DEPARTMENT OF THE ARMY TECHNICAL MANUAL

FIELD AND DEPOT MAINTENANCE MANUAL METER, PHOTOGRAPHIC EXPOSURE LM-46A

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual covers the field and depot maintenance of Meter, Photographic Exposure LM-46A. It includes instructions appropriate to fourth and fifth echelons for troubleshooting, replacing maintenance parts, and final testing the equipment, It also lists the tools and test equipment required for fourth and fifth echelon maintenance, The mechanical and electrical functions of the exposure meter are described in paragraphs 3 and 4.

b. Forward comments concerning this manual to the Commanding Officer, U. S. Army Signal Materiel Support Agency, ATTN: SIGMS-PA2d, Fort Monmouth, N. J.

Note. For applicable forms and records, see paragraph 2, TM 11-6760-206-12.

2. Associated Publications

The complete technical manual for this equipment includes TM 11-6760-206-12 and TM 11-6760-206-35P.

Section II. THEORY

3. Mechanical Functions

a. Calibrated Dials and EXP, ASA INDEX Selector. The three calibrated dials and the EXP. ASA INDEX selector are mounted concentrically and function like a circular slide rule to compute the correct exposure (combination of f/ stop setting and shutter speed setting) at a particular light intensity in relation to a specific film emulsion speed. The exposure index dial is fixed; the relative aperture dial, the time and brightness dial (which is divided into two scales, a time scale and a brightness scale), and the EXP. ASA INDEX selector can be rotated. The EXP. ASA INDEX selector is used to mark the point on the exposure index dial that corresponds to the ASA emulsion speed rating on the film in use. The point on the brightness scale that corresponds to the particular light intensity then can be aligned accurately with the ASA film emulsion speed rating set on the exposure index dial. When the light intensity has been set in relation to the film emulsion speed, the aligned calibrations on the relative aperture dial and the time scale indicate the f/ stop and shutter speed settings that will provide the proper exposure. The relative aperture dial has two positions so that the relative position of its calibration markings can be shifted with respect to the calibration markings on the time scale to permit the calculation of exposures using either reflected light intensity readings or incident light intensity readings, The position of the relative aperture dial is controlled by the baffle and the slider assembly (b below).

b. Baffle and Slider Assembly. The hinged baffle is controlled by a baffle button that operates a spring latch (1, fig. 5), and a spring-loaded slider assembly that is linked mechanically to the relative aperture dial. When the baffle button is depressed, the spring latch is released and the baffle is pushed down by the slider (4) so that the entire surface of the photoelectric cell is exposed to incident light (para 4). When the baffle is lowered, the slider assembly moves forward. The forward movement of the slider assembly causes the relative aperture dial stud (9) to move to the forward end of its slot and the relative aperture dial rotates clockwise (as viewed from the upper

side) about 45° so. that the dial marking REFLECTED LIGHT is hidden and the dial marking INCIDENT LIGHT appears at the left. This shifts the relative position of the calibration markings (f/ stops) on the relative aperture dial with respect to calibration markings (shutter speeds) on the time scale. When the baffle is raised, the slider is pushed back and the slider assembly returns the relative aperture dial to its normal (REFLECTED LIGHT) position. The spring latch reengages the baffle and holds it in the raised or closed position so that only a limited area of the photoelectric cell is exposed to the light.

4. Lightmeter

(fig. 2)

a. Circuit. The lightmeter circuit consists of a matched photoelectric cell and microammeter (meter movement), and the necessary resistors. When light strikes the photoelectric cell, the photoelectric cell emits electrons proportional in amount to the intensity of the incident light. The resulting current flows through a parallel resistance network, consisting of a thermistor and a shunt resistor, and the coil of the microammeter. The current through the coil of the microammeter sets up a magnetic field that reacts with the magnetic field of the permanent magnet of the microammeter. This causes the coil to move and the needle pointer attached to the coil is deflected across the lightmeter dial, wvhich is calibrated in candles per square foot, a degree proportional to the amount of current flowing in the coil. The thermistor acts as a stabilizing resistor to compensate for the tendency of the photoelectric cell to produce a varying amount of current for a given light

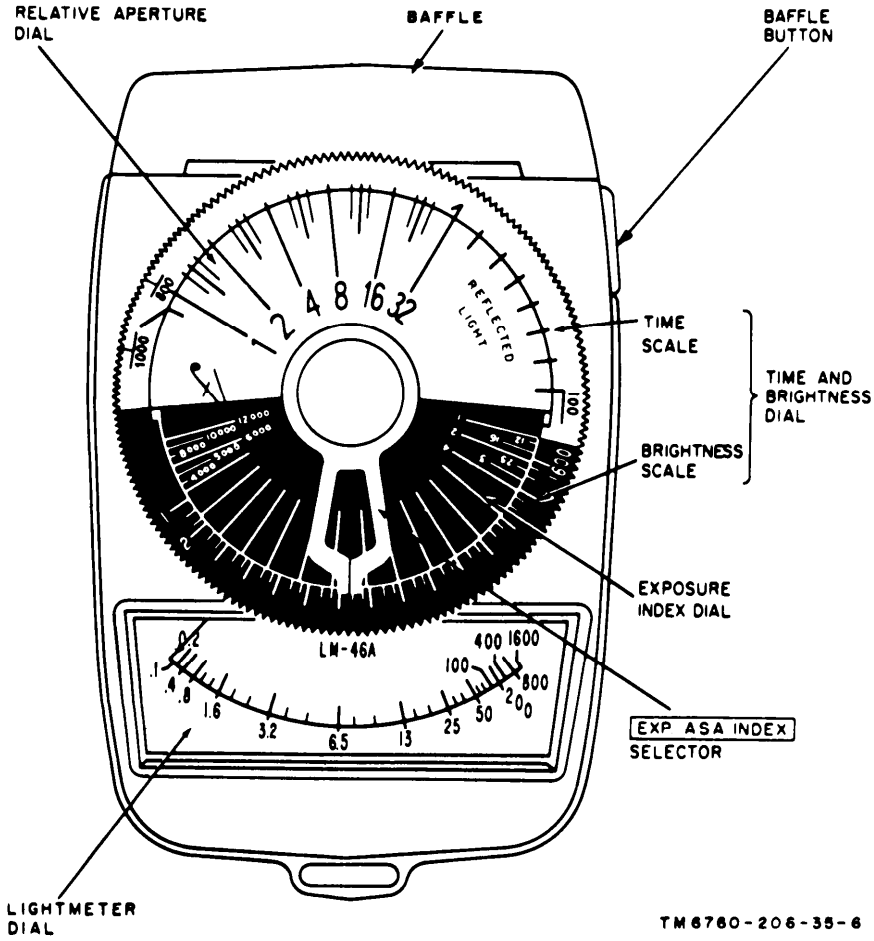


Figure 1. Exposure meter, top view.

intensity because of temperature variations. The parallel comb nation of the thermistor and shunt resistor, in series with the microammeter, limits the current flowing in the microammeter coil. Full-scale needle pointer deflection occurs when the intensity of the light striking the photoelectric cell is 1,600 footcandles.

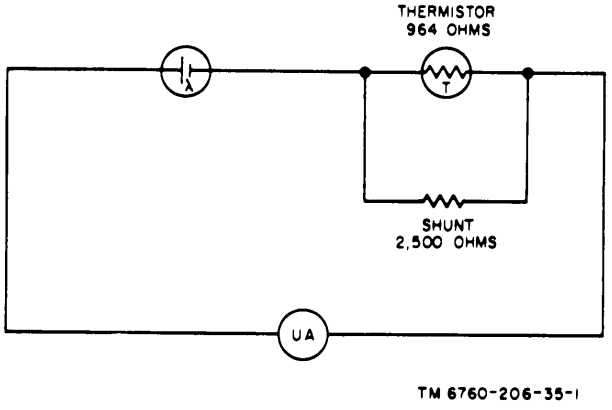


Figure 2, Lightmeter circuit, schemutic diagram.

b. Light Intensity Measurements. The light intensity measured by the lightmeter is a function of the average brightness of the entire area physically within the range of the exposure meter. The light value indicated by the lightmeter may be a real or a relative value, depending upon the type of light reading taken. For incident light readings (baffle lowered), the entire surface of the photoelectric cell is exposed and the lightmeter reading is a true measurement in candles per square foot of the intensity of the light striking the photoelectric cell. For reflected light readings (baffle raised), only a portion of the surface of the photoelectric cell is exposed and the lightmeter reading is an indication of the relative intensity of the light reflected from the subject to a restricted area of the photoelectric cell. To permit accurate exposure calculations to be made using either real or relative light intensity values, the calibration markings of the relative aperture dial can be shifted with respect to those of the time scale of the time and brightness dial (para 3).

CHAPTER 2

TROUBLESHOOTING

5. Scope of Troubleshooting

Troubleshooting at field and depot maintenance level includes all the techniques required to isolate a defective part or assembly to determine the cause of the malfunctioning of the equipment. The field and depot maintenance procedures are not complete in themselves but supplement the maintenance procedures described in TM 11-6760-206-12.

6. Troubleshooting Procedures

Most of the faults that may occur in the exposure meter have definite symptoms that can be observed during thorough inspection and systematic performance checks. Before disassembling the exposure meter, examine it carefully and check its performance.

a. Visual Inspection. Look for physical damage, such as a dented case, cracked or broken windows, a loose or sticking lightmeter pointer, and loose or bent calculator dials and EXP. ASA INDEX selector.

b. Performance Checks.

(1) Check the operation of the baffle and the relative aperture dial, and check the zero adjustment of the lightmeter pointed as described in TM 11-6760-206-12.

(2) Check the balance of the lightmeter pointer (para 8a).

(3) Check the regularity of movement of the lightmeter pointer (para 8b).

(4) Check the accuracy of the lightmeter (para 8c).

c. Troubleshooting Chart. Use the troubleshooting chart (para 9) to determine the probable causes of malfunctions of the exposure meter and the corrective actions required.

7. Tools and Test Equipment

The following tools and test equipment are required for troubleshooting and repair of the exposure meter:

Tool Equipment TK-21/G

Screwdriver, straddle (DeJur part No. Z-7. 182B or equal)

Exposure meter known to be accurate

Note. A straddle screwdriver is required when the meter movement nuts (fig. 4) have to be removed. If this tool is not available in field maintenance shops, fabricate a similar tool in accordance with figure 9.

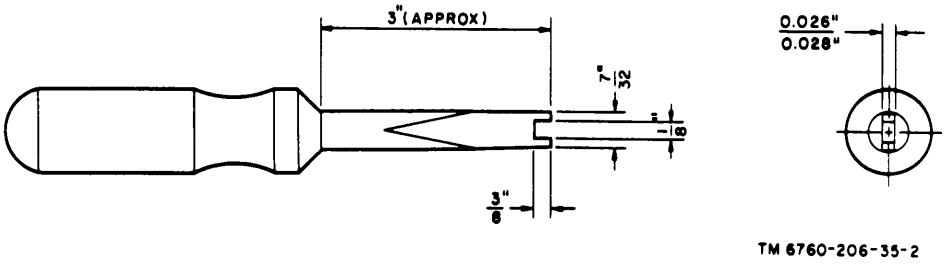


Figure 3. Straddle acrewdriver, fabrication detai1s.

8. Performance Checks

Before making the performance checks described in a through c below, check the zero adjustment of the lightmeter pointer and, if necessary, adjust the pointer as described in TM 11-6760-206-12. If the pointer cannot be adjusted to the 0 position, omit the performance checks and refer to the troubleshooting chart (para 9).

a. Balance of Lightmeter Pointer. Cover the baffle end of the exposure meter closely with an opaque material so that no light can strike the photoelectric cell. Hold the exposure meter in a horizontal position. Watch the lightmeter pointer and slowly rotate the exposure meter back and forth through a wide arc. The lightmeter pointer should not deviate from the 0 position while the exposure meter is being rotated.

b. Regularity of Lightmeter Pointer Movement. With the baffle lowered, expose the photoelectric cell to a light source sufficiently brilliant to cause a full-scale deflection of the lightmeter pointer. Watch the lightmeter pointer and gradually cover the window of the photoelectric cell with an opaque material. The pointer should move smoothly and evenly from the 1600 position to the 0 position. Gradually uncover the window of the photoelectric cell. The pointer should return smoothly and evenly to the 1600 position.

Caution: Do not point the exposure meter directly at an extremely bright light source, such as the sun, because too sudden or extreme pointer deflection may damage the pointer or the meter movement.

c. Accuracy of Lightmeter. Take several reflected light readings and several incident light readings (TM 11-6760-206-12) and note the light intensity value indicated by the lightmeter for each. Use a similar exposure meter known to be accurate and take a second set of light readings of the same subjects under exactly the same conditions of light and distance, Com--pare the two sets of readings.

9. Troubleshooting Chart

Symptom	Probable trouble	Correction
Lightmeter pointer cannot be adjusted to 0 position.	Defective SET ZERO screw	Replace SET ZERO screw (para 10a and 12d).
	Defective meter movement	Replace photoelectric cell and meter movement (para 10c and 12b).
Lightmeter pointer does not remain at 0 position when exposure meter in rotated.	Defective meter movement	Replace photoelectric cell and meter movement (para 10c and 12b).
Lightmeter pointer movement irregular or jerky.	Defective meter movement	Replace photoelectric cell and meter movement (para 10c and 12b).
Lightmeter pointer remains at 0 position irrespective of intensity of light striking photoelectric cell.	Broken wire connection or broken wire.	Check wiring between photoelectric cell assembly, resistor assembly, and meter movement, Resolder defective connection or replace broken wire.
	Defective photoelectric cell	Replace photoelectric cell and meter movement (para 10c and 12b).
	Defective resistor assembly	Replace resistor assembly (para 10d and 12a).
	Defective meter movement	Replace photoelectric cell and meter movement (para 10c and 12b).
Lightmeter does not indicate correct light intensity values.	Defective resistor assembly	Replace resistor assembly (para 10d and 12a).
	Defective photoelectric cell or meter movement.	Replace photoelectric cell and meter movement (para 10c and 12b).
EXP. ASA INDEX selector or calculator dials bind or are loose.	Defective case assembly	Replace case assembly (para 10a and b and 12c and d).
Relative aperture dial does not position correctly, or binds when ra-e is lowered or raised.	Defective relative aperture dial.	Replace case assembly (para 10a and b and 12c and d).
	Defective slider assembly	Replace slider assembly (para 10b and 12c).
Baffle does not spring open when baffle button is depressed.	Defective baffle button	Replace baffle button (para 10a and 12d).
	Defective slider assembly	Replace slider assembly (para 10b and 12 c).
Baffle does not remain closed when baffle is raised.	Defective latch spring	Replace case assembly (para 10a and b and 12c and d).

CHAPTER 3

DISASSEMBLY AND REASSEMBLY AND FINAL TESTING AFTER REPAIR

Section I. DISASSEMBLY AND REASSEMBLY

10. Disassembly

a.. Separating Case Assembly from Base Assembly (fig. 4).

(1) Lay the exposure meter face downward on a flat surface. Remove the Phillips head screws that fasten the nameplate to the base assembly and carefully lift off the nameplate.

(2) The SET ZERO screw and washer now can be removed from the base.

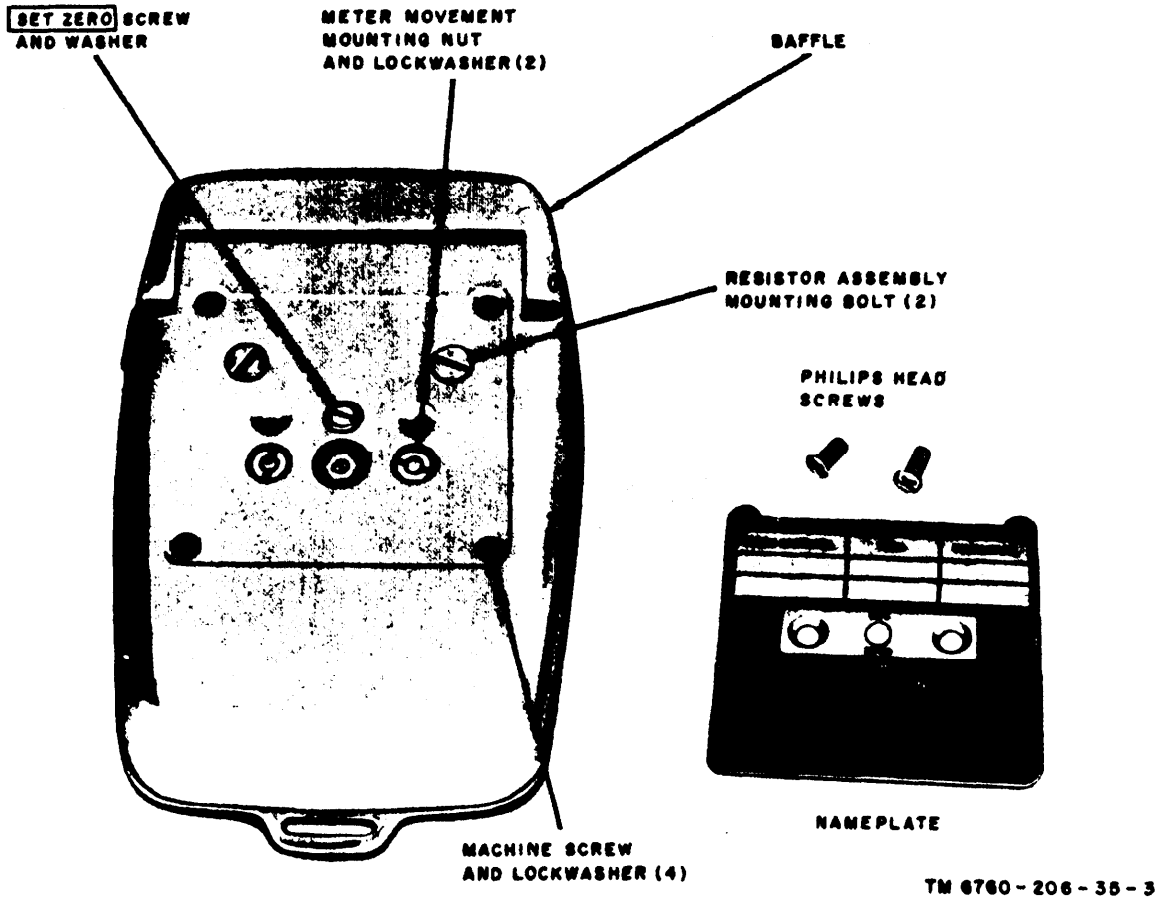


Figure 4. Exposure meter, bottom view, nameplate removed.

assembly. If neither the SET ZERO screw nor the meter movement requires replacement, leave the SET ZERO screw installed and place a piece of gummed tape, such as masking tape, over the SET ZERO screw to prevent it from falling out.

(3) Remove the machine screw and lockwashers that hold the case assembly (fig. 5) to the base assembly (fig. 6).

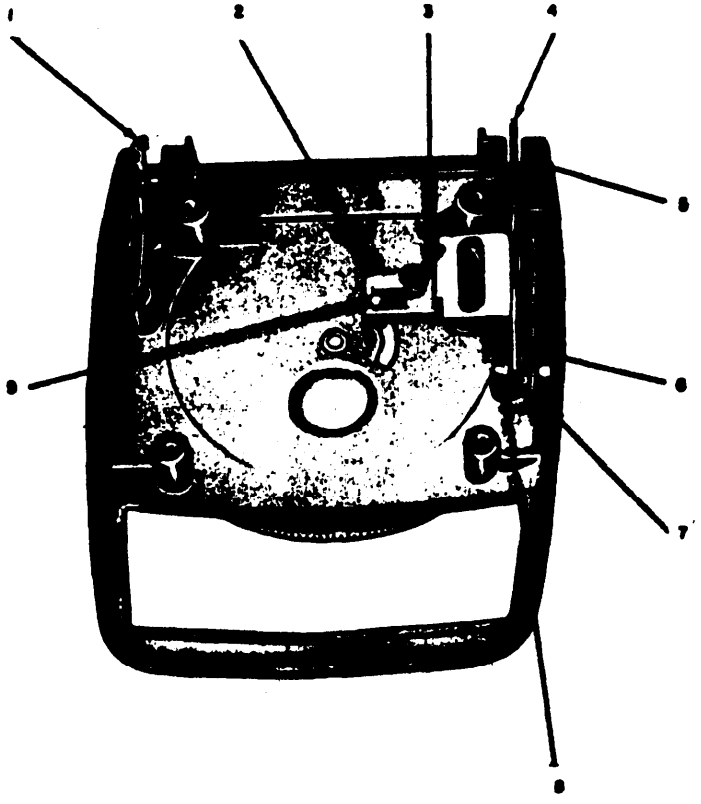
(4) Depress the baffle button (fig. 1) to release the spring latch (1, fig. 5) and lift the base assembly off the case assembly.

(5) The baggle button (3, fig. 6) and the gasket (6) now can be removed from the base assembly.

b. Removing Slider Assembly (fig. 5).

(1) Separate the case assembly from the base assembly (a above).

(2) With tweezers, pull back the slider spring (6) from the rear slotted stud (8) of the case assembly and lift out



TM6760-206-35-4

1 Spring latch
2 Lug (part of slider assembly)
3 Stud spring (part of slider assembly)
4 Slider (part of slider assembly)
5 Right-hand slot
6 Slider spring
7 Slider-spring pin
8 Rear slotted stud
9 Relative aperture dial stud

Figure 5. Case assembly, interiorw view.

the slider spring (6) together with the slider-springpin (7).

(3) With tweezers, disengage the stud spring (3) from the relative aperture dial stud (9) and lift out the remaining parts of the slider assembly.

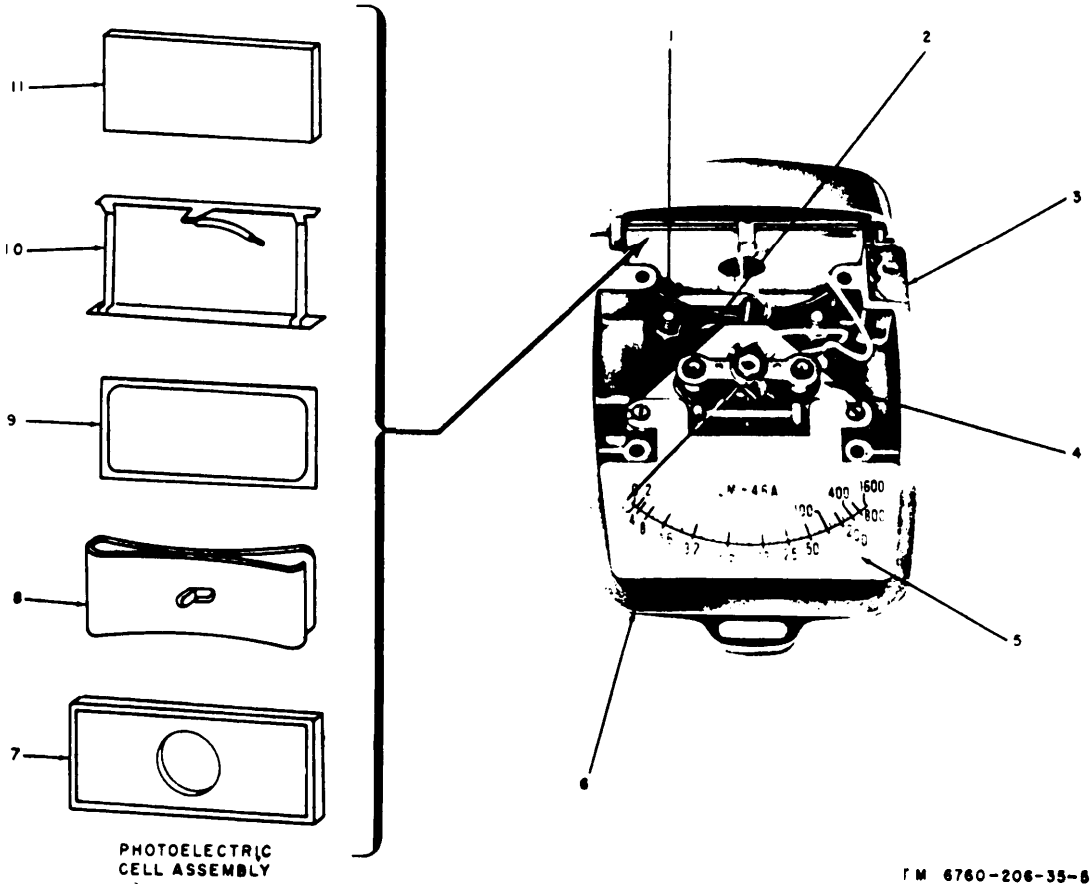
c. Removing Photoelectric Cell Assembly and Meter Movement (fig. 6).

Note. The photoelectric cell and the meter movement are matched units and must be replaced as a set.

(1) Separate the case assembly from the base assembly (a above).

(2) Mark for identification and unsolder the lead that connects the photoelectric cell assembly to the resistor assembly at the resistor assembly. Use a heat sink, such as pliers, between the soldering iron and the thermistor (2) and unsolder quickly. The thermistor will be damaged by direct heat from the soldering iron.

(3) Mark for identification and unsolder the lead that connects the photoelectric cell assembly to the meter movement at the meter movement.



1 Resistor assembly mounting bolt, washer, lockwasher, and nut
2 Thermistor (part of resistor assembly)
3 Baffle button
4 Meter movement
5 Lightmeter dial
6 Gasket
7 Housing
8 Spring
9 Photoelectric cell
10 Contact and leadwire assembly
11 Window

Figure 6. Base assembly, interior view.

(4) Grasp the photoelectric cell assembly firmly by the window (11) and the housing (7) and lift out the complete photoelectric cell assembly as a unit.
(5) Mark for identification and unsolder the lead that connects the resistor assembly to the meter movement at the meter movement.
(6) Remove the screws that secure the lightmeter dial (5) and lift the dial off the meter movement.
(7) Remove the meter movement nuts (fig. 4) with a straddle screwdriver (fig. 3) and remove the lockwashers under the nuts. Lift the meter movement (4, fig. 6) out of the base assembly.

d. Removing Resistor Assembly (fig. 6).
(1) Separate the case assembly from the base assembly (a above).
(2) Mark for identification and unsolder the two leads from the terminals of the resistor assembly. Use a heat sink, such as pliers, between the soldering iron and the thermistor (2) and unsolder quickly, because direct heat from the soldering iron will damage the thermistor.
(3) Remove the resistor assembly mounting nuts, lockwashers, washers, and bolts (1).
(4) Remove the resistor assembly and the spacers (not shown) under the resistor assembly.

11. Cleaning and Inspection

Whenever the case assembly and the base assembly are separated (para 10a), clean and inspect the interior of the exposure meter. Use a clean, dry, lint-free cloth to clean the inside of the case and base assemblies and all interior parts. Do not use liquids of any kind to clean any part of the exposure meter. Dust and foreign particles may be removed from the meter movement with a hand-operated blower; never blow into the meter movement because moisture in the breath may cause corrosion. Inspect all interior parts carefully and replace any that are not in satisfactory condition and may cause trouble in the near future. Replace the resistor assembly if the thermistor or the shunt resistor is discolored. Replace wiring that has cracked or frayed insulation. Replace the slider assembly if the springs are weak or distorted or the slider is bent. Replace the window of the photoelectric cell assembly or the lightmeter dial window if the window is scratched badly. Replace the gasket if it is hard, cracked, or broken.

12. Reassembly

a. Reinstalling Resistor Assembly (fig. 6).
(1) Insert the two resistor assembly mounting bolts (fig. 4) into the base assembly from the bottom. Place a spacer (not shown) over each of the resistor assembly mounting bolts.
(2) Place the resistor assembly (resistors upward) on the resistor assembly mounting bolts. Secure the resistor assembly in place with washers, lockwashers, and nuts.
(3) Solder the lead from the photoelectric cell assembly and the lead from the meter movement to the terminals of the resistor assembly. Use a heat sink, such as pliers, between the soldering iron and the thermistor (2, fig. 6) and solder quickly. Direct heat from the soldering iron will damage the thermistor.
(4) Reassemble the case assembly and the base assembly (d below).

b. Reinstalling Photoelectric Cell Assembly and Meter Movement (fig. 6).

Note. The photoelectric cell and the meter movement are matched units and must be replaced as a set.

(1) If the photoelectric cell assembly was disassembled for replacement of the photoelectric cell (9) or the window (11), reassemble the parts in the order and in the relative positions shown in figure 6.
(2) Grasp the photoelectric cell assembly by the window (11) and the housing (7) and insert the assembly as a unit into the base.
(3) Place the meter movement (4) in the base and secure it in position with the meter movement nuts and lockwashers (fig. 4). Tighten the meter movement nuts with a straddle screewdriver (fig. 3). Mount the lightmeter dial (5, fig. 6) on the meter movement.

(4) Solder the lead from the photoelectric cell assembly and the lead from the resistor assembly to the meter movement terminals.

(5) Reassemble the case assembly and the base assembly (d below).

c. Reinstalling Slider Assembly (fig. 5).

(1) Lay the case assembly, calculator dials downward, on a flat surface. Move the relative aperture dial stud (9) to the forward end of its slot.

(2) Apply a thin coating of Grease, Aircraft and Instrument (GL) to the right-hand slot (5) of the case assembly. Place the slider assembly in the case assembly so that the slider (4) lies in the right-hand slot (5) and the rear slotted stud (8), and so that the relative aperture dial stud (9) is in the rectangular hole of the lug (2) of the slider assembly.

(3) With tweezers, pull the slider spring (6) forward and insert the slider-spring pin (7) into the rear slotted stud (8).

(4) Wth tweezers, hook the stud spring (3) to the relative aperture dial stud (9).

(5) Reassemble the case assembly and the base assembly (d below).

d. Reassembling Case Assembly and Base Assembly (fig, 4).

(1) Reinstall the baffle button (3, fig. 6) and the gasket (6), if they were removed (para 10a).

(2) With the baffle lowered, position the case assembly on the base assembly and align the two assemblies carefully, Hold the case assembly and the base assembly together firmly and raise the bale so that the spring latch (1, fig. 5) engages the baffle.

(3) Continue to hold the case assembly and the base assembly together firmly and fasten the two assemblies together with the four machine screws and lockwashers (fig. 4).

(4) Lay the exposure meter face downward. Reinstall the SET ZERO screw and washer, if they were removed, or remove the retaining tape (para 10a).

(5) Place the nameplate on the bottomof the exposure meter and fasten it in position with the two Phillips head screws.

Section II. FINAL TESTING AFTER REPAIR

13. Purpose of Final Testing

The purpose of final testing is to determine the acceptability of repaired equipment. The specific requirements set forth in paragraphs 15e through g must be met before the equipment is returned to the using organization or to depot stock.

14. Test Equipment for Final Testing

The test equipment listed below is required for final-testing the exposure meter.

Meter, Foot Candle, Photographic ME-86/U
Variable light source capable of supplying from 4 to 400 foot-candles per square foot

15. Final Testing Procedures

Final testing of the exposure meter must be performed in an area from which all extraneous light can be excluded.

a. Place the ME-86/U and the variable light source (such as an incandescent lamp connected in series with a rheostat) on a suitable workbench or table. Position the ME-86/U about 4 feet from the light source and so that the light will fall directly on the ME-86/U.

b. Check the zero adjustment of the light-meter pointer of the exposure meter and, if necessary, adjust the pointer (TM 11-6760-206-12). Depress the baffle button of the exposure meter to lower the baffle.

c. Darken the area and energize the light source. Adjust the variable light source and, if necessary, move the ME-86/U toward or away from the light source until the ME-86/U indicates exactly 4 foot-candles.

d. Place the exposure meter alongside the ME-86/U so that light from the light source falls directly on the window of the photoelec-

tric cell assembly and so that the window and the lightsensing element of the ME-86/U are exactly the same distance from the light source.

e. Read the lightmeter of the exposure meter. The lightmeter reading should be within 10 percent of the value indicated by the ME-86/U.

Note. On the lightmeter dial, 10 percent of a particular reading is approximately the width of one scale calibration mark (not one scale division) on the dial.

f. Successively, adjust the variable light source (or position the ME-86/U and the exposure meter) (e and d above) so that the ME-86/U indicates 40, 100, and 400 foot-candles. After each adjustment, read the lightmeter and compare the reading with the ME-86/U indication. In each case, the lightmeter reading should be within 10 percent of the ME-86 U indication (40, 100, and 400 foot-candles, respectively).

g. Check the regularity of the lightmeter pointer movement as described in paragraph 8b. The pointer shall have full-scale deflection and return to 0 position within erratic movement or binding.

APPENDIX

REFERENCES

TM 11-4700	Electrical Indicating and Measuring Instruments; Repair Instructions.
TM 11-6760-206-12	Operator's and Organizational Maintenance Manual, Meter, Photographic Exposure LM-46A.
TM 11-6760-206-35P	Field and Depot Maintenance Repair Parts and Special Tools List, Meter, Photographic Exposure LM-46A.

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