REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF A **DEVICE**
(AMENDED IN ITS ENTIRETY)

No.: NR-0155-D-126-S DATE: March 1, 2013 PAGE: 1 OF 11

DEVICE TYPE: Mortar Sight Unit

MODEL: M67

Distributor:

Department of the Army
U.S. Army TACOM LCMC AMSTA-CSC-Z
6501 East 11 Mile Road
Warren, MI 48397
(formerly U.S. Army TACOM Life Cycle Management Command AMSTA-CS-CZR)

Manufacturers:

Seiler Instruments and Manufacturing Company, Inc.
3433 Tree Court Industrial Blvd.
St. Louis, MO 63122

Elcan Optical Technologies (a division of Raytheon Systems Canada Ltd.)
450 Leitz Road
Midland, Ontario, Canada L4R 588

ISOTOPE:	MAXIMUM ACTIVITY:
Hydrogen-3	5.79 Curies (214.2Gbq) (11729510-1, 2@ 0.05 Ci(1.85 Gbq each) (11733736, 1@ 1.0 Ci(37 Gbq)) (11733738, 3@ 0.03 Ci(1.11 Gbq) each) (11733744-1, 1@ 0.7 Ci(25.9.Gbq) (11733744-2, 2@ 1.0 Ci(37 Gbq) each) (9356141, 2@ 0.4 Ci(14.8 Gbq} each} (9356170, 1@ 1.1 Ci(40.7 Gbq)

LEAK TEST FREQUENCY: As specified in the user's materials license

PRINCIPAL USE: (W} Self Luminous Applications

CUSTOM SOURCE: X YES _____ NO

CUSTOM USER: U.S. Department of Defense
Principally the Department of the Army

DEVICE TYPE: Mortar Sight Unit

DESCRIPTION:

The Model M67 Mortar Sight Unit is a modified version of the M64 and M64A1 Mortar Sight Units. The modifications included changing several of the light sources and their mounting, and modifications to the unit to allow its use on a 120 mm mortar and to make it more rugged due to the greater shock forces it will experience.

The M67 Sight Unit consists of an elbow telescope assembly (consisting of an eyepiece assembly, a reflecting prism assembly, and the sighting cell assembly), and a mount assembly containing four aiming scale assemblies. The elbow telescope and each scale assembly contain one or more tritium light sources as shown in Attachment 1. The light sources are manufactured by Mb-Microtec (Model 400 Series), or other approved supplier, according to the Army's specifications, and are secured in the assemblies by means of an epoxy adhesive. In addition, each light source is provided protection from external damage by a molded plastic scale and/or metal enclosure. Overall dimensions of the elbow telescope are approximately 4.3" x 1.9" x 4" (10.9cm x 4.8cm x 10.2cm) and of the mount are approximately 5" x 4.5" x 6.5" (12.7cm x 11.4cm x 16.5cm). When assembled, the overall device measures about 5" x 4.5" x 8.9" (12.7cm x 11.4cm x 22.6cm).

The elbow telescope body is constructed from case aluminum alloy. The mount is constructed from case aluminum alloy and stainless steel. The telescope is secured to the mount by means of a stainless steel cylindrical holder and clamping wing nut. In addition, accidental or unauthorized separation of the telescope from the mount is prevented by means of a mounting ring installed on the telescope with a set screw that requires a special tool for removal. This mounting ring prevents the telescope from being withdrawn from the cylindrical mount.

Each of the sighting scale assemblies are constructed from cast aluminum alloy into which one or two light sources (0.03-1.1 Ci [1.11-40.7 GBq] each) are mounted and secured by an epoxy adhesive. The light sources are intended to provide illumination of the aiming scales in low light conditions. The scales are constructed from transparent molded plastic and are

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DESCRIPTION (cont.):

glued and screwed onto each assembly, covering the tritium light source. The scales also provide additional protection for the light sources from external impact hazards. The scales contain a total of 4.99 Ci (184.63 GBq) tritium.

The elbow telescope assembly contains two additional tritium light sources (0.4 Ci [14.8 Gbq] each) in the eyepiece to provide illumination of the aiming cross hairs in low light conditions. These sources are secured in an aluminum assembly by means of an epoxy adhesive and an aluminum retaining ring. This assembly is next inserted in the eyepiece and secured by means of an epoxy adhesive. The eyepiece assembly is then inserted in the body of the telescope and secured with an epoxy adhesive. The entire telescope assembly is sealed with a sealing compound to prevent the ingress of contaminants in the optical assemblies.

The fully assembled unit is mounted to the mortar by sliding the base plate of the mount assembly into a corresponding slot on the mortar barrel. A spring actuated locking mechanism secures the baseplate in the slot on the mortar. After firing the mortar, the locking mechanism is released by means of a lever on the mount body and sight unit may then be removed.

The sight unit is stored in a padded, fiberglass or nylon carrying case, of various designs, when not in use. The case protects the sight from incidental drops and impacts during transport from site to site, and reduces and exposures of the sight to humid and dirty environments.

LABELING:

The M67 sight units contain several labels on the telescope assembly and the mount assembly. The labels are made of adhesive backed metal foil, aluminum alloy or equivalent attached by screws, and adhesive backed decal material. Lettering is stamped, engraved, or painted and coated with a finished material.

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LABELING (cont.):

The information contained in the labeling on the telescope assembly includes the radiation trefoil symbol, isotope (H3), activity (contained in the telescope assembly only), date of source vial manufacture, telescope serial number, the words "CAUTION-RADIOACTIVE MATERIAL'', and a statement that the device, if found, should be returned to any military base.

The information contained in the labeling on the mount assembly includes the radiation trefoil symbol, isotope (H3), activity (contained in the mount assembly only), date of source vial manufacture, mount serial number and date of manufacture, the words "CAUTION-RADIOACTIVE VIALS, SCALES, INDEXES" AND "Sight Unit, M67", the NRC License Number, and a statement that the device, if found, should be returned to any military base.

DIAGRAM:

See Attachments 1, 2, and 3.

CONDITIONS OF NORMAL USE:

The sight unit is intended for use of 60 mm, 81 mm, and 120 mm mortar systems (principally 120 mm) in a towed or carrier configuration. During firing of the mortar, the sight unit experiences extreme shock percussions and vibration. When not in use and during transport, the sight unit is stowed in its case inside a vehicle. During transport, the unit and case may experience extended vibration, drops from several feet, and a variety of impacts. In addition, in the towed configuration, the mortar unit may tip over and fall on the sight unit. The sight unit is designed to withstand repeated exposure to these conditions. The optical components of the unit are likely to become unusable before damage to the tritium glass vials occurs. The unit would then be taken out of service. As the sight unit requires a person for mounting and un-mounting, the unit will always be used in environments suitable for human

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CONDITIONS OF NORMAL USE (cont'd):

occupancy. Typical use temperature range is -33°C to 71°C (-27°F to 160° F) with occasional extremes to -50°F (-46°C).

PROTOTYPE TESTING:

The M67 sight unit is essentially a modified M64A1 (a variation of the M64) sight unit. Therefore, initially an M64A1 sight unit was modified to meet the design specifications of a M67 sight unit. A prototype M67 was then constructed and both units were subjected to the following tests:

- Temperature (sight only)	65°C & -30°C (149.0 °F & -22.0 °F), hold for 60 min. each
- Thermal Shock (sight w/case)	65°C (149.0 °F) for 15 min to -30°C (-22.0 °F) immediate for 15 min.
- Reduced pressure (sight w/case)	hold at 175 mm (6.89") Hg for four 15 min. periods dropped 20 times from 1 m (3.28') and 2 times from 2m (6.56') in various orientations
- Vibration (sight w/case)	10 to 55 Hz in 1 min; 0.075 cm (0.030") amplitude; 0.15 cm (0.060") maximum excursion
- Immersion (sight w/case)	0°C (32°F) bath for 15 min.; 65°C (149.0 °F) bath for 15 min., 5 cycles
- Soak (sight only)	immerse in a water bath for 24 hours

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PROTOTYPE TESTING (cont.):

The forgoing tests were conducted in accordance with an ANSI N540 test level of 6, with the exception of the immersion test temperature that was reduced to 65°C (149.0 °F). The custom user indicated the units would not normally encounter temperatures greater than this during use. Each unit was also subjected to an additional temperature test as part of the acceptance testing for these devices. Each unit was tested to a temperature range of -50°F to 160°F (-46°C to 71°C) and held at these temperatures for a minimum of four hours. Following the additional temperature test each unit was tested for tritium leakage by a wipe test, soak test, and a visual examination. Both units remained functional following all of the above tests. In addition, visual inspections of the tritium glass vial sources, swipe tests following each test, and the soak test water analysis indicated that the sources were not damaged. The units were tested in their respective cases (first sight in a fiberglass case and second in a nylon case) for the Thermal Shock, Reduced pressure, Impact, Vibration, and Immersion tests since a unit would likely be in its case during incidences of these conditions (e.g., during transport).

During use of a unit, it is removed from its case and mounted on the mortar. The custom user indicated that during these operations, a unit could be subjected to impacts (drops), temperature extremes, and exposure to wet environments (e.g., rain). Therefore, the two units above were subjected to the Temperature and Soak tests without their cases. A production model M67 sight unit was constructed and subjected to the additional temperature test described above and an additional impact and soak test, all without the case. The additional impact test consisted of dropping the unit 20 times from a height of 1 meter (3.28') in 10 different orientations selected to impact the most damage to the unit. The unit was slightly damaged during these drops, but the tritium vials showed no damage. On the 21st drop, the height was increased to 2 meters (6.56') to simulate an accidental drop from the maximum height a unit would normally be subjected (during mounting or un-mounting of the unit to the mortar). This drop caused a

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PROTOTYPE TESTING (cont.):

plastic scale to break off from the unit and expose one of the tritium source vials. A visual examination of the unit and a swipe test indicated no damage to the source integrity or mounting. A second drop was planned, but was not performed as the first 2 m drop exposed the source vial to possible direct external damage. It is expected that the device would be able to withstand a second 2 m impact without damage to the source vials. In addition, the custom user indicated that damage of the type indicated above would cause the unit to be taken out of service and repaired. The production Model M67 was next subjected to the Soak Test. The results of this test also confirmed the tritium vials were undamaged. The above test data indicates the device could be given an ANSI N540 classification of T6GC1333443.

In addition, three production Model M67 devices were subjected to simulated and actual shock levels encountered during firing of the mortar. The first and third units were subjected to 850 shocks at a simulated charge level of 4 (the highest level) and 2530 shocks at a simulated charge level of 3. The second unit was subjected to 680 shocks at a simulated charge level of 4. During testing, units 3 and 2 experienced damage to the elevation locking knob. Unit 2 was damaged sufficiently to prevent additional testing. Units 3 and 1 were modified (during testing) to prevent further damage to the elevation locking knobs, and were able to complete the full test. The elevation locking knob assemblies were redesigned and units 1 and 3 were next tested to 500 shocks from live firings (125 at an actual charge level of 4 and 375 at an actual charge level of 3). Units 1 and 3 were then successfully retested to the full 3380 simulated shocks. No further damage to the units or light sources was noted.

Following each shock test, the tested unit was visually inspected for damage and swipe tested for tritium leakage. All tritium vial sources remained secured in the device, were undamaged, and were shown not to be leaking.

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PROTOTYPE TESTING: (cont.):

The protective case can house either the M64 or M67. The cases are designed to provide versatility in storing and protecting the sights and has met acceptable military standards.

Two prototype M67 sight units were also subjected to a series of shock tests, including 1003 live firings at a charge level of 4. The tritium source vials and their mounting were not damaged and determined to not be leaking following the tests.

The U.S. Army indicates Model M64 sight units have been in use on 60 mm and 81 mm mortars since 1983 under conditions similar to those expected for the M67 unit with no reported incidents of failure of the source vials or containment due to the design of the unit. The similarity of the design and construction of the M67 sight unit to the M64 sight unit indicates the units should perform similarly when used on 60 mm and 81 mm mortars.

EXTERNAL RADIATIOON LEVELS:

As the device contains only tritium in glass vials, the external radiation levels from the device are not discernible from background.

QUALITY ASSURANCE AND CONTROL:

The U.S. Army is responsible for the design, development, and production of the M67 sight unit. This is accompanied through U.S. Army personnel, **manufacturers**, contractors, and non-government subcontractors. The elements of quality assurance and control (QA/QC) for the M67 are determined and prescribed by the U.S. Army. Each **manufacturer**, contractor and/or non-government subcontractor must have a QA/QC program consistent with the requirements specified by the U.S. Army. **Manufacturers, Elcan Optical Technologies and Seiler Instruments and Manufacturing Inc. have** a QA/QC program for the manufacture and production of the sight units and the installation of the tritium vials that has been approved by the U.S. Army. In addition, the U.S. Army/contractor performs incoming inspections and acceptance tests on completed sights

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received from the manufacturer prior to release for use. These

QUALITY ASSURANCE AND CONTROL (cont'd):

QA/QC programs have been deemed acceptable for custom licensing of the M67 sight units, and copies of the programs are on file with the NRC.

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

- The M67 sight unit may be used only by the custom user as specified in this document.
- Handling, storage, use, transfer and disposal: To be determined by the licensing authority.
- The Model M67 sight unit may only contain tritium source vials manufactured in accordance with Department of the Army specifications as described in this document and that have been approved and registered in accordance with 10 CFR 32.210 or equivalent Agreement State regulation.
- The device shall not be subjected to conditions which would exceed ANSI N540 classification of T6GC, with the exception of a temperature range of -50°F to 160°F (-46° to 71°C), and maximum shock levels as listed in this certificate.
- This registration sheet and the information contained within the reference shall not be changed without the written consent of the NRC.

Reviewer Note:

Previously Model M67 was only manufactured by Elcan Optical Technologies, and their predecessors stationed in Canada.

US Army reviewed first article test (FAT) and quality control management plans of Seiler Instrument & Manufacturing Co. and found them capable of manufacturing Model M67 mortar sights.

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SAFETY ANALYSIS SUMMARY:

Based on our review of the Model M67 sight unit, and the information and test data cited **herein**, we continue to conclude that **this device is** acceptable for custom licensing purposes.

Furthermore, we continue to conclude that the M67 sight unit would be expected to maintain its containment integrity for normal and accidental conditions of use as specified in this certificate.

REFERENCES:

The following supporting documents for the Model M67 sight unit are hereby incorporated by reference and are made a part of this registry document:

- Department of the Army letter dated May 23, 2001, January 22, 2001, April 7, 1998, March 13, 1996, February 12, 1996, December 22, 1995, December 13, 1995, November 22, 1995, November 16 1995, March 3, 1995, and January 28, 2004, with enclosures thereto.

- U.S. Department of the AY facsimile received March 21, 1996, January 29, 2004, and March 24, 2004, with enclosures thereto.

- Department of the Army email received September 23, 2005, with enclosures thereto.

- Department of the Army facsimile dated December 12, 2005, with enclosures thereto.

- **Department of the Army letter dated January 9, 2013, and with enclosures thereto.**

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REFERENCES (Cont'd):

- **Department of the Army e-mail dated January 28, 2013, January 30, 2013, and February 28, 2013, with enclosures thereto.**

ISSUING AGENCY:

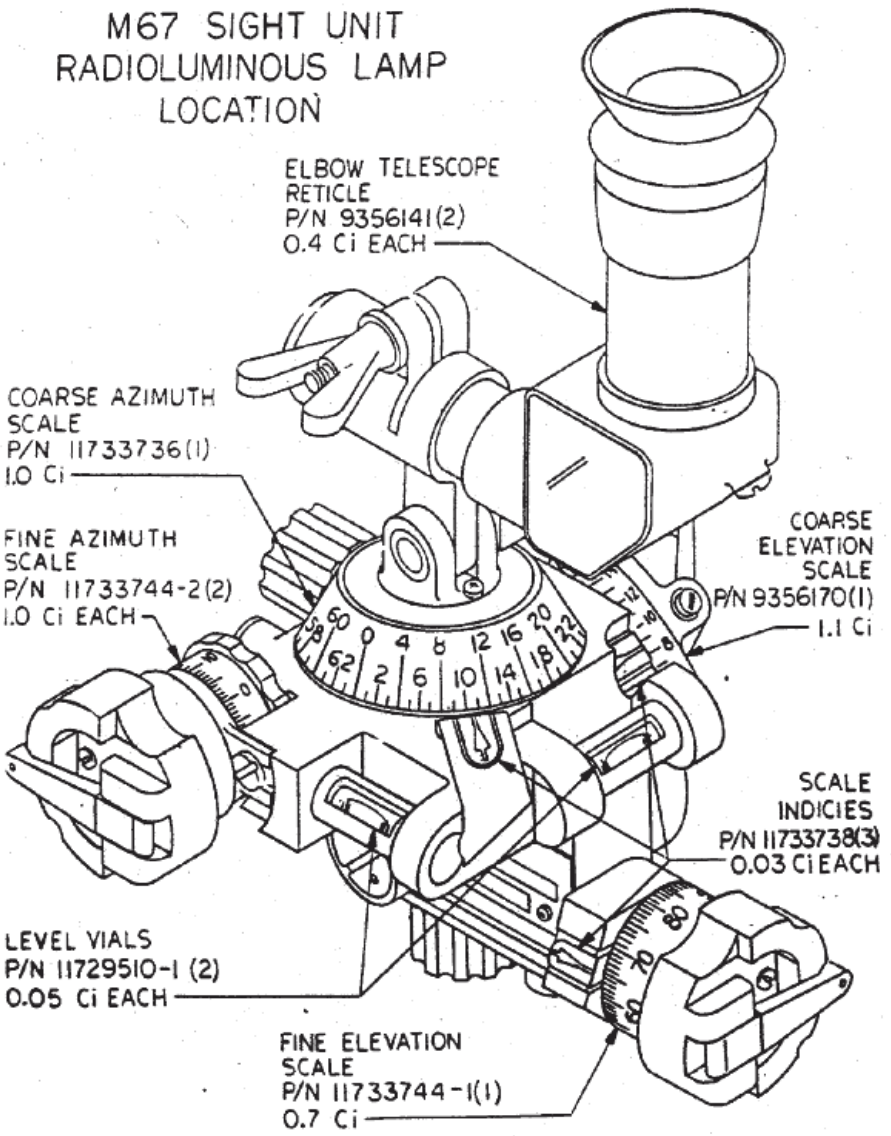
US Nuclear Regulatory Commission

Date: March 1, 2013 Reviewer: **/RA/**
Ujagar S. Bhachu

Date: March 1, 2013 Concurrence: **/RA/**
Lymari Sepulveda

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF A DEVICE
(AMENDED IN ITS ENTIRETY)

No.: NR-0155-D-126-S DATE: March 1, 2013 ATTACHMENT: 1 of 3



TOTAL TRITIUM PER SIGHT UNIT 5.79 CURIES

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SAFETY EVALUATION OF A DEVICE
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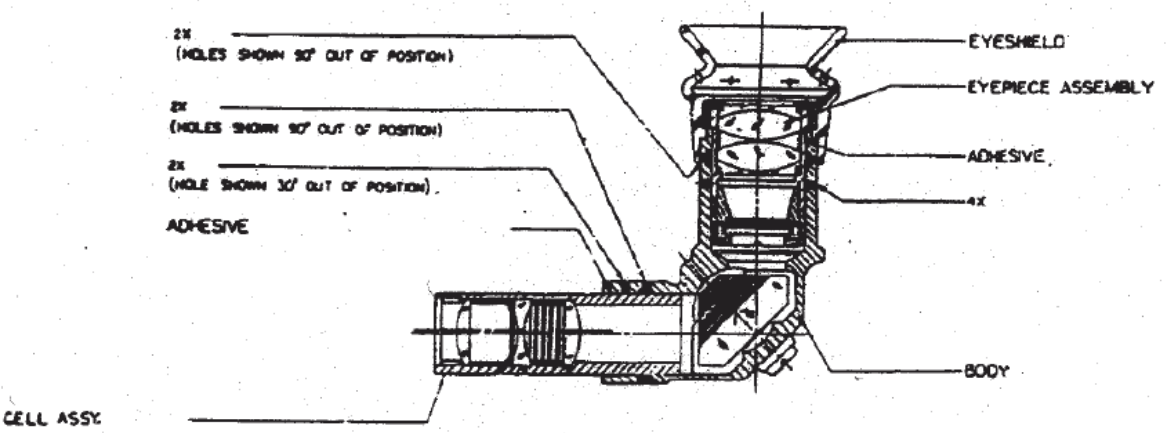
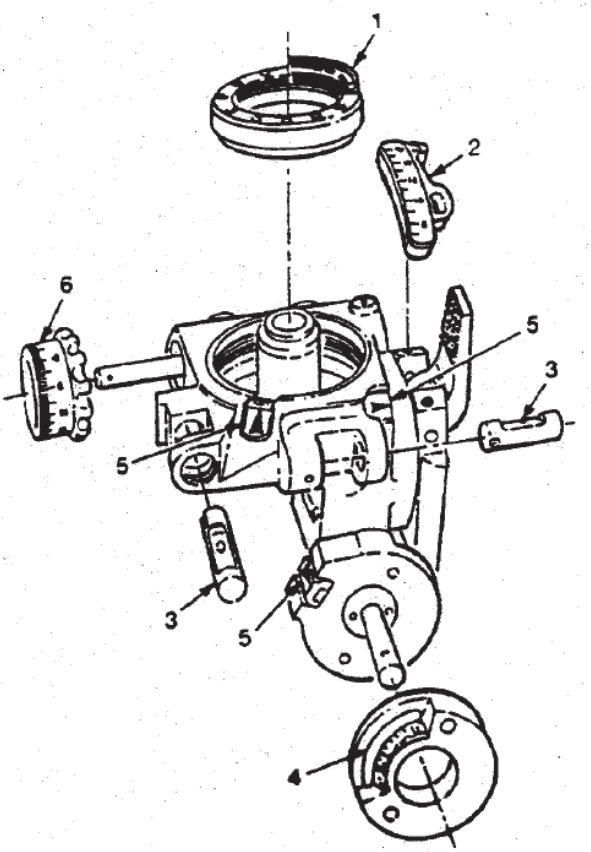
No.: NR-0155-D-126-S DATE: March 1, 2013 ATTACHMENT: 2 of 3



Telescope Assembly Components



1. Course Azimuth
2. Course Scale
3. Level vials (2)
4. Fine Scale
5. Scale (3)
6. **Fine Azimuth**

Mount Assembly components

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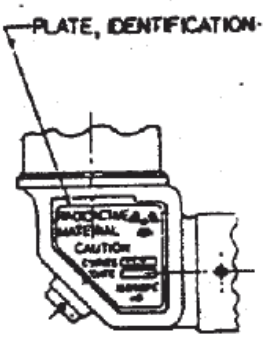
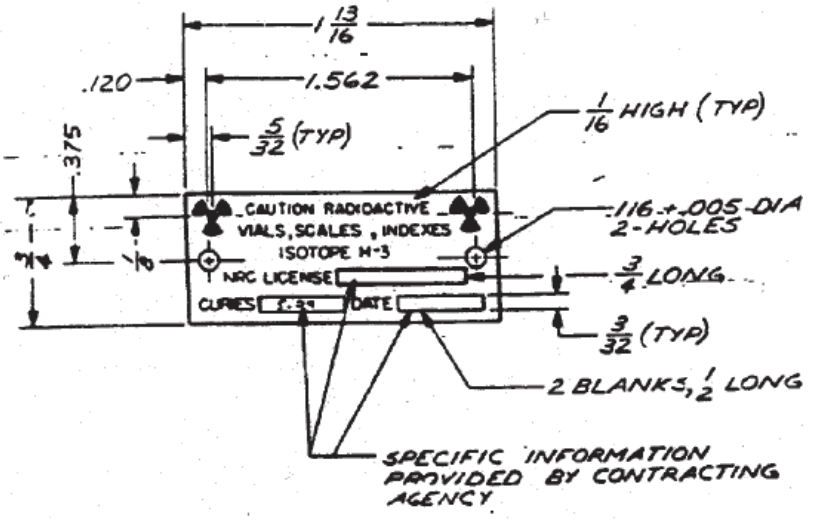


Telescope Assembly Radioactive Material Identification Plate

Mount Assembly Rad. Mat'l. dentification Plate



M67 Sight Unit Identification Plate