

MIL-R-12144F  
29 October 1982  
SUPERSEDING  
MIL-R-12144E  
29 December 1967

## MILITARY SPECIFICATION

### REFLECTOR, INDICATING, CLEARANCE

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

#### 1. SCOPE

1.1 Scope. This specification covers a plastic reflector assembly, composed of a reflecting element and a backing, mounted within a metal flange.

1.2 Classification. Reflectors shall be furnished with reflecting elements in the following colors (see 6.2):

Type I - Red  
Type II - Amber

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents.

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

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Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Tank-Automotive Command, ATTN: DRSTA-GSS, Warren, MI 48090, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

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FSC 9905

## MIL-R-12144F

## SPECIFICATIONS

## FEDERAL

- L-P-380 - Plastic Molding Material, Methacrylate.
- QQ-S-698 - Steel, Sheet and Strip, Low-Carbon.

## MILITARY

- MIL-R-3065 - Rubber, Fabricated Parts.
- MIL-F-13927 - Fungus Resistance Test; Automotive Components.

## STANDARDS

## MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-130 - Identification Marking of U.S. Military Property.
- MIL-STD-193 - Painting Procedures, Tactical Vehicles (Tracked and Wheeled).
- MIL-STD-810 - Environmental Test Methods.
- MS35387 - Reflector, Indicating, Clearance.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity, or as directed by the contracting officer.)

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

## NATIONAL BUREAU OF STANDARDS PUBLICATIONS

- Circular C429 - Photoelectric Tristimulus Colorimetry with Three Filters.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

## MIL-R-12144F

## 3. REQUIREMENTS

3.1 First article (preproduction). The contractor shall furnish sample units for first article inspection and approval (see 4.4 and 6.3). First article samples shall be inspected by the contractor under the surveillance of the Government to determine conformance to quality assurance provisions of this specification. First article samples shall be fully representative of reflector assemblies to be supplied from production tooling and facilities. Any change or deviation of production units from first article sample shall be subject to the approval of the Government.

3.2 Materials. Materials shall be as specified herein and in referenced specifications, standards and drawings. Material shall be free of defects which adversely affect performance or serviceability of the finished product (see 4.1.1 and 6.4).

3.2.1 Reflecting element. The reflecting element shall be injection molded and fabricated of acrylic material conforming to class 3 of L-P-380. Reflecting element color shall be type I (red) or type II (amber) (see 1.2).

3.2.2 Backing. The reflector assembly backing shall be of plastic material conforming to type I, class 1 of L-P-380.

3.2.3 Flange. Flange shall be steel having a minimum thickness of .0357 inch and shall conform to QQ-S-698.

3.2.4 Gasket. Gasket shall be made of rubber conforming to grade SC610 of MIL-R-3065.

3.2.5 Metal parts. All metal parts shall be of a corrosion-resistant material or shall be protected from corrosion in accordance with 3.5.

3.2.6 Qualified products. The contractor shall be responsible for using parts and assemblies from Qualified Products Lists (QPLs) whenever available. Contractor's inspection records shall specifically list all QPL items by number and date of the QPL, name of contractor and part or drawing number(s). When parts and assemblies are approved as qualified products, but not yet listed on the QPL, the contractor shall list the products by number and date of the approved document and name of contractor.

3.3 Design and construction. The reflector assembly dimensional requirements and configuration shall be in accordance with MS 35387.

## MIL-R-12144F

**3.4 Performance.**

3.4.1 Color comparison. Reflector shall evidence no weakening of color contrast and shall be examined to determine conformance to 3.4.2.1 or 3.4.2.2.

3.4.2. Photometer. Reflecting element shall evidence no weakening or distorting of the reflecting power of the element, and shall have color characteristics conforming to 3.4.2.1 or 3.4.2.2.

3.4.2.1 Type I reflecting element. Color of the red reflecting element, as determined by the tests specified in 4.6.2, shall be such that chromaticity coordinate Y will not be greater than 0.335 and Z not greater than 0.008.

3.4.2.2 Type II reflecting element. Color of the amber reflecting element, as determined by the tests specified in 4.6.2, shall be such that chromaticity coordinate Y will not be greater than 0.429 nor less than 0.398 and Z not greater than 0.007.

3.4.3 Specific intensity. Light reflected by the reflecting element shall not be less than that specified in table I. Reflector shall be visible at a minimum distance of 600 feet (182.9 meters) when directly in front of lawful upper beams of approaching headlamps. Presence of an insert dividing line on a reflector element shall not be cause for rejection, providing the minimum requirements for specific intensity are met.

TABLE I. Specific intensity.

Observation	Minimum candlepower per foot candle incident					
	Type I (Red)			Type II (Amber)		
	angle of light entrance			angle of light entrance		
Degrees	0°	10°	20°	0°	10°	20°
0.1	6.0	4.0	1.5	12.0	8.0	3.0
0.2	6.0	4.0	1.5	12.0	8.0	3.0
0.3	4.0	3.0	1.0	8.0	6.0	2.0
0.5	1.5	1.5	0.2	3.0	3.0	0.4
1.5	0.07	0.05	0.03	0.1	0.1	0.04

3.4.4 Shock resistance. The reflector assembly shall be exposed to three shock impulses of  $30 \pm 3.0$  gravity units (g) amplitude, for  $11 \pm 1.1$  milliseconds (ms) duration of half sine wave applied in each direction of three mutually perpendicular axes for a total of 18 impulses.

## MIL-R-12144F

3.4.5 Vibration resistance. The reflector assembly shall be exposed to sinusoidal vibration for a period of 180 minutes in each of the 3 mutually perpendicular axes. The vibration shall be imposed at a logarithmic sweep rate of 15 minutes per sweep cycle from 5 to 500 to 5 Hertz (Hz).

3.4.6 Waterproofness. The reflector assembly shall be submerged in tap water at a depth of one foot for a period of two hours at room temperature.

3.4.7 Low temperature. After soaking for two hours at minus  $65^{\circ} + 5^{\circ}\text{F}$  ( $-54^{\circ} + 2.7^{\circ}\text{C}$ ), the reflector assembly shall evidence no physical damage.

3.4.8 Sand and dust resistance. The reflector assembly shall perform as specified herein after undergoing the sand and dust resistance test for 28 hours.

3.4.9 Salt fog. The reflector assembly shall evidence no change in physical or material characteristics as specified herein after 48 hours of exposure to a five percent sodium chloride atomized spray.

3.4.10 Fungus resistance. Reflector shall not support microbial growth that would affect performance after undergoing fungus test for 90 days.

3.5 Finish. The reflector assembly case (ferrous metal) shall be primed and painted with a synthetic enamel of camouflage forest green as specified in MIL-STD-193.

3.6 Marking. Marking shall be in accordance with MIL-STD-130 and as a minimum shall include the following information:

Reflector assembly  
National stock number  
Manufacturer's identification  
Military part number  
US

3.7 Workmanship. Workmanship shall be of a quality which will assure a product free of burrs, rust, scratches, chips, sharp edges, or other defects.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except

## MIL-R-12144F

as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Materials. The contractor's inspection records shall be examined to determine conformance to 3.2 through 3.3.5.

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

- a. First article (preproduction) inspection (see 4.4).
- b. Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified herein, all examinations and tests shall be performed under conditions specified in 4.3.1 and 4.3.3.

4.3.1 Temperature. Unless otherwise specified, the ambient room temperature during testing shall be  $77^{\circ} + 15^{\circ}\text{F}$  ( $25^{\circ} + 8^{\circ}\text{C}$ ). Except as otherwise specified herein or in applicable specifications, test specimens shall be thermally stabilized for one hour prior to testing in a laboratory free of dust, drafts, and fumes.

4.3.2 Relative humidity. Unless otherwise specified, relative humidity during testing shall be  $50 \pm 30$  percent.

4.3.3 Atmospheric pressure. Unless otherwise specified, the atmospheric pressure during testing shall be 725 (+50, -75) mm of Mercury.

4.4 First article (preproduction) inspection. Three first article samples (see 3.1 and 6.3) shall be inspected, at a location approved by the Government, to determine conformance to requirements of this specification. Inspection shall consist of examination as specified in table III and all tests specified in table II. All inspections shall be done by the contractor under Government surveillance.

4.4.1 Failure. Failure of a first article sample to pass any examinations or tests specified may be cause for the Government to withdraw from surveillance of additional testing until the faults revealed by the tests have been corrected.

## MIL-R-12144F

TABLE II. Order of first article testing.

Description	Requirement	Test
Color comparison	3.4.1	4.6.1
Photometer	3.4.2	4.6.2
Type I reflecting element	3.4.2.1	4.6.2
Type II reflecting element	3.4.2.2	4.6.2
Specific intensity	3.4.3	4.6.3
Shock resistance	3.4.4	4.6.4
Vibration resistance	3.4.5	4.6.5
Waterproofness	3.4.6	4.6.6
Low temperature	3.4.7	4.6.7
Sand and dust resistance	3.4.8	4.6.8
Salt fog	3.4.9	4.6.9
Fungus resistance	3.4.10	4.6.10

4.5 Quality conformance inspection.

4.5.1 Lot formation. Unless otherwise specified (see 6.2), a lot shall consist of all reflector assemblies of one part number, from an identifiable production period, from one manufacturer, submitted for inspection at one time.

4.5.2 Quality conformance examination.

4.5.2.1 Sampling for quality conformance examination. Samples for quality conformance examination shall be selected in accordance with level II of MIL-STD-105.

4.5.2.2 Acceptable quality level. Each sample selected in accordance with 4.5.1.1 shall be examined for conformance to the following acceptable quality levels (AQLs), on the basis of percent defective:

<u>Classification</u>	<u>AQL</u>
Major	1.0
Minor	2.5

4.5.2.3 Classification of defects. For examination purposes, defects shall be classified as specified in table III.

## MIL-R-12144F

TABLE III. Classification of defects.

Category	Defect	Method of inspection
Major:		
101	Incorrect or faulty materials (see 3.2).	Visual
102	Dimensions affecting interchangeability, not within tolerance (see 3.3).	Gage
103	Color not conforming to class (see 3.3).	Visual
Minor:		
201	Dimensions not affecting interchangeability, not within tolerance (see 3.3)	Gage
202	Incorrect or illegible marking (see 3.6).	Visual
203	Poor workmanship (see 3.7).	Visual

4.5.3 Quality conformance tests.4.5.3.1 Acceptance tests.

4.5.3.1.1 Sampling for acceptance testing. Samples for acceptance testing shall be selected in accordance with level S-3 of MIL-STD-105.

4.5.3.1.2 Acceptance tests. Each sample selected in accordance with 4.5.3.1.1 shall be subjected to the tests specified in table IV, in the order listed, using an AQL of 0.5 on the basis of percent defective.

4.5.3.1.3 Failure. Failure to pass acceptance examination or test shall be cause for the Government to refuse to accept subsequent lots until it has been proven to the satisfaction of the Government that any deficiency has been corrected.

TABLE IV. Acceptance tests.

Description	Requirement	Test
Color comparison	3.4.1	4.6.1
Photometer	3.4.2	4.6.2
Type I reflecting element	3.4.2.1	4.6.2
Type II reflecting element	3.4.2.2	4.6.2
Specific intensity	3.4.3	4.6.3

4.5.3.2 Control tests.

4.5.3.2.1 Sampling for control testing. Control test samples shall be selected at the rate of 1 of each 100 units produced, except that not more than 4 nor less than 2 shall be tested in any 30 day period.



## MIL-R-12144F

4.5.3.2.2 Control testing. Reflector assemblies, selected in accordance with 4.5.3.2.1 shall be examined for the defects specified in table III and subsequently subjected to the tests specified in table V.

TABLE V. Control tests.

Description	Requirement	Test
Shock resistance	3.4.4	4.6.4
Vibration resistance	3.4.5	4.6.5
Waterproofness	3.4.6	4.6.6
Low temperature	3.4.7	4.6.7
Sand and dust resistance	3.4.8	4.6.8
Salt fog	3.4.9	4.6.9
Fungus resistance	3.4.10	4.6.10

4.5.3.2.3 Failure. Failure of a control test sample to pass any specified examination or test may be cause for the Governemnt to refuse to accept subsequent lots until it has been proven to the satisfaction of the Government that any deficiency revealed by examination or test has been corrected.

4.6 Method of inspection.

4.6.1 Color comparison. To determine conformance to 3.4.1, the reflector and apparatus shall be as illustrated in figure 1 with a suitable light source for such apparatus. The light shall be placed so that it passes through the standard limit glasses and the diffusing glasses before being reflected from the mirror to the observer. The position of one diffusing glass shall be adjustable. By altering the position of the diffusing glass, the brightness of these two portions of the field of view may be made the same. A similar diffusing plate and mirror shall be positioned so that the observer may view the reflector under examination. With the device adjusted, a brightness match may be obtained between the test source and the limit glass beams. The color of the reflector disc shall be examined to determine compliance with 3.4.2.1 or 3.4.2.2, as applicable.

4.6.2 Photometer. To determine conformance to 3.4.2.1 or 3.4.2.2, the reflector and apparatus shall be as illustrated in figure 2 using a light source conforming to International Commission on Illumination (ICI) standard illuminant operating at 2850°Kelvin (°K). The receiver shall be a photoelectric photometer having a spectral response similar to that of the human eye. The calibration mirror shall be an uncoated front surface aluminized plane mirror used as a 100 percent reflecting reference. The limit glasses and the tristimulus filters shall be of known chromaticity values. The beam splitter mirror shall be half-silvered or aluminized front surface plane mirror. The limit glass

## MIL-R-12144F

corresponding to the color of the reflector disc to be tested (red or amber) shall be inserted in the apparatus. The calibration mirror shall be positioned, and the photometric reading shall be taken as each of the tristimulus filters (amber, blue and green) is placed in position. The calibration mirror shall be replaced by the reflector disc to be tested, and readings shall be taken as each tristimulus filter is placed in position. The percent of light reflected to the photometer by the reflector disc shall be determined for each color on the basis of using the calibration mirror reflectance as 100 percent. Values of x, y, z shall be computed by using the equations characteristic to the tristimulus filters placed in the optical system and the illuminant. Information pertaining to photoelectric tristimulus colorimetry with three filters may be obtained from National Bureau of Standards Circular C429 (see 2.2). The X, Y, Z chromaticity coordinates shall be determined by the following, to determine conformance to 3.4.2.1 or 3.4.2.2, as applicable.

$$X = \frac{x}{\sum(x+y+z)}$$

$$Y = \frac{y}{\sum(x+y+z)}$$

$$Z = \frac{z}{\sum(x+y+z)}$$

$$X + Y + Z = 1$$

4.6.3 Specific intensity. To determine conformance to 3.4.3, the reflector and apparatus shall be as shown in figure 3. The apparatus shall consist essentially of a photoelectric photometer, corrected to a spectral response similar to that of the International Commission on Illumination standard observer, having a receiver aperture not greater than 0.5 by 1.0 inch (0.197 by .394 centimeter (cm)) and a minimum sensitivity of 1 by 10<sup>-7</sup> foot-candles per millimeter scale division. When installed in the apparatus, the aperture shall have the long dimension parallel to the surface of the test bench. The photometer shall be shielded to eliminate stray light and shall be calibrated by limit glasses for each color to be tested. The light source, which shall be operated at a color temperature of 2850°K, and shall provide a uniform beam having an effective diameter of two inches (.787 cm) at the source. At each angle specified in table I, the light reflected shall be measured to determine compliance with 3.4.3. In each position of measurement the reflector shall be rotated in its own plane and the minimum value of specific intensity shall be used as the criterion.

4.6.4 Shock resistance. To determine conformance to 3.4.4, the reflector assembly shall be subjected to test procedures specified in procedure I of MIL-STD-810 in each of three mutually perpendicular

## MIL-R-12144F

directions. After completion of this test, reflector shall evidence no breakage, loosened or distorted parts or other physical damage and shall meet the requirements of 3.4.1 through 3.4.3.

4.6.5 Vibration resistance. To determine conformance to 3.4.5, the reflector assembly shall be subjected to method 514, procedure VIII of MIL-STD-810, for a period of 180 minutes in each of the three mutually perpendicular axes. After completion of this test, the reflector assembly shall evidence no breakage, or distorted parts and shall meet the requirements of 3.4.1 through 3.4.3.

4.6.6 Waterproofness. To determine conformance to 3.4.6, the reflector assembly shall be mounted on a steel plate as in the intended use, and submerged in tap water at a depth of one foot for a period of two hours at room temperature. The reflector assembly shall then be removed from the water tank and allowed to drain for 15 minutes. The reflector assembly shall evidence no water penetration and shall meet requirements of 3.4.1 through 3.4.3.

4.6.7 Low temperature. After completion of the waterproofness test (see 4.6.6), the reflector assembly shall be placed in a temperature test chamber at minus  $65^{\circ} + 5^{\circ}\text{F}$  ( $-54^{\circ} + 2.7^{\circ}\text{C}$ ) for two hours. After the two hour period, the reflector assembly shall be removed and examined for any physical damage and shall meet requirements of 3.4.1 through 3.4.3.

4.6.8 Sand and dust resistance. To determine conformance to 3.4.8, the reflector assembly shall be subjected to test procedures specified in MIL-STD-810, method 510, procedure I for 28 hours, and shall meet requirements of 3.4.1 through 3.4.3..

4.6.9 Salt fog. To determine conformance to 3.4.9, the reflector assembly shall be subjected to procedure I, method 509 of MIL-STD-810 for a period of 48 hours, while exposed to a five percent sodium chloride atomized spray, and shall meet requirements of 3.4.1 through 3.4.3.

4.6.10 Fungus resistance. To determine conformance to 3.4.10, reflector assembly shall be subjected to class 2, method B of MIL-F-13927 for a period of 90 days.

## 5. PACKAGING

5.1 Packaging requirements. The requirements for packaging for the desired level of protection shall be in accordance with the applicable packaging standard or packaging data sheet specified by the contracting authority (see 6.2).

## MIL-R-12144F

## 6. NOTES

6.1 Intended use. This specification covers reflectors to be used on vehicles. The reflectors indicate the position of the vehicle by picking up light rays from the headlights of an approaching vehicle and reflecting the rays back to the operator of the approaching vehicle. Reflectors may also be used on structures or road hazards for supplementary night parking.

6.2 Ordering data. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type and part number of reflective assemblies required (see 1.2).
- (c) Inspection lot information, if other than specified (see 4.5.1.1).
- (d) Levels of preservation and packing required (see 5.1).

6.3 First article. First article samples shall be tested and approved under the appropriate provisions of 7-104.55 of the Defense Acquisition Regulation. The contracting officer should include specific instructions in all acquisition instruments regarding arrangements for examination, tests and approval of the first article (see 3.1 and 4.4).

6.4 Recycled materials. The use of recycled materials which meet the requirements of the applicable material specifications without jeopardizing the intended use of the item shall be encouraged (see 3.2).

6.5 Changes from previous issue. Asterisks are not used in this revision, to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:  
 Army - AT  
 Air Force - 99

Preparing activity:  
 Army - AT

Project No. 9905-0270

Review activities:  
 Army - GL

User activities:  
 Navy - YD  
 Army - ME

MIL-R-12144F

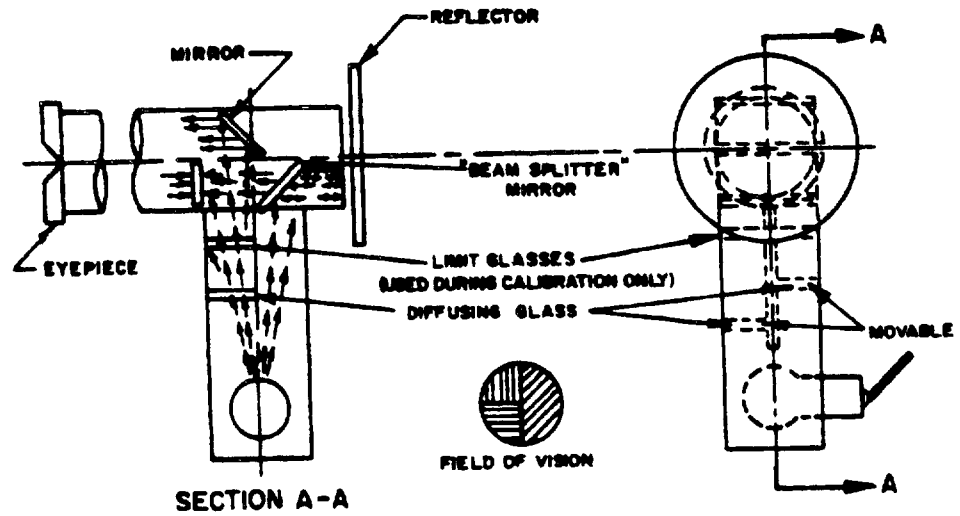


Figure 1. Retroreflector color comparator (suggested operational principles).

MIL-R-12144F

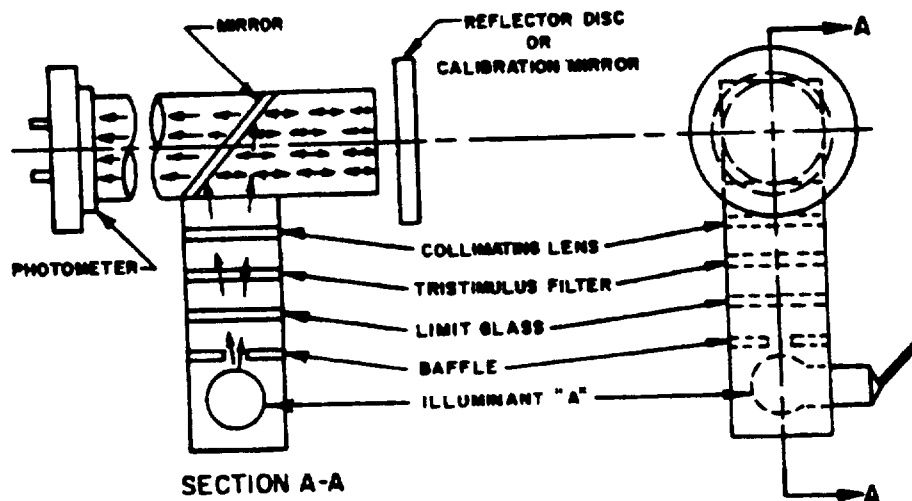


Figure 2. Photometer color comparator (suggested operational principles).

MIL-R-12144F

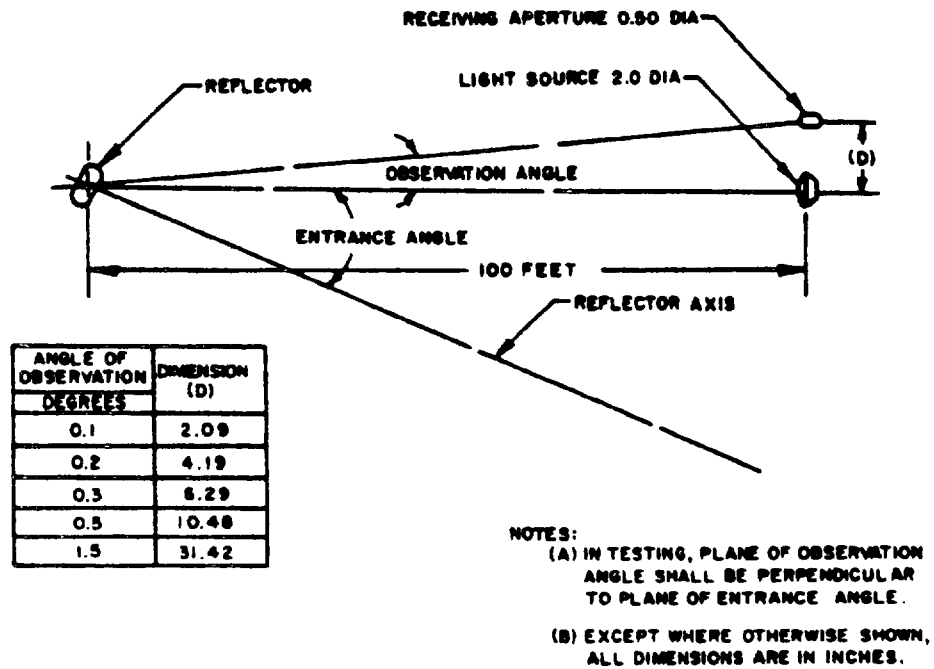


Figure 3. Positioning of apparatus.





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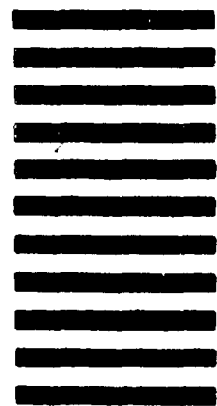
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*(See Instructions - Reverse Side)*

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3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION <i>(Mark one)</i>	
b. ADDRESS <i>(Street, City, State, ZIP Code)</i>		<input type="checkbox"/> VENDOR	
		<input type="checkbox"/> USER	
		<input type="checkbox"/> MANUFACTURER	
		<input type="checkbox"/> OTHER <i>(Specify):</i> _____	
5. PROBLEM AREAS			
a. Paragraph Number and Wording:			
b. Recommended Wording:			
c. Reason/Rationale for Recommendation:			
6. REMARKS			
7a. NAME OF SUBMITTER <i>(Last, First, MI) - Optional</i>		b. WORK TELEPHONE NUMBER <i>(Include Area Code) - Optional</i>	
c. MAILING ADDRESS <i>(Street, City, State, ZIP Code) - Optional</i>		8. DATE OF SUBMISSION (YYMMDD)	

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