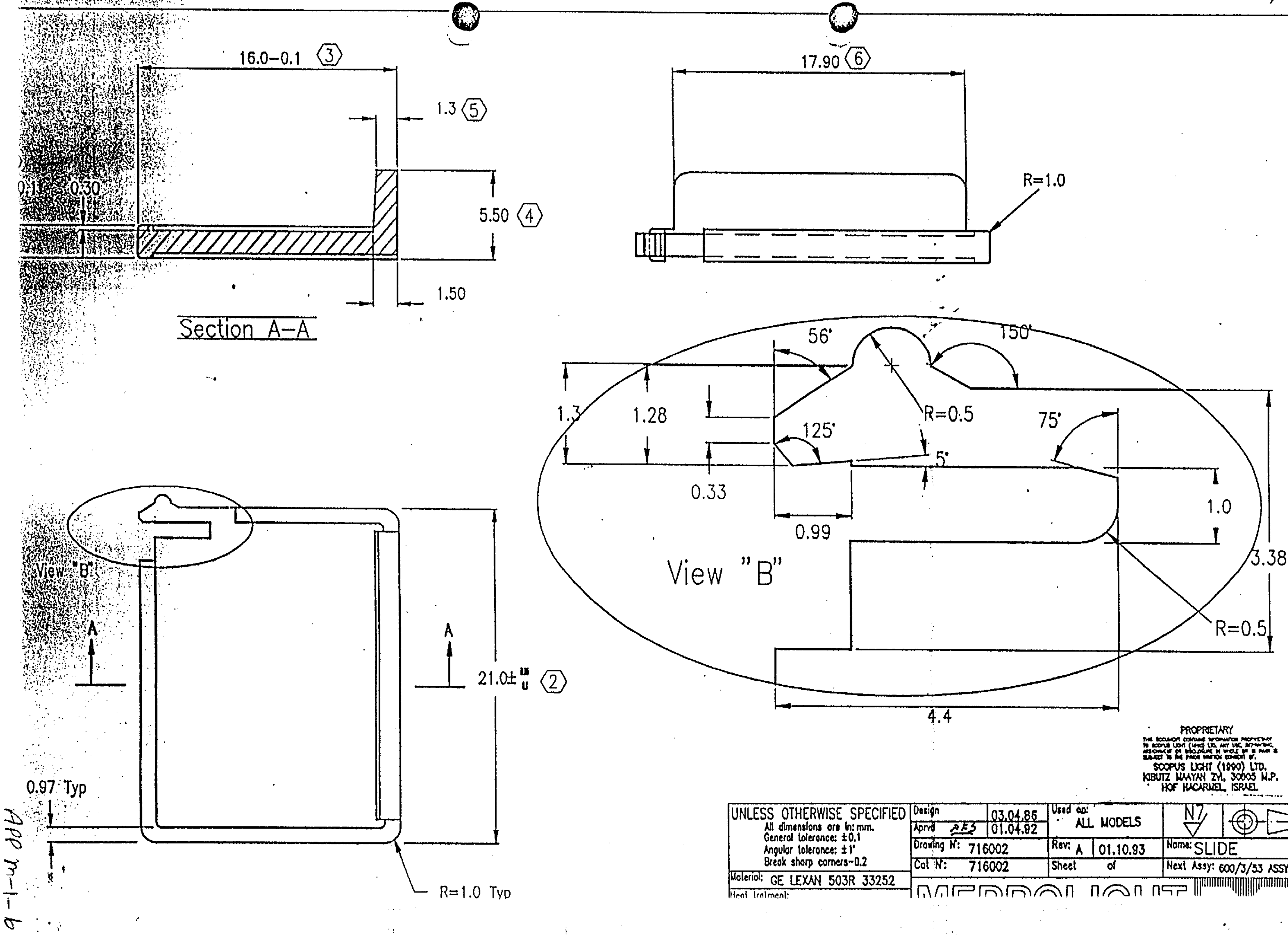
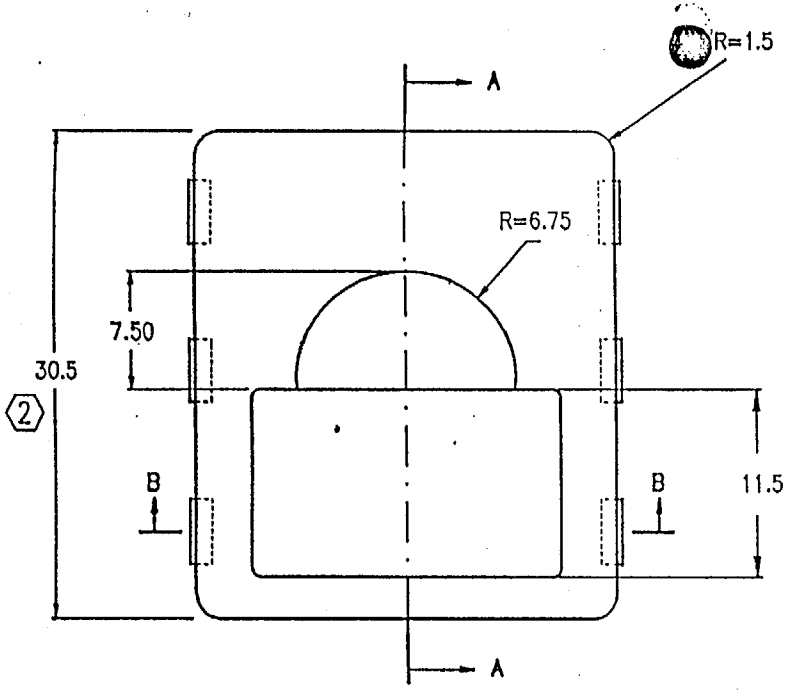
KIBUTZ MAAYAN ZVI, 30805 M.P.
HOF HACARMEL, ISRAEL

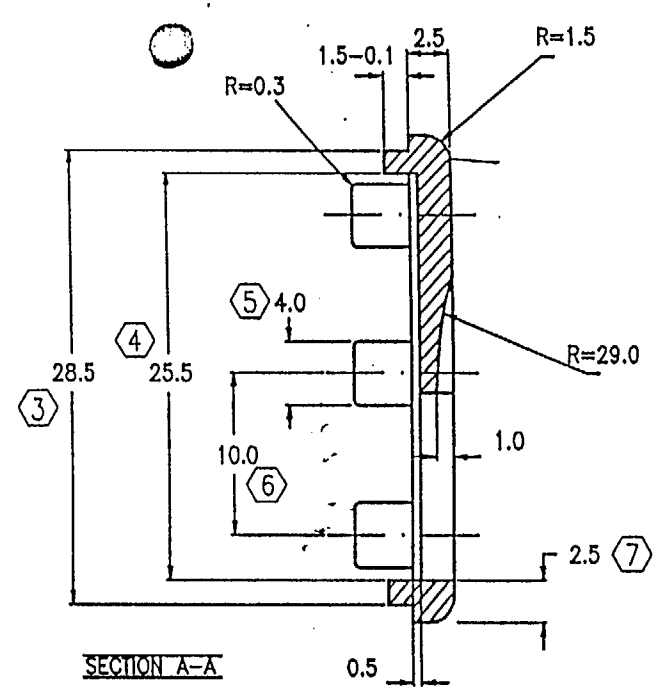
41980/3

UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.1 Angular tolerance: ±1° Break sharp corners-0.2	Design	03.04.86	Used on: ML-41600/3	N7
	Aprvd	01.04.92		Name: BODY
	Drawing N: 716001		Rev: A 27.09.93	
	Col N: 716001		Sheet of	Next Assy: 600ASSY
Material: GE LEXAN 503R 33252				
Heat tretment:				
Finish: BLAST-OLIVE GREEN				MEPROLIGHT

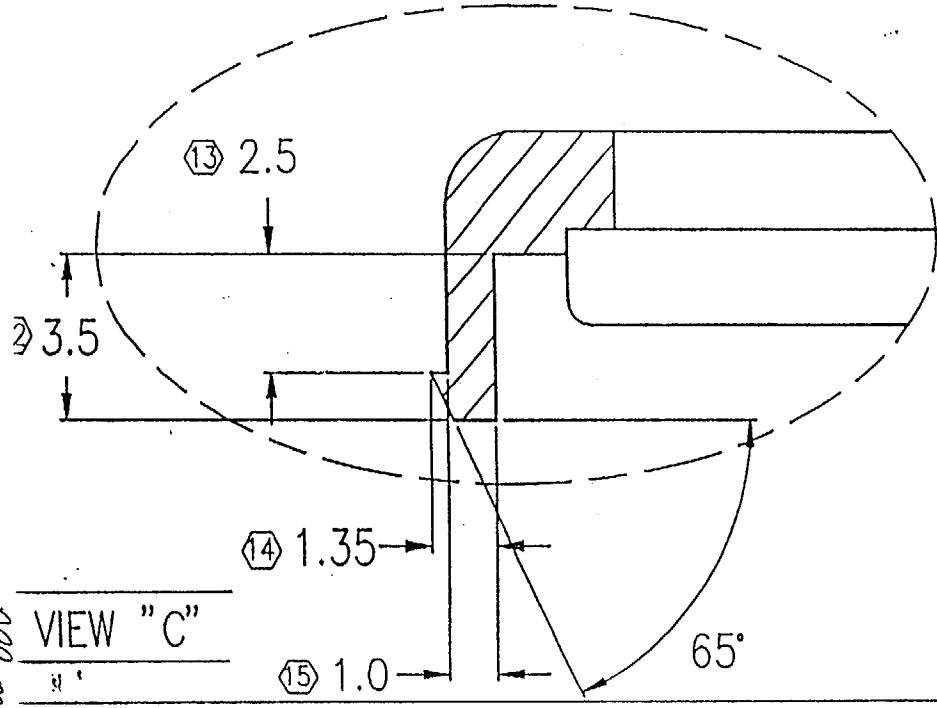
APP M-1-5


16.0-0.1 ⟨3⟩
1.3 ⟨5⟩
0.30
5.50 ⟨4⟩
1.50
Section A-A
17.90 ⟨6⟩
R=1.0
56'
150'
1.3
1.28
R=0.5
125'
75'
5'
0.33
0.99
1.0
View "B"
3.38
R=0.5
4.4
View "B"
A
A
21.0± ⟨2⟩
0.97 Typ
R=1.0 Typ
PROPRIETARY
SCOPUS LIGHT (1990) LTD.
KIBUTZ MAAYAN ZVI, 30805 M.P.
HOF HACARMEL, ISRAEL
UNLESS OTHERWISE SPECIFIED
All dimensions are in: mm.
General tolerance: ±0.1
Angular tolerance: ±1'
Break sharp corners-0.2
Material: GE LEXAN 503R 33252
Heat treatment:
Design 03.04.86
Aprvd 01.04.92
Used on: ALL MODELS
N7
Drawing N: 716002
Rev: A 01.10.93
Name: SLIDE
Cat N: 716002
Sheet of
Next Assy: 600/3/53 ASSY
App M-1-b

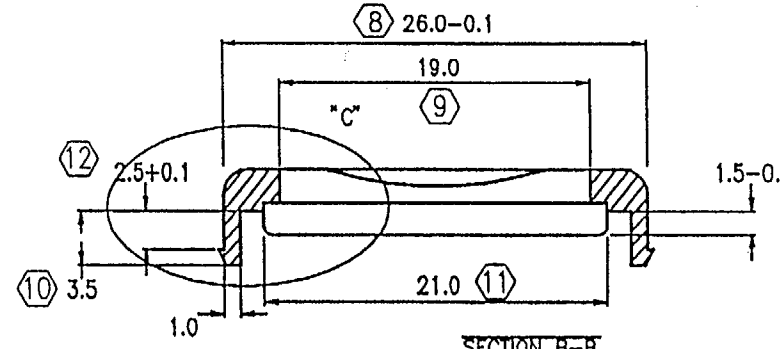




SECTION A–A



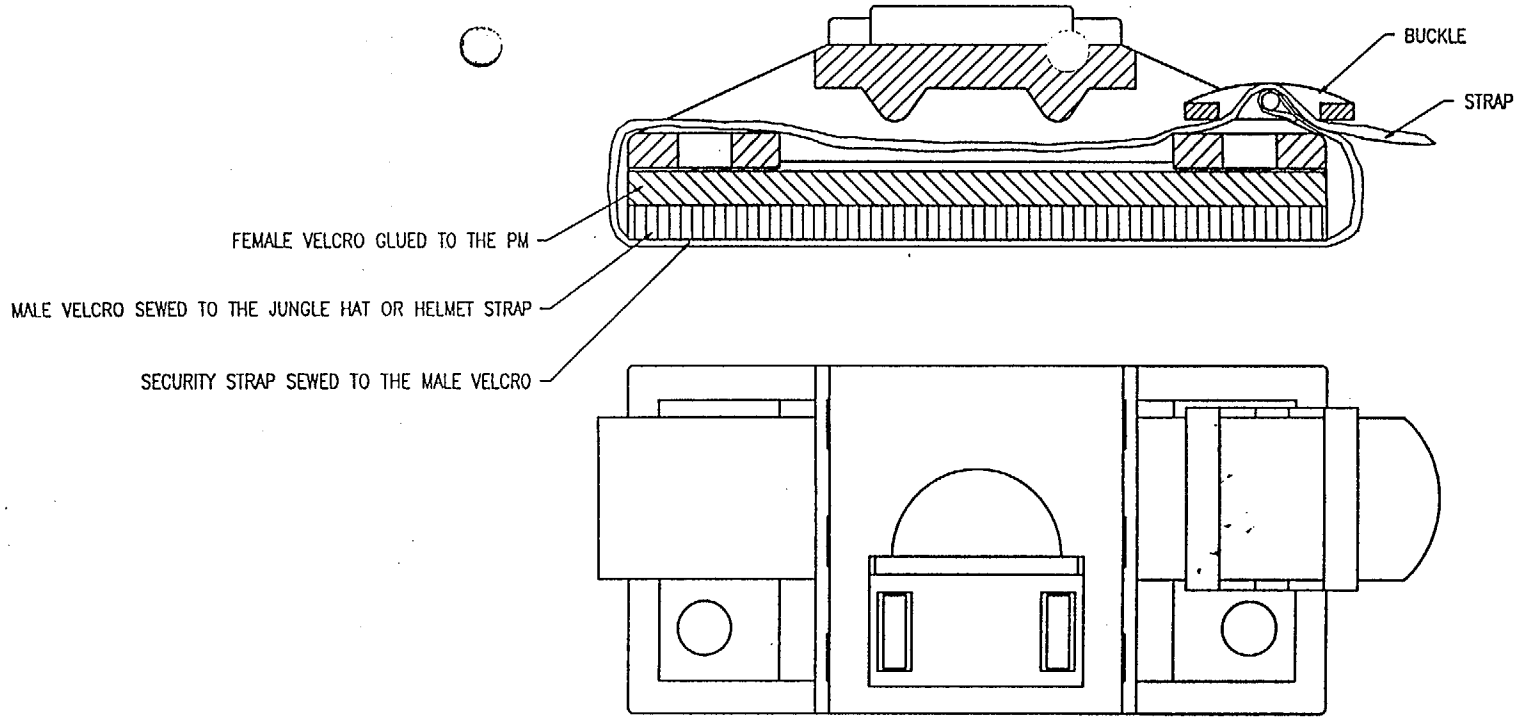
VIEW "C"

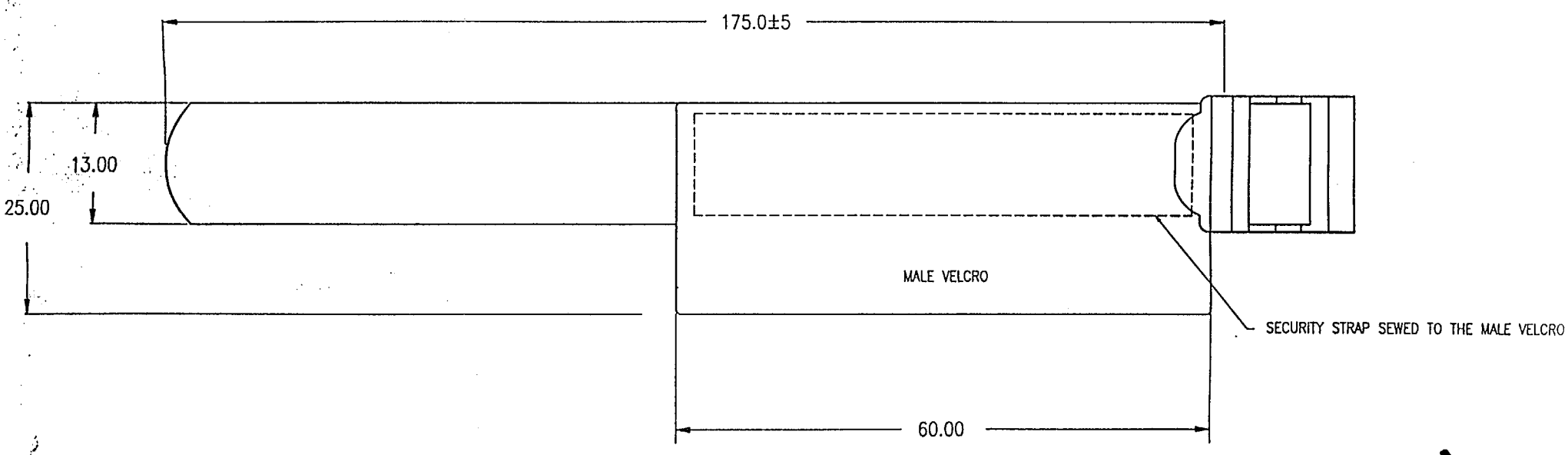


SECTION B–B

UNLESS OTHERWISE SPECIFIED All dimensions are in: mm. General tolerance: ±0.1 Angular tolerance: ±1° Break sharp corners–0.2	Design	03.04.86	Used on: ALL MODELS	N7
	Aprvd	01.04.92		
	Drawing N°: 716003		Rev: A 04.10.93	Name: COVER
	Cat N°: 716003		Sheet of	Next Assy: 600/3/53 ASSY
Material: GE LEXAN 503R 33252				
Heat tratment:				
Finish: BLAST–OLIVE GREEN				

MEPROLIGHT


BUCKLE
STRAP
FEMALE VELCRO GLUED TO THE PM
MALE VELCRO SEWED TO THE JUNGLE HAT OR HELMET STRAP
SECURITY STRAP SEWED TO THE MALE VELCRO


175.0±5
13.00
25.00
MALE VELCRO
SECURITY STRAP SEWED TO THE MALE VELCRO
60.00

MEPROLIGHT

FedEx International Air Waybill

Customs Copy

1 From

Date 07 02 2000 Sender's FedEx Account Number 1433-2680-2

Sender's Name (26843) Phone 06-6395062

Company T.I.P. MEPROLIGHT

Address M.P. HOF HACARMEL

MA'AYAN ZVI 30805

MA'AYAN ZVI, ISRAEL ZIP Postal Code 30805

2 Your Internal Billing Reference

3 To

Recipient's Name Mr. John Jankovich Phone 301-415-7904

Company US NUCLEAR REGULATORY COMMISSION (NRC)
Materials Safety Branch
Division of Industrial & Medical Nuclear Safety, NMSS
Source Containment and Dept./Floor
Devices Branch
Sealed Source Safety Section

City Two White Flint North, State Province
11545 Rockville Pike
North Bethesda, MD 50852 ZIP Postal Code MD 50852
USA

Country

Recipient's Tax I.D. number for Customs purposes
e.g., GST/RFC/VAT/IN/EIN, or as locally required

208
Washington DC
20555

4 Shipment Information

Total Packages (Shipper's Load and Count/SLAC) 1 Total Weight 2 1/2 lbs. ☐ kg ☒ DIM L / W / H in. ☐ cm ☐

☐ For EU Only: Tick here if goods are not in free circulation and provide C.I.

All shipments can be subject to Customs charges.†

Commodity Description	Harmonized Code	Country of Manufacture	Value for Customs
DOCUMENTS		Israel	$20.00
			U.S.D.

For U.S. Export Only: Check One
☐ No SED required per Exemption
☐ No SED required, value $2500 or less per Schedule B Commodity number

Total Declared Value for Carriage N.V.D.

Total Value for Customs (Specify Currency) 20 $

☐ SED attached (provide export license no. and exp. date or license exception symbol, w/ECCN if applicable) USD

5 Express Package Service

Packages up to 150 lbs. / 68 kg
For packages over 150 lbs. (68 kg), use the FedEx Expanded Service Intl. Air Waybill.

Not all services and options are available to all destinations.

1 ☒ FedEx Intl. Priority
6 ☐ FedEx Intl. First — Available to select locations. Higher rates apply.
☐ ☐
3 ☐ FedEx Intl. Economy — FedEx Envelope/Letter and FedEx Pak rate not available

6 Packaging

These unique brown boxes with special pricing are provided by FedEx for FedEx Intl. Priority only.

6 ☐ FedEx Envelope/Letter 2 ☐ FedEx Pak 1 ☒ Other Pkg. — Includes FedEx Box, FedEx Tube, and customer pkg. PW ☐ FedEx 10kg Box PX ☐ FedEx 25kg Box

7 Special Handling

1 ☐ HOLD at FedEx Location
3 ☐ SATURDAY Delivery — Available to select locations

☒ **Shipper must check / tick:**
This shipment does not contain Dangerous Goods.
Dangerous Goods cannot be shipped using this Air Waybill.

8a Payment *Bill transportation charges to:*

Enter FedEx Acct. No. or Credit Card No. below.

1 ☒ Sender Acct. No. in Section 1 will be billed. 2 ☐ Recipient 3 ☐ Third Party 4 ☐ Credit Card 5 ☐ Cash Check/ Cheque

Total Transportation

FedEx Acct. No.
Credit Card No.
Credit Card Exp. Date
Specify Currency

8b Payment *Bill duties and taxes to:* †FedEx cannot estimate Customs charges.

Enter FedEx Acct. No. below.

1 ☐ Sender Acct. No. in Section 1 will be billed. 2 ☒ Recipient 3 ☐ Third Party 5 ☐ Cash Check/ Cheque

FedEx Acct. No.

9 Required Signature

Use of this Air Waybill constitutes your agreement to the Conditions of Contract on the back of this Air Waybill, and you represent that this shipment does not require a U.S. State Department License. Certain international treaties, including the Warsaw Convention, may apply to this shipment and limit our liability for damage, loss, or delay, as described in the Conditions of Contract. WARNING: These commodities, technology, or software were exported from the United States in accordance with Export Administration Regulations. Diversion contrary to U.S. law prohibited.

Sender's Signature: Date Executed 02.07.2000

This is not authorization to deliver this shipment without a recipient signature.

Received above shipment in good order and condition. We agree to pay all charges, including Customs duties and taxes as applicable, and we agree to the Conditions of Contract as stated on the reverse side of the Recipient's Copy.

Recipient's Signature:

381

PART 155374
Rev. Date 7/99
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FedEx Tracking Number 8187 8523 5403 0402

Form I.D. No.

Origin Station I.D.	Destination Station I.D.	URSA Routing	Handling Units
LHFAA	DSMA	XC/DSMA	Total Volume (cm)

Received At: 1 ☐ Reg. Stop 2 ☐ On-Call Stop 3 ☐ Drop Box 4 ☐ World Service Center 5 ☐ Station

Forms Attached: ☐ CI ☐ SED ☐ CO

Base Charges ____ Declared Val. Chrg. ____ Other ____ ODA/ OPA ____ Credit Card Auth. ____

FedEx Emp. # 92 Audit Emp. # ____ Date ____ Time ____ Del. Courier Emp. # ____ Date ____ Time ____

• 99 SRC