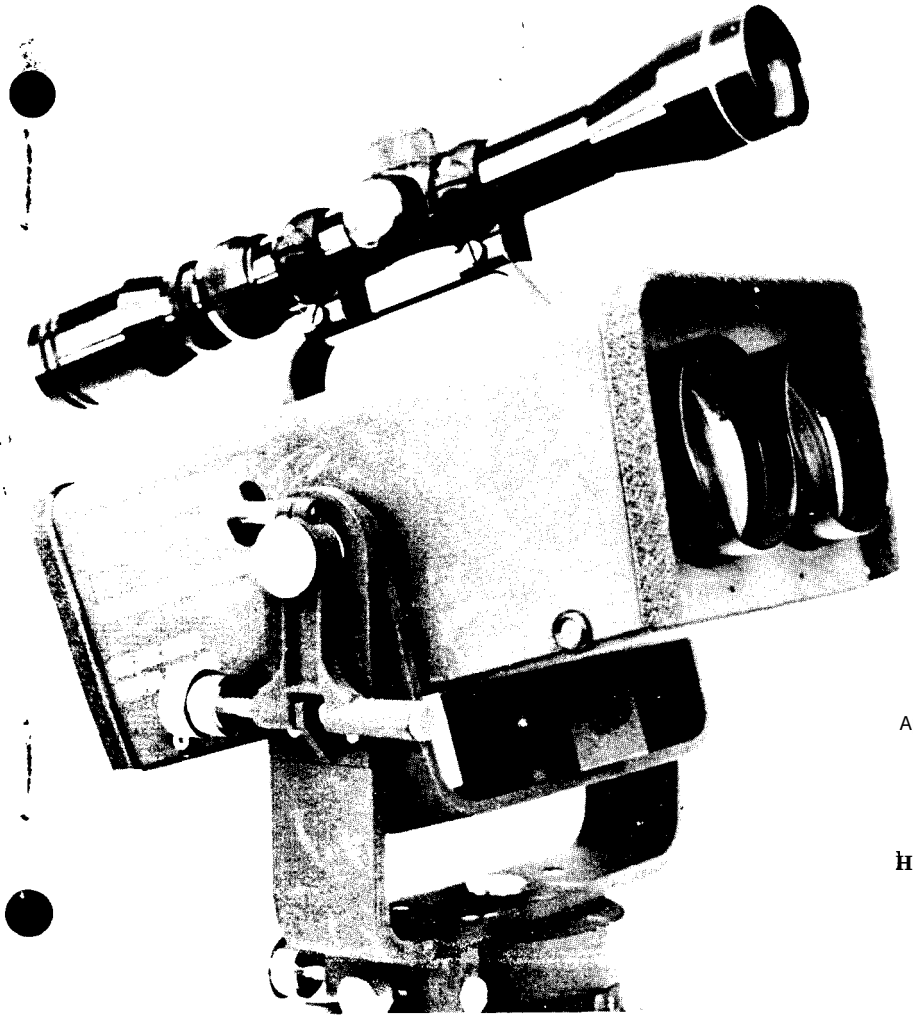

TM 5-6675-330-12&P

Technical Manual

Operator and Unit Maintenance Manual
(Including Repair Parts and Special Tools List)

for

SURVEY EQUIPMENT, DISTANCE MEASURING, ELECTRONIC, MEDIUM RANGE

MODEL/PART NO. 76-0507-1

NSN 6675-01-187-5139

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TECHNICAL MANUAL

NO. 5-6675-330-12&P

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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of away to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), to: Commander, U. S. Army Troop Support Command, ATTN: AMSTR-MCTS, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. A reply will be furnished directly to you.

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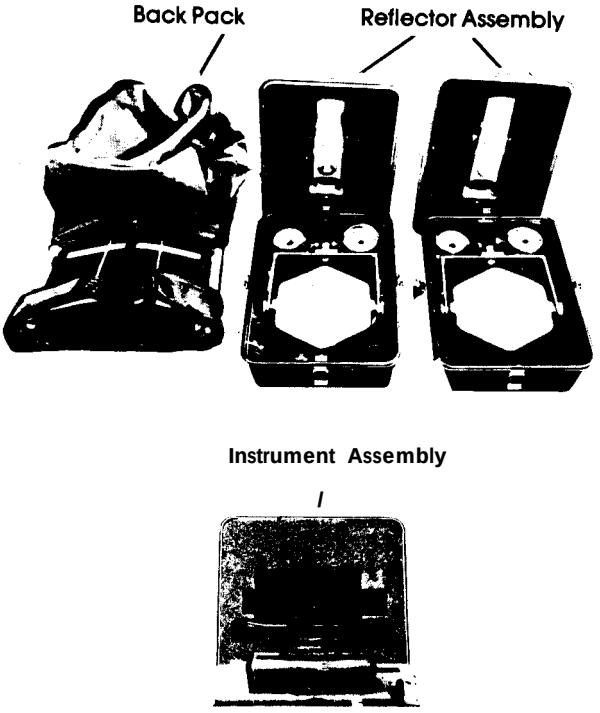

Figure 1- SEDME-MR

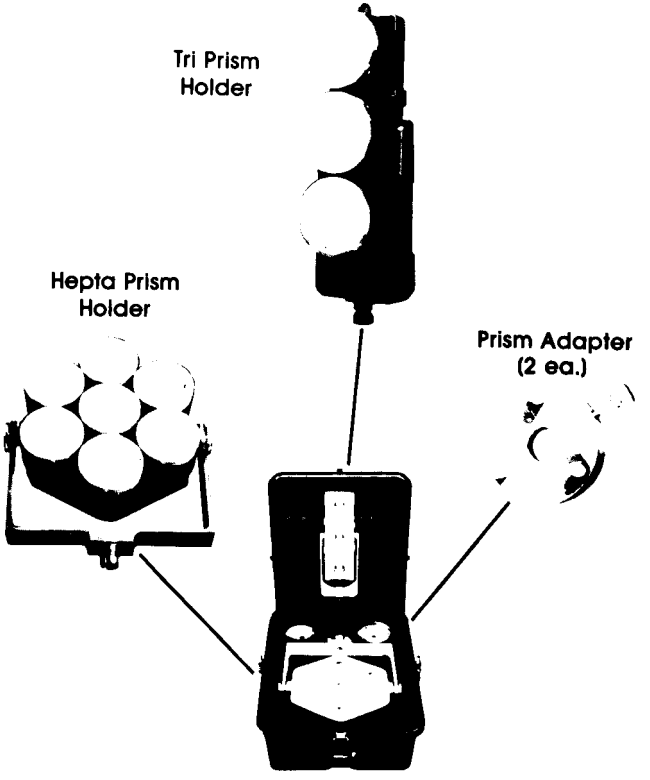

Figure 2 - Reflector Assembly

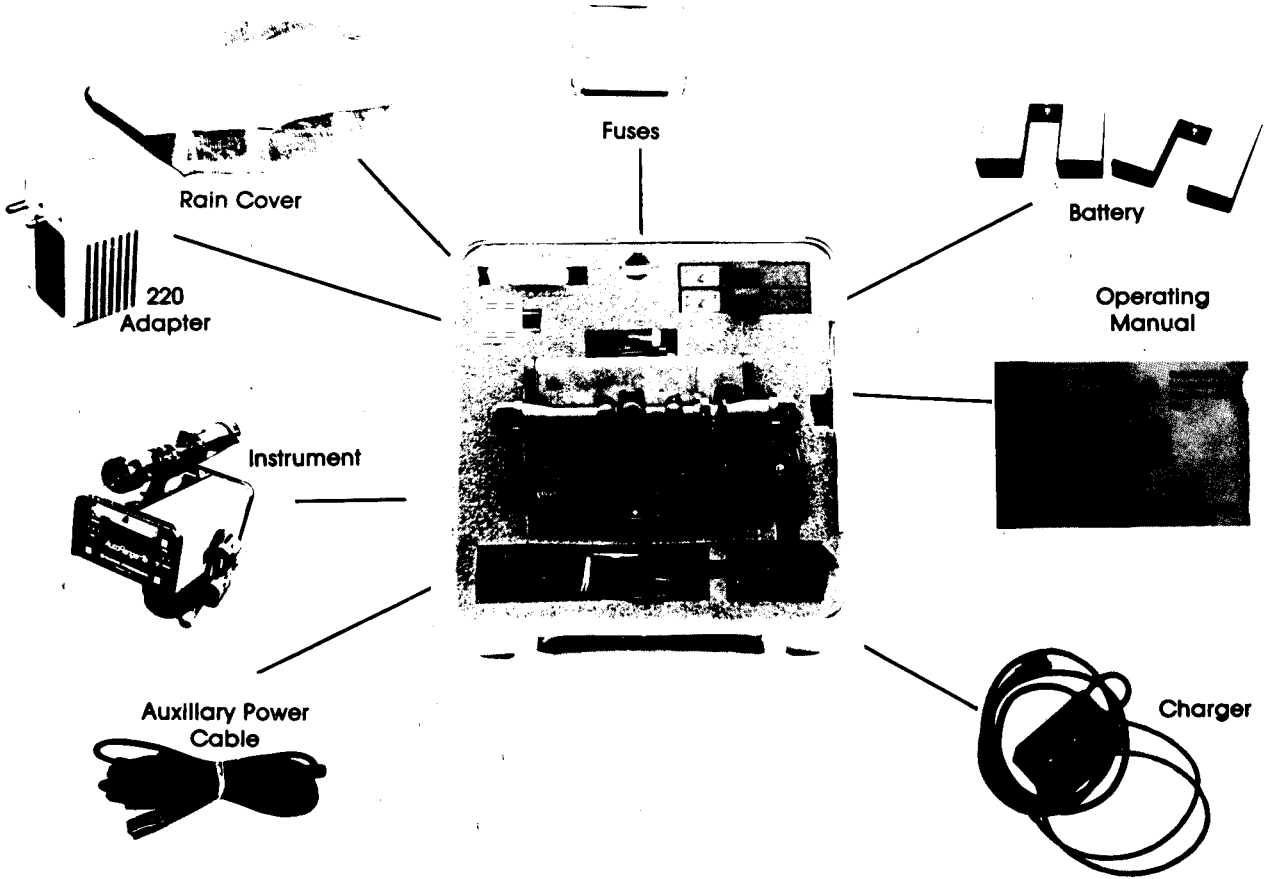

Figure 3 - Instrument Asembly

SECTION I
GENERAL INFORMATION

Scope of Manual

This manual is divided into four main sections, Section I contains descriptive data and specifications pertaining to the AutoRanger ® IIx Electronic Distance Measuring (EDM) instrument. Operating controls, indicators, and connectors are also illustrated and their functions are described in Section I. Section II provides instructions for initial inspection and check of an instrument upon receipt, and instructions for return of the instrument, if necessary. Section III provides detailed operating instructions and operating notes. A brief description of the principles of EDM measurement and a simplified block diagram of the instrument are also provided in Section III, Section IV provides operator maintenance instructions,

Equipment Description

Economic, simple operation, lightweight, and a high degree of accuracy area few of the features of the AutoRanger ® IIx EDM instrument which make it especially suitable for short- and mid-range surveying applications. Only a few seconds are required for distance measurements (dependent upon atmospheric conditions and number of prisms used), The instrument is accurate to within ± [5 millimeters (mm) + 5 parts per million (PPM)].

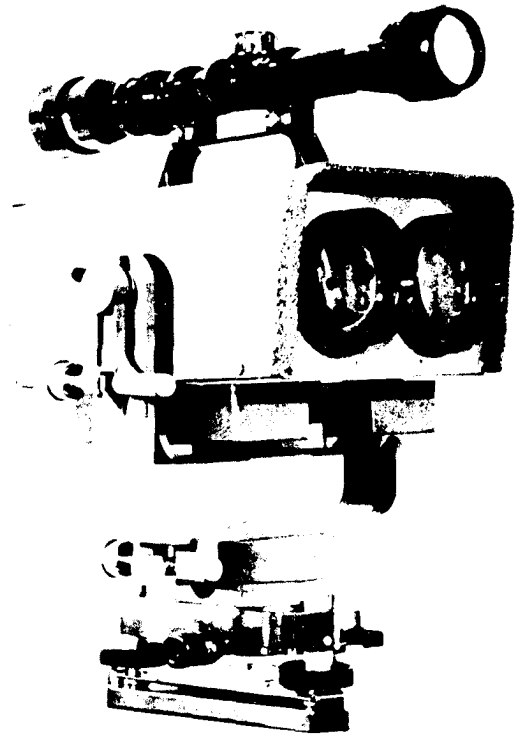

Figure 4- Typical Mounting

System Configuration

The AutoRanger ® IIx EDM instrument is a lightweight, compact unit designed for convenient tribrach mounting (see Figure 4), The integral yoke azimuth base provides a convenient set-up for distance measurements only.

Operating power for the AutoRanger ® IIx EDM instrument is supplied by a compact, 12-volt battery unit, An auxiliary power cable which permits operation of the instrument from any convenient 12-volt DC power source, such as a lead-acid battery, is also supplied,

The instrument uses a current modulated, solid state, light-emitting diode as a light source, The light beam modulating frequencies are generated by an internal quartz-crystal oscillator, which has a stability of ±1 ppm to assure measurement accuracy, An audible signal indicates when the invisible [infrared) light beam is on target,

Automatic Display Updating

With the instrument set to range mode, the 8-digit numerical display is continually updated approximately every 6 seconds. A rodman can move backward or forward with the retro-reflector, and the instrument will display the new distance automatically. Momentary interruptions of the light beam by traffic, atmospheric disturbances, wildlife, etc., will not affect the ranging sequence or accuracy of the distance measurements. Slope distance readouts are provided directly in meters and must be converted to horizontal distances for survey computation.

Simple Operation

After sighting the instrument onto the retro-reflector and maximizing the return signal, the operator performs the following simple steps,

a. Presses calibrate switch.
b. Waits for Ready Light.
c. Switches from the aim mode to the range mode by pressing a switch

The AutoRanger ® IIx EDM instrument is designed for operation with an on-board battery unit, Two battery units are supplied with the instrument. Approximately 750 continuous measurements can be made from each battery before recharging is necessary, A battery charger is supplied which is capable of charging both batteries at the same time.

Specifications

Range: 30 to 7000 meters. Maximum range is dependent upon atmospheric conditions and number of prisms used. (See table 1.)

Accuracy: ± (5mm + 5ppm)

Resolution: 1 mm

Unit of Measurement: Meters (slope distance)

Readout: Automatic, 8-digit Liquid Crystal Display (LCD]

Light Source: Infrared light emitting diode 865nm wavelength

Optical Configuration: Binocular

Lens Aperture: 2.1 inches, transmit and receive (with antireflective coating)

Offset Correction: ± 99mm, front panel switch

PPM Correction: ± 99ppm, front panel switch

Sighting Scope: Variable 3 to 9 Power

Battery: 12V 1.2 AH Nickel-Cadmium

Power Consumption: 10 watts

Temperature Range: –20°C [–5°F) to + 55°C (130°F]

Humidity: 95% relative humidity (noncondensing)

Measuring Time: 6 seconds under average conditions

Weight With Battery (approximately) 8 lbs. 13 oz.

Dimensions: 12''x8''xl2", including telescope and yoke

Maximum Range Capabilities

The maximum ranges listed below are those that can normally be expected under the stated atmospheric conditions,

	Excellent	Good	Average	Poor
Visibility	40 Km 25 Mile	23.5 Km 14,6 Mile	15 Km 9.3 Mile	3 Km 1.9 Mile
Haze	None	None	Light	Strong
Sky	Overcast	Partially Clear	Moderate Sun	Bright Sun
Heat Shimmer	None	Minimum	Light	Severe

Prisms	Maximum Range			
2 Sets		7 Km		
1 Set	7Km	6Km	5-6 Km	2-3 Km
7 Cluster	6-7 Km	5-6 Km	4-5 Km	1-2 Km
3 Cluster	4-5 Km	3-4 Km	2-3 Km	0.5-1 Km

Table 1 Maximum Range vs Atmospheric Conditions and Number of Prisms

Electronic Distance Measuring Instrument Certification

Any parts of the instrument (except batteries) found by Cubic Precision, Inc. to be defective in material or workmanship will be repaired, or at Cubic Precision's option, replaced for the original purchaser within one year of original purchase, provided the instrument is returned transportation prepaid to the appropriate authorized Service Center within a one-year period and the instrument is in as good condition as when originally purchased, ordinary wear resulting from careful use only expected, and the instrument has not been subjected to misuse, rough handling, alteration or servicing by other than an authorized service representative, negligence, fire, accident, water damage, ACTS of God, or other casualty.

The above is in lieu of any expressed or implied warranties and **THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR USE.** We assume no responsibility for any inconvenience, loss, injury, or direct or consequential damage arising from the possession or use of the instrument.

Operating Controls and Indicators

Index No.	Control, Indicator or Connector	Function
1	Fuse Holder	Permits changing fuse"
2	Power Connector	Connects instrument to battery unit or external battery using Auxiliary Power Cable
3	PWR Switch	Alternate action pushbutton switch turns instrument ON and OFF,
4	Battery Lamp	Flashes when battery is low. Readings may be made until automatic power off mode is entered, at which point light glows bright and steady,
	NC Under low ambient light conditions a faint glow may be observed. This is normal and does not indicate **a** low battery voltage condition.	
5	Offset Switches	Provide means for entering off-set correction into instrument in mm steps ± 00-99mm.

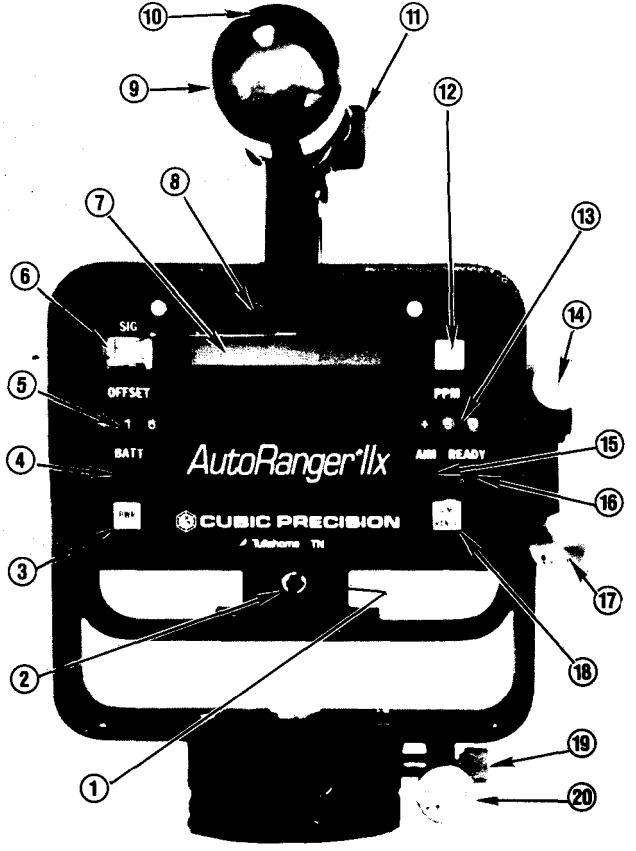

Figure 5- Operating Controls and Indicators

Operating Controls and Indicators (cont.)

Index No.	Control, Indicator, or Connector	Function
6	Signal Meter	Indicates average return signal level used to peak instrument on target.
7	Numerical Display	8-digit liquid-crystal display, Indicates range in meters,
8	Night Illumination Switch	When in UP position illuminates front panel for night operation
9	Zoom Adjustment	Provides sighting telescope adjustments from 3 to 9 power.
10	Vertical Cross-hair Adjustment	Provides vertical adjustment for boresighting telescope.
11	Horizontal Cross-hair Adjustment	Provides horizontal adjustment for boresighting telescope.
12	Cal/Start	Initiates calibration sequence to adjust return signal to normal operating level when in aim mode; in itiates a new range sequence when in range mode.
13	PPM Switch	Used to enter barometric and temperature corrections into instrument ±99ppm
14	Vertical Lock	For securing vertical adjustment
15	Aim Lamp	ON in aim mode.
16	Ready Lamp	When ON , calibration sequence has been completed and return signal is in the optimum range to measure
17	Twc Speed Vertical Tangent Screw	For coarse and fine vernier vertical adjustment to achieve maximum target acquisition.
18	Aim/Range	Alternate action pusn-button switch; aim mode is used for target acquisition and return signal level ad justment; mode is used for ranging,
19	Horizontal Lock	For securing horizontal adjustment.
20	Two Speed Horizontal Tangent Screw	For coarse and fine vernier horizontal adjustment to achieve maximum target acquisition.

SECTION II
INITIAL INSPECTION

Mechanical Check

> NOTE:
> Upon receipt of the SEDME-MR, a complete mechanical inspection should be made.

Check to make certain that all components of end items are included in the carrying cases. (See Figures 1, 2, 3].

Examine the lenses and prisms to make certain that they are clean and undamaged.

Operate the OFFSET and the PPM switches and check for smoothness of operation.

Performance Check

To verify that the instrument is operating properly, make a performance check after completing the mechanical inspection. Set up the instrument on a known base line, make at least three measurements, and compare the mean of the displayed range readouts with the known range. (Page 18).

If the instrument operates incorrectly, consult the OPERATING NOTES and the MAINTENANCE section. If additional corrective action is required, return instrument to appropriate repair facility.

Repacking For Shipment

1. A failed distance meter must be returned in its case for repair.

> NOTE:
> The carrying case is not a shipping container, Ensure that the carrying case is packaged adequately for commercial shipment to prevent damage.

2. Attach exchange tag to the instrument specifying the organization that presently operates/maintains the SEDME-MR and a brief description of the problem. All , tags should identify the instrument by its serial number.

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SECTION III

OPERATING PROCEDURES

Operating Instructions

1. Preliminary Set-up

(a] Set up tripod and plumb accurately over the point from which the distance measurement is to be made.

NOTE:
Set up over the point very carefully; Inaccurate set-up is usually the cause of measurement errors.

(b) Adjust the tribrach leveling screws as required to center the tribrach leveling bubble, Make the leveling adjustment accurately. Remove theodolite and mount instrument on tribrach. Check tribrach leveling bubble; readjust if necessary.

(c) Adjust vertical lock (14) and horizontal lock (19) firmly enough to allow holding action, but free enough to permit movement of the instrument under pressure.

(d) Place battery pack into instrument (21) or us- auxiliary power cable connect to remote 12vdc power source.

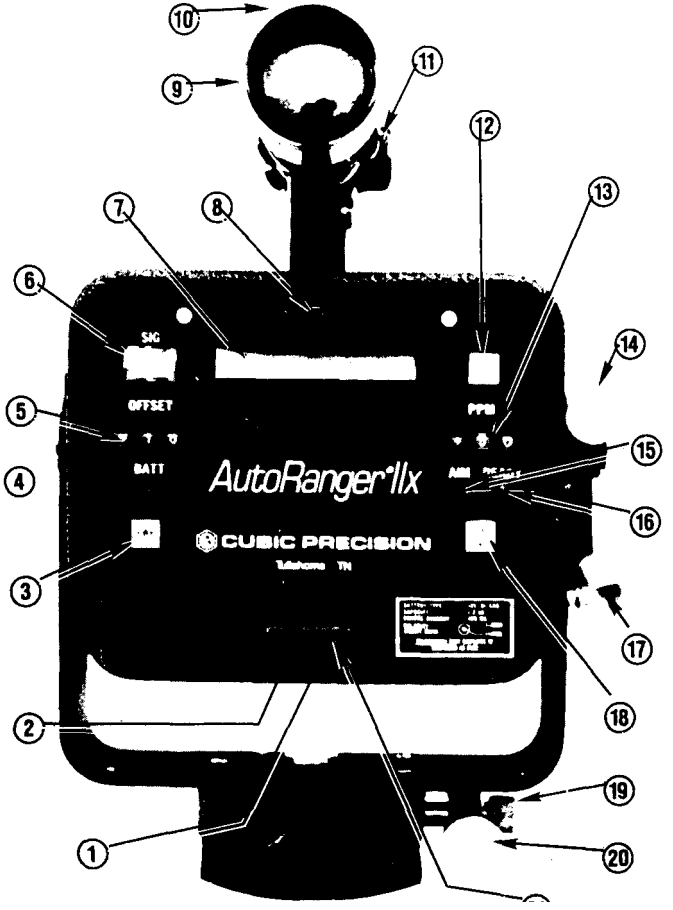

Figure 6- Controls

(e) When using the auxiliary cable, connect the power cable to power connector (2). Connect the red clip lead of the power cable to the positive terminal of the 12 volt DC power source, and connect the black clip lead to the negative terminal of the DC power source.

(f) Setup the retro-reflector accurately over the point to which the distance measurement is to be made. Align the retro-reflector on the line of sight to the instrument (see Figure 7). For maximum signal return the retro-reflectors should be perpendicular, with ±5 degrees, to the instrument line-of-sight.

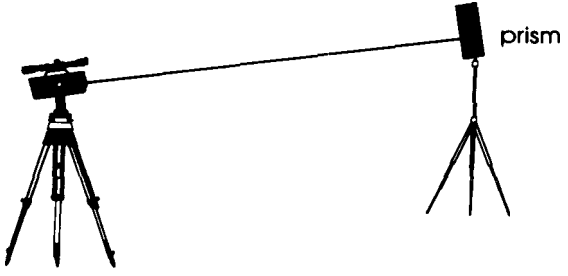

Figure 7- Prism Alignment

2. Computing PPM Correction

NOTE:
This computation is not required by field artillery and the PPM switches should be set to 00.

[a] Take a temperature reading with the thermometer placed in a shaded area and positioned six to eight feet above ground surface. Record this temperature reading.

(b) Take a barometric reading with the barometer placed in a shaded area that is protected from gusty wind conditions. Record this barometric reading,

(c) Using the Atmospheric Correction Graph (See Figure 8), Page 17, read the PPM Correction at the intersection of lines extending from the measured temperature and pressure, A one PPM variation will cause a 1 millimeter per 1 kilometer distance variation.

(d) Using PPM switches (43), dial the computed PPM correction into the instrument.

NOTE:
The computed PPM correction can be either positive or negative. Remember that the ± section of the PPM switch (43) will have to be set to one of the positive or negative position for positive or negative PPM corrections, respectively.

3. Offset Switch Setting

(a) Obtain the instrument total offset correction (TOC) from the instrument offset plaque located at the bottom front of the instrument. (Page 18].

[b] Using OFFSET switches (5), dial the offset correction into the instrument.

4. Test

An automatic test function is built into the instrument, The test provides a quick check of the internal microcomputer and display circuits, To perform a test, proceed as follows:

(a] Press PWR switch (3) to turn on the instrument.
(b] When power is turned ON the instrument enters the test mode, and the numerical display (7) should sequence automatically from all zeros to all nines and then display four zeros.

5. Target Acquisition

NOTE:
Maximum range accuracy can be achieved only if the instrument is positioned accurately on target.

After the test function has been completed, the instrument is ready for alignment on the retro-reflector target. Using the vertical (17) and horizontal (20) tangent screws, position the sighting scope reticle on the target. For shorter distances

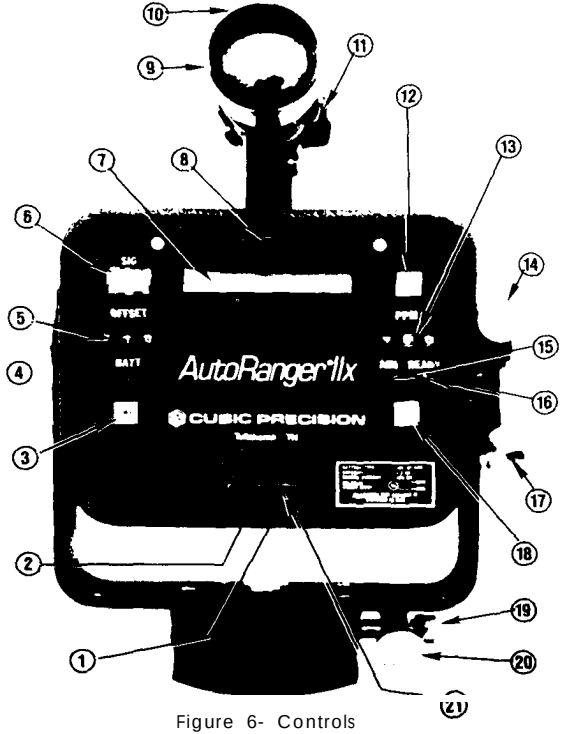

Figure 6- Controls

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the sighting point should be 4.5 inches above the retro-reflector. When the retro-reflector is first acquired and a return signal is received, an audio tone will sound for approximately two seconds and then go off. The audio tone will be reinitiated each time the return signal falls below a predetermined level after initial acquisition. When the retro-reflector has been acquired, proceed as follows:

(a) Note the indication on SIGNAL meter (6). Carefully adjust the vertical and horizontal tangent motions as required to maximize the SIGNAL meter indication.

(b] If the pointer of SIGNAL meter (6) runs up against the right stop because the signal level is too great, press CAL/START switch (12). READY light (16) should light and the meter pointer should be positioned automatically to approximately mid-scale before further adjustment of vertical and horizontal tangent motions is attempted, Near maximum range of instrument the meter pointer may indicate left of center, but, if READY light is on, target acquisition may continue.

(c) Repeat steps (a) and (b) until no further increase in the indication on SIGNAL meter (6) can be obtained.

(d)As the last step in the acquisition procedure, press CAL/START switch (12) and wait for READY light (46) to light. When the READY light lights, the instrument is ready for ranging.

6. Ranging

(a) After the target acquisition procedure has been completed, press AIM/RANGE switch (18), being very careful not to move the instrument, AIM light (15) should go out.

(b) The instrument will begin to cycle automatically, A slight clicking sound will indicate that the measurement is being made, In approximately six seconds, the measured range will be displayed on numerical display (7) Read the range directly, in meters, The instrument will continue to make range measurements automatically, updating the range indication on numerical display (7) approximately every six seconds as long as the instrument remains in the range mode. Readings may vary by a few millimeters at short distances to several millimeters at long distances.

NOTE:
The audio tone will not function in the range mode of operation.

(c) When in the range mode, pressing the CAL/START switch will initiate a range sequence.

(d) The range sequence may be stopped by pressing the AIM/RANGE (18) switch to select the aim mode or by pressing the PWR (3) switch to turn off instrument power.

Operating Notes

The following information facilitates rapid and proper use of the instrument. Since the distance measurement process is completely automatic, these operating notes are intended to provide clarification Of the instrument set-up procedures. The information included here is particularly important when either a new instrument is to be used for the first time, or when an operator desires an initial familiarization with the instrument.

1. Mounting.

The instrument is designed for mounting on a tripod-mounted theodolite tribrach. If the tribrach type is changed, a different mounting adapter may be required.

2. Retro-reflectors (Prisms)

Since an offset correction can be dialed manually into the instrument, the instrument can be used with any prism whose reflection constant is known. The supplied prism assemblies and adapters are designed for mounting on a tripod-mounted theodolite tribrach.

3. Instrument and System Offset.

The true distance between the vertical axis of an EDM instrument and the vertical axis of a retro-reflector usually differs from the uncorrected distance computed by the EDM instrument. This difference is due to a combination of the retro-reflector prism offset and the instrument offset. Prior to shipment of each AutoRanger ® IIx EDM instrument an offset correction, calibrated for that instrument and a standard 30mm retro-reflector prism, is entered into the instrument using the offset switches. The total offset correction (TOC) is stamped on a decal affixed to the bottom-front of the instrument. As long as retro-reflector prisms of the same offset are used with the instrument, and the offset switch settings are not disturbed, the display range of the AutoRanger ® IIx EDM instrument will correspond to the true range, with no need for operator entry of offset corrections.

4. Bright Sun Caution.

Optical systems for EDM equipment are designed for infinity focus. The sensitive detector is located at the focal point of the receiver optics. Do not aim the instrument directly at a bright sun.

5. Ready Light.

High accuracy is maintained in the AutoRanger ® IIx EDM Instrument through use of a window circuit that automatically monitors the ranging signal. This circuit permits range computations only when the return signal is within preset limits. When the target has been properly acquired and the **CAL/START** switch is pressed, an internal servo system, automatically adjusts an optical attenuator as required to bring the signal level within the proper operating limits. Proper adjustment of return signal level is indicated by lighting of the **READY** light.

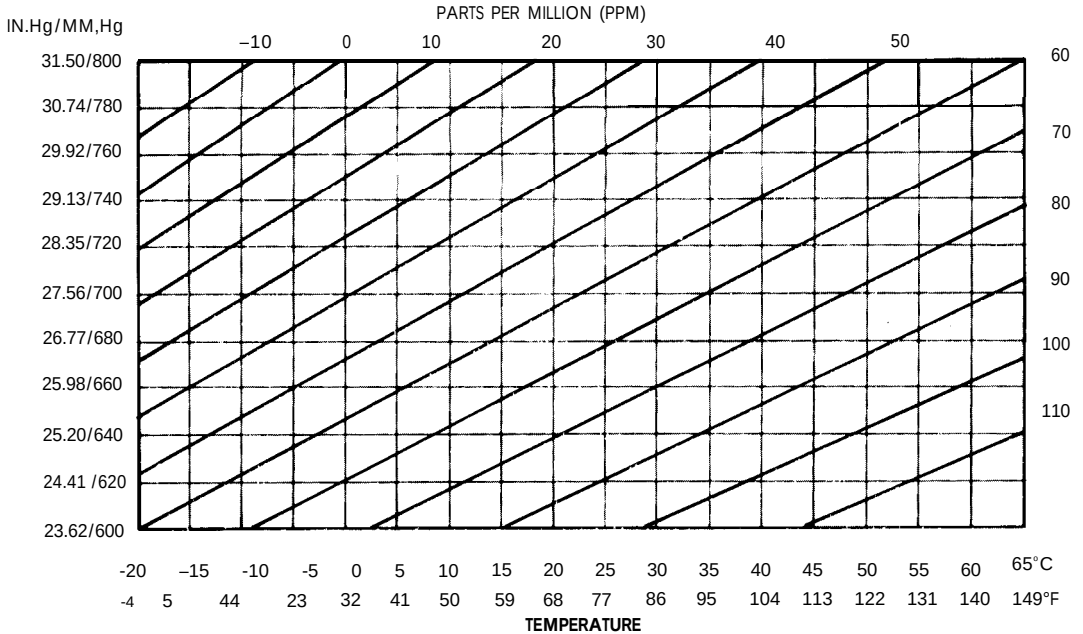


Figure 8 Atmospheric Correction Graph

6. Atmospheric Correction.

Because the velocity of light in air varies slightly with different atmospheric conditions, an atmospheric correction is required for local conditions if the full accuracy of the AutoRanger ® IIx EDM instrument is to be attained. The main atmospheric factors affecting light velocity are air pressure and temperature; humidity changes have a negligible effect.

The atmospheric correction should be taken from the graph (see Figure 8). Enter the graph at a known pressure and temperature and read the atmospheric constant (in parts per million), This value must be entered into the EDM instrument to obtain corrected distance measurements.

When measuring long lines or lines having different elevations at the end points, measuring the pressure and temperature at both ends of the line and averaging the values provides a more accurate atmospheric correction constant.

7. Power Fuse.

The power circuits of the instrument are protected against overload by a power fuse. If the power fuse should fail, power is no longer applied to the internal circuits, If no response is seen when the **PWR** switch **(3)** is actuated, check or replace fuse, If more than one fuse failure occurs, the instrument should be returned to depot repair facility for repair.

8. BATT Light.

A low battery condition is indicated by flashing of **BATT** light **(4).** Reliable range measurements can still be made with the light flashing; however, the instrument will go into an automatic power-off mode when battery voltage falls below a preset limit. At this point, the **BATT** light will glow brightly and steadily, Connection of a fully charged battery pack or auxiliary source to the instrument will permit resumption of normal operation.

NOTE:
Under low ambient light conditions a faint glow may be observed, This is normal and does not indicate a low battery voltage condition,

9. Determination of Total Offset Correction.

Although the total offset correction has been entered into the instrument before shipment from the factory, the accuracy of the total offset should be verified under actual operating conditions. (Refer to performance Check,) If no known base line is available, use the following procedure.

The true distance between the vertical axis of an EDM instrument and the vertical axis of a retro-reflector will usually differ from the instrument's displayed range unless the proper offset correction figure is used. The difference is due primarily to two factors: retro-reflector prism offset, and instrument offset.

A prism offset is positive (the effect of the prism is to increase the indicated range beyond the true value),

If a known base line is not available for determination of the ranging accuracy of the instrument, the following peg test may be used to determine the total offset correction required:

NOTE:
For optimum results make A=60m ± 1m, B=40m ± 1m, and C= 100m ± 1m, or multiples thereof.

(a] Lay out three points in a straight line, These points do not have to be on a level plane, but they should be on a uniform grade, The intermediate point should not divide the line into two equal segments.

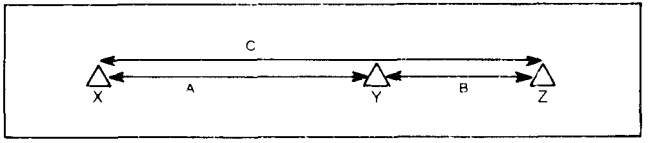


Figure 9- System Offset Correction Test Layout

(b) Set the offset (5) ppm (13) switches on the front panel to 00.

[c) Set up the instrument on each of the three points and make measurements to each of the other points. This gives double measurements for both segments of the line and for the overall length; that is, one measurement will be made from each end of each line, Use the mean of the two measurements in the calculation. All measurements consist of the mean of ten individual range displays on the instrument.

[d) Compute the total offset correction, using the designations in figure 9 and the following equations,

C = A + B

MA = Mean distance read for Segment A

MB = Mean distance read for Segment B

MC = Mean distance read for Segment C

Then:

TOC = MC –(MA+MB]

NOTE:
Instrument has been calibrated using prisms having a 30mm offset

EXAMPLE 1

Assume the following field readings:

From X to Y = 39.939m
From Y to X = 39.941m Average = MA = 39.940m

From Y to Z = 59.939m
From Z to Y = 59.941m Average = MB = 59.940m

From X to Z = 99.939m
From Z to X = 99.941m Average = MC = 99.940m

TOC = MC – (MA + MB)

TOC = 99.940–(39.940 + 59.940)

TOC = + 60mm (see decal on instrument)

EXAMPLE 2

From X to Y = 40.039m
From Y to X = 40.041m Average = MA = 40.040m

From Y to Z = 60.039m
From Z to Y = 60.041m Average = MB = 60.040m

From X to Z = 100.041m
From Z to X = 100.039m Average = MC = 100.040m

TOC = Mc – (MA + MB)
or
TOC = 100,040–(40,040 + 60.040)

TOC = –0.040m

TOC = –40mm [see decal on instrument)

If the peg test has been run to verify the TOC as stamped on the instrument (assuming the use of 30mm prisms), verify or change accordingly.

If the peg test has been run to establish the TOC using other than 30mm prisms, the new TOC should be used in place of factory established TOC.

To enter a different TOC see pages 13-14 for instructions.

10. Sighting Telescope Alignment.

Place a single prism or a triple prism cluster, with only the center prism uncovered, at a distance of 30 to 50 meters from the EDM instrument, Using the vertical and horizontal tangent screws, position the telescope crosshairs on the center of the prism. Turn the instrument power on and select the AIM mode, If there is no signal indication, search the area near the prism until the signal is acquired. Using the tangent screws maximize the signal. (see Target Acquisition, page 14). Remove covers from vertical **(10)** and horizontal **(11)** crosshair adjustments. Using horizontal adjustment **(11),** position vertical crosshair to center of prism. Using vertical adjustment **(10),** position horizontal crosshair to a point 4.5 inches above center of prism (see Figure 10], After adjustments, re-maximize signal to insure proper alignment, Replace adjustment covers.

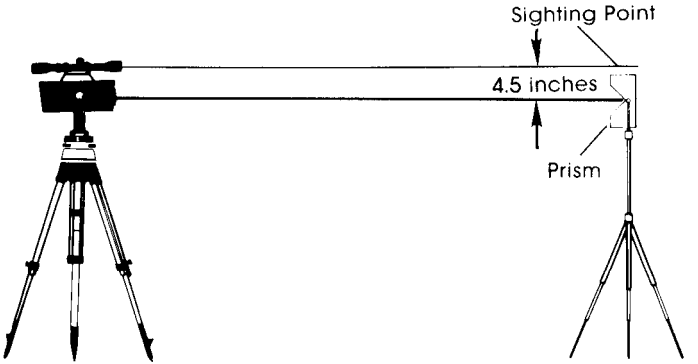


Figure 10 - Telescope Alignment

11. Trouble Shooting.

If the operating instructions are carefully followed, no problems should be encountered in ranging operation using the Auto-Ranger ® IIx EDM instrument, If a problem is encountered, check the following table before attributing the cause of the problem to the instrument,

Malfunction	Probable Cause	Corrective Action
Instrument inoperative	Power fuse blown	Replace fuse
Fuse blows repeatedly		Return to Depot
Instrument operates but BATT light flashes	Power unit battery voltage is low	Recharge power unit battery
During target acquisition, panel meter pointer does not reach center scale, READY light does not come on, and target screw adjustment will not raise pointer.	Not enough prisms for range being measured.	Increase number of prisms
	Instrument lens may be dirty.	Clean lens
	Internal Electronic failure	Return to depot
Instrument operates, but total operating hours shorter than normal	Battery pack may have bad cell	Replace Battery pack
Range reading incorrect by constant amount	Offset switch setting may have been disturbed	Make certain that offset switches are set to offset correction value
Instrument appears to operate but will not complete range cycle. Signal Meter drops to zero and READY lamp goes out.	Target Path blocked after range cycle started	Clear target path
	Internal electronic failure	Return to depot

Basic Principles of Operation

The AutoRanger ® IIx EDM instrument uses a technique typical of EDM systems, known as phase comparison (Figure 11). The modulated light beam is directed onto a retro-reflector positioned at the point to which the range measurement is to be made, A reflected light beam returns from the retro-reflector to the instrument, where it is converted into an electrical signal (Figure 12), The phase relationship between the transmitted and reflected beams of light is compared by the unit's self-contained computer processing circuitry, and is converted into a direct read-out of slope distance. Figure 13 shows a simplified block diagram of the AutoRanger ® IIx EDM instrument.

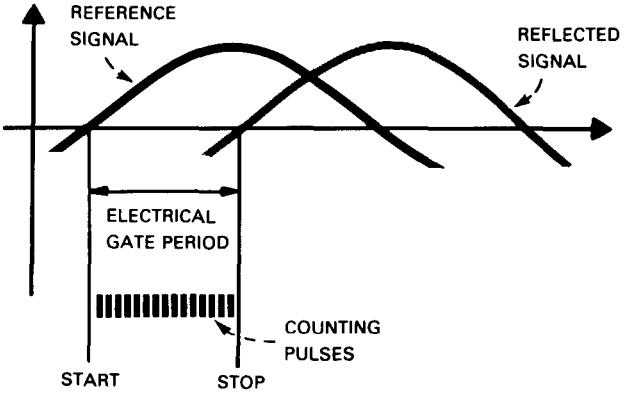


Figure 11- Phase Comparison

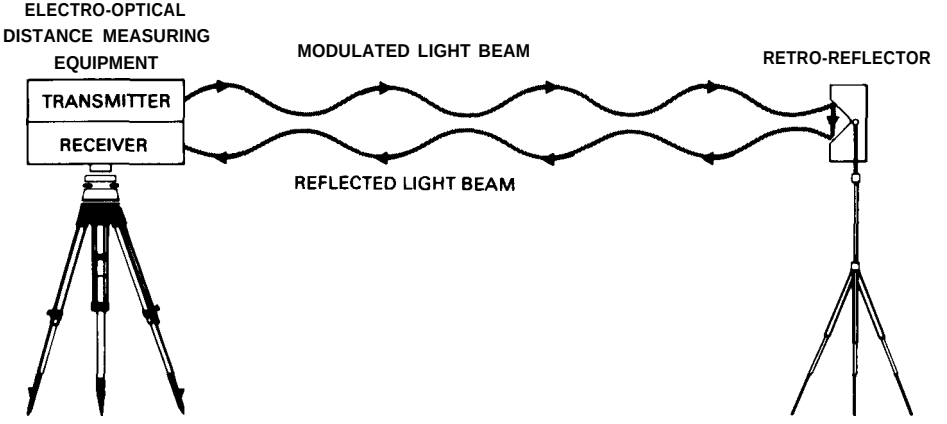


Figure 12- Typical EDM System Configuration

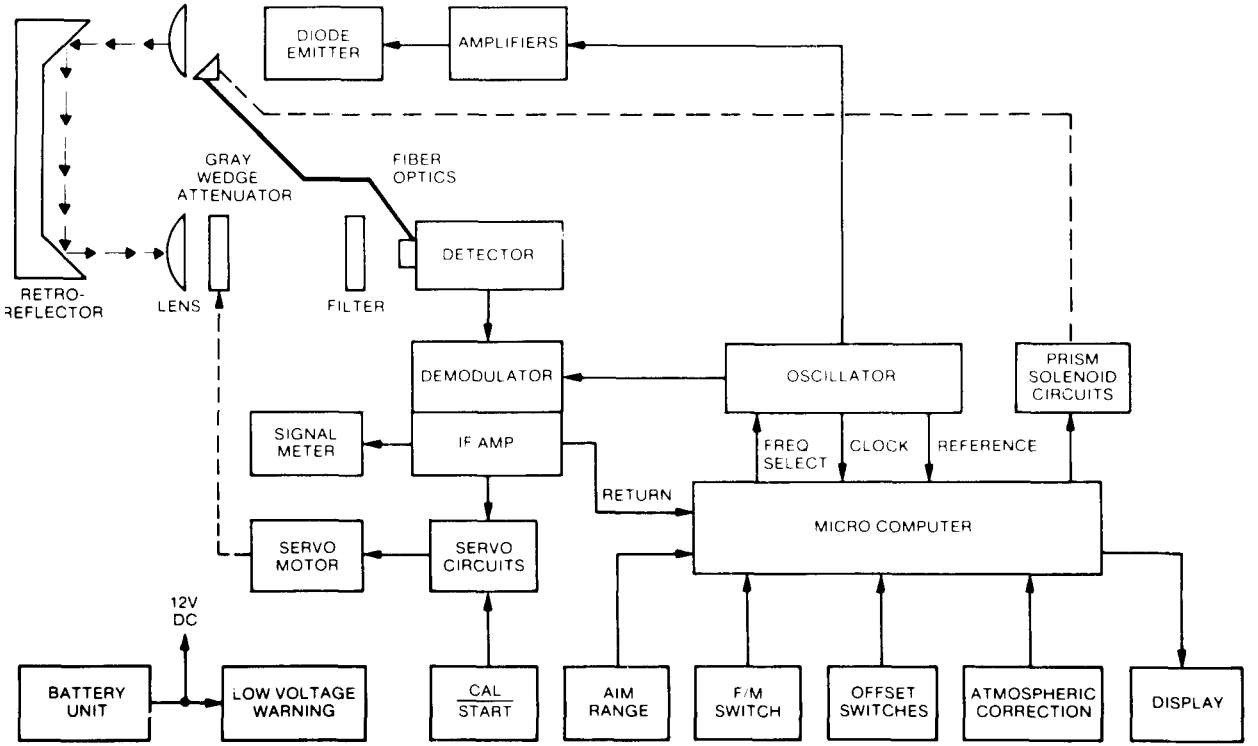


Figure 13 - Simplified Block Diagram

Effects of Prisms and Atmosphere on Maximum Range

Cube corner prisms, normally the type of reflector used as a target for light emitting instruments, have the property of reflecting light rays back in the same direction as the incoming rays. This eliminates critical angular alignment with respect to the EDM instrument, The quality of the prism, defined by the flatness of the surfaces and the accuracy of the 90 degree angles, and the total number of prisms have a square law effect on the maximum distance that can be measured. For example, decreasing the quality of the prisms by a factor of two increases by a factor of four the number of prisms required to give the same maximum range, or, for a given quality prism, doubling the range would require a factor of four increase in the number of prisms required. Atmospheric factors such as absorption, scattering, refraction, and background radiation tend to reduce the maximum distance that can be measured. Absorption and scattering relate to particles such as dust, fog, smoke, rain/snow, etc., in the air and have the effect of reducing maximum range in an exponential manner. This atmospheric condition is normally defined in terms of sea level visibility and, for a given number and quality of prisms, can cause wide variations in the maximum range achievable.

Variations in atmospheric pressure and temperature, which cause localized changes in the index of refraction of air, result in the bending of light rays and can cause a reduction in range capability for a given number of reflector prisms, These localized variations are generally described as scintillation or heat shimmer and are more pronounced along lines having low ground clearance, As a general rule, high scintillation conditions can be considered as a square law function, thus requiring four times the number of prisms to double the range, Light ray bending due to more gradual gradients in the index of refraction, especially over long ranges, can result in an apparent change in a target's position, This, in the case of low ground clearance along a measured line, could result in the loss of a target when going from daytime to night time conditions, Back-ground radiation, in the visible and infrared wave lengths, has the affect of increasing electronic noise internal to the instrument and may cause wide variations in readings for a given distance, This condition normally exists only when working with the EDM instrument pointed close to the sun and should be avoided because of possible damage to internal instrument components.

SECTION IV
MAINTENANCE

Packaging

The instrument is packaged in a molded carrying case with foam inserts. [See Figure 3). Pack the equipment in the carrying cases when it is not in use.

Transportation

The carrying case has been designed to minimize the possibility of damage to the instrument and the accessories when they are being transported. Make sure that all equipment is properly packed in the carrying case. Protect the equipment from shock and vibration to the maximum extent possible while it is being transported.

Shipment

Packaging for shipment requires special attention because shipped items may be handled roughly. When shipping the instrument to an authorized service center for repair, ship only the instrument in its carrying case.

NOTE:
The carrying case is not a shipping container Ensure that the carrying case is packaged adequately for shipment to prevent damage.

Lens Care

Use care when cleaning dust or moisture from lenses. Do not touch with fingers or use coarse cloth, paper, or other material that might scratch the lenses. Tissue, or a camel's hair brush may be used. Although rarely required, mild soap and water solutions may be used safely for the removal of fingerprints.

Condensation

Condensation of moisture on the instrument lenses can occur when the instrument is taken from a cold environment to a warm environment, such as from outdoors to indoors. It is recommended that the instrument be left in its carrying case for several hours under such conditions to allow for a gradual temperature change.

Retro-Reflector Prism Care

The retro-reflector prisms are high-quality optical prisms, and should be given the same care as recommended for lenses.

Lubrication

The threads of the yoke tangent and locking screws are the only items that may require lubrication. Application of a small amount of dry lubricant (such as graphite) to the threads will be sufficient in most cases.

Nickel-Cadmium Battery

1. The power unit consists of a unitized, 12-volt, NiCad battery package. A battery charger is supplied with the instrument for recharging of the battery pack after each normal day of operation, and after prolonged periods of storage. The battery charger has been designed for an "overnight" charge.

2. A NiCad battery has been selected for use in the power unit, because such a battery, under proper care, provides good performance over an extended lifetime. The following information is provided to assist the user in obtaining optimum battery performance.

3. Temporary effects on battery capacity may occur if repetitive discharge and charge cycles are used. This is sometimes referred to as "memory." When the battery is fully discharged or discharged to random levels as in normal operation and charged for random times, this memory effect does not occur.

CAUTION

Before plugging the battery charger into an AC power outlet, make certain that the rating of the battery charger matches the rating of the available AC Power source.

4. The battery charger is designed to operate from a nominal 110 volt, 50/60Hz supply. When only a 220 volt 50/60Hz source is available, use the supplied 220/110 volt adapter.

Charging Procedure

1. To charge the battery unit:

   (a) Plug the battery charger into an AC power outlet that is continuously supplied with power.

   [b) Plug the connector end of the battery charger cable into the power connector on the battery unit, The battery charger contains red charge lights, which indicate that the power unit is taking a charge.

   (c) A fully discharged battery unit requires approximately 16 hours to complete recharge, using the supplied battery charger.

2. The battery unit may be left plugged into the battery charger without danger of overcharging; however, during prolonged periods of inactivity, the battery charger should be disconnected from the battery pack and stored,

3. To prevent possible damage to the NiCad battery, the battery unit should never be charged in an area where the temperature falls below 5°C (40°F), The ideal temperature range for charging is 5°C (40°F) to 27°C [90°F].

NOTE

While the battery unit is charging, the battery charger may become warm to the touch and may emit a buzzing sound, This is normal, and is not an indication of a malfunction in the battery charger

APPENDIX A
MAINTENANCE ALLOCATION CHART

SECTION I – INTRODUCTION

A-1 GENERAL

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories.

b. The Maintenance Allocation Chart (MAC] in section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component, The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

A-2 MAINTENANCE FUNCTIONS, Maintenance Functions will be limited to and defined as follows:

a. **Inspect.** To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

b. **Replace.** To remove an unserviceable item and install a serviceable counterpart in its place, "Replace" is authorized by the MAC and is shown as the 3d position code of the SMR code.

c. **Repair.** The application of maintenance services[1], including fault location/troubleshooting[2], removal/installation, and disassembly/assembly[3] procedures, to identity troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system,

'Services – inspect, test, service, adjust, aline, calibrate, and/or replace,

'Fault locate/troubleshoot — The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT].

[3]Disassemble/assemble — encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of its least componency identified as maintenance significant (i.e., assigned an SMR code] for the category of maintenance under consideration,

A-3 EXPLANATION OF COLUMNS IN THE MAC, SECTION II

a. **Column 1, Group Number.** Column 1 functioncl group code numbers, the purpose of which is to identiify maintenance significant components, assembiies, sub-assemblies, and modules with the next higher assembly. End item group number shall be "00".

b. **Column 2, Component/Assembly.** Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized,

c. **Column 3, Maintenance Function** Column 3 lists the functions to be performed on the item listed in Column 2. (For detailed explanation of these functions, see paragraph A-2.)

d. **Column 4, Maintenance Category.** Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance, If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate work time figures will be shown for each category The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions, This time includes preparation time (including any necessary disassembly/assembly time troubleshooting/fault location time, and qualify assurance/qualify control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart, The symbol designations for the various maintenance categories are as follows:

C. . . . Operator or crew

O. . . . . Unit Maintenance

F . . . . Intermediate Direct Support Maintenance

H Intermediate General Support Maintenance

D Depot maintenance

e. **Column 5, Tools and Equipment.** Column 5 specifies, by code, those common tool sets (not individual tools] and special tools, TMDE, and support equipment required to perform the designated function.

f. **Column 6, Remarks.** This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks

SECTION II. MAINTENANCE ALLOCATION CHART

NOMENCLATURE OF END ITEMS

(4) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			UNIT		INTERMEDIATE		DEPOT		
			C	O	F	H	D		
00	SEDME-MR								
01	Instrument Assy	Inspect	.1						
		Replace							
		Repair	.1						
	Distance Meter	Replace	.1						
		Repair	.1				*		See (A)
02	Reflector Assy	Inspect	.1						
		Replace	.1						
		Repair	.2						
03	Backpack Assy	Inspect	.1						
		Replace	.1						

Remarks: (A) Return to depot for repair.

APPENDIX B
REPAIR PARTS AND SPECIAL TOOLS LIST

SECTION I – INTRODUCTION

1. **SCOPE.**
This RPSTL lists and authorizes spares and repair parts; special tools; special test, measurement, and diagnostic equipment (TMDE); and other special sup port equipment required for performance of depot maintenance of the SEDME-MR. It authorizes the requisitioning, issue, and disposition of spares, repair parts and special tools as indicated by source, maintenance, and recoverability [SMR) codes.

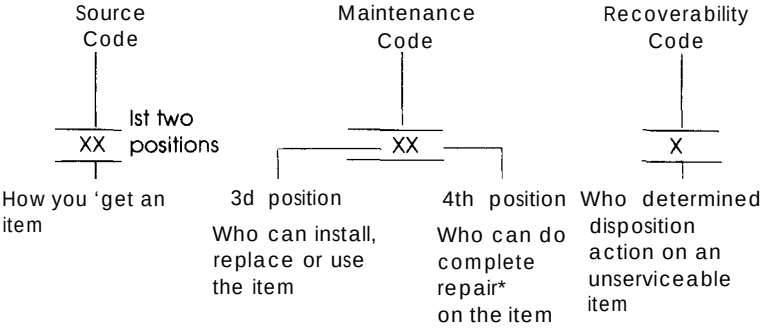
2. **GENERAL.**
In addition to Section I, Introduction, this Repair Parts and Special Tools List contains the following section:

a. Section II – Repair Parts List. A list of spares and repair parts authorized by this RPSTL for use in the performance of maintenance. The list also includes parts which must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in ascending alphanumeric sequence. Bulk materials are listed by item name in FIG. BULK at the end of the section. Repair parts kits are listed separately in their own functional group within Section II. Repair parts for repairable special tools are also listed in this section.

3. **EXPLANATION OF COLUMNS, SECTION II**

a. Item No. (Column (l)). Indicates the number used to identify items called out in the illustration,

b. SMR Code (Column (2)). The Source, Maintenance, and Recoverability [SMR) code is a 5-position code containing supply/requisitioning information, maintenance category authorization criteria, and disposition instruction, as shown in the following breakout:



"Complete Repair: Maintenance capacity, capability, and authority to perform all corrective maintenance tasks of the "Repair" function in a use/user environment in order to restore serviceability to a failed item.

(1) **Source Code.** The source code tells you how to get an item needed for maintenance, repair, or overhaul of an end item/equipment. Explanations of source codes follows:

Code	Explanation
PA	Stocked items; use the applicable NSN to request/requision items with these source codes, They are authorized to the category indicated by the code entered in the 3rd position of the SMR code.

[2] **Maintenance Code.** Maintenance codes tell you the level(s) of maintenance authorized to USE and REPAIR support items, The maintenance codes are entered in the third and fourth positions of the SMR Code as follows:

[a) The maintenance code entered in the third position tells you the lowest maintenance level authorized to remove, replace, and use an item, The maintenance code entered in the third position will indicate authorization to one of the following levels of maintenance.

Code	Application/Explanation
C	–Crew or operator maintenance done within organizational or aviation unit maintenance,
o	–Organizational or aviation unit category can remove, replace, and use the item.
F	–Direct support or aviation intermediate level can remove, replace, and use the item.

(b) The maintenance code entered in the fourth position tells whether or not the item is to be repaired and identifies the lowest maintenance level with the capability to do complete repair (i.e., perform all authorized repair functions.) [NOTE: Some limited repair may be done on the item at a lower level of maintenance, if authorized by the Maintenance Allocation Chart (MAC) and SMR codes.) This position will contain one of the following maintenance code.

Code	Application/Explanation
F	–Direct support or aviation intermediate is the lowest level that can do complete repair of the item.
Z	–Nonreparable. No repair is authorized.
D	–Depot is the lowest level that can do complete repair of the item.

(3) **Recoverability Code.** Recoverability codes are assigned to items to indicate the disposition action on unserviceable items. The recoverability code is entered in the fifth position of the SMR Code as follows:

Recoverability Code	Application/Explanation
Z	–Nonreparable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in 3rd position of SMR Code.

F –Reparable item. When uneconomically reparable, condemn and dispose of the item at the direct support or aviation intermediate level.

D –Reparable item. When beyond lower level repair capability, return to depot. Condemnation and disposal of item not authorized below depot level.

c. FSCM (Column (3)). The Federal Supply Code for Manufacturer (FSCM) is a 5-digit numeric code which is used to identify the manufacturer, distributor, or Government agency, etc., that supplies the item

d. PART NUMBER (Column (4)]. Indicates the primary number used by the manufacturer [individual, company, firm, corporation, or Government activity], which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements to identify an item or range of items.

NOTE: When you use a NSN to requisition an item, the item you receive may have a different part number from the part ordered.

e Description and Usable on Code [UOC) (Column (5)). This column includes the following Information

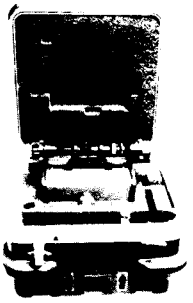
(1] The Federal item name and, when required. a minimum description to identify the item.

(2] The statement "END OF FIGURE" appears just below the last item description in Column 5 for the given figure in Section II.

f. QTY (column [6)). The QTY [quantity per figure column) indicates the quantity of the item used in the breakout shown on the illustration figure, which is prepared for a functional group, subfunctional group, or an assembly.

(1) ITEM NO.	(2) SMR CODE	(3) FSCM	(4) NUMBER	(5) DESCRIPTION AND USABLE ON CODE	(6) QTY.
				FIGURE B1 SEDME-MR	
1	PBODD	63939	8300-1103	ASSY, DISTANCE, INST.	1
2	PAOFF	50527	SW39X32	TELESCOPE	1
3	PAOZZ	75915	21802.5	FUSE	5
4	PAOZZ	62676	272-1136	LAMP	2
5	PAOZZ	63939	8300-1304	LOCK, HORIZONTAL	1
6	PAOZZ	63939	8300-1305	SCREW, TANGENT	2
7	PAOZZ	63939	8300-2007	LOCK, VERTICAL	1
8	PAOZZ	63939	8300-2000	COVER, LENS	1
9	PAOZZ	63939	8300-1105	PACK, BATTERY	2

(1) ITEM NO.	(2) SMR CODE	(3) FSCM	(4) NUMBER	(5) DESCRIPTION AND USABLE ON CODE	(6) QTY.
10	PAOZZ	63939	8300-1104	CABLE, POWER, EXT.	1
11	PAOZZ	63939	8300-2001	COVER, RAIN	1
12	PAOZZ	63939	8300-1302	HOLDER, HEPTAPRISM	2
13	PAOZZ	6P229	015-3004	HOLDER, TRIPRISM	2
14	PAOZZ	6P229	015-4001	PRISM	20
15	PAOZZ	6P229	100-0116	COVER, PRISM	20
16	PAOZZ	63939	8300-1106	CHARGER, BATTERY	1
17	PAOZZ	62676	273-1401A	ADAPTER, 220V	1
18	PAOZZ	533533	6640-00-240-5851	PAPER, LENS	1
				END OF FIGURE	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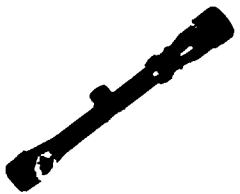
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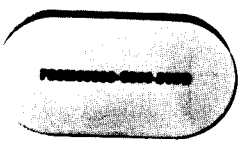
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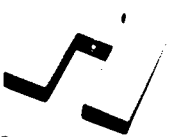
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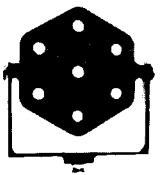
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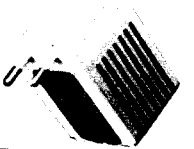
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Figure B-1

APPENDIX C
COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

SECTION I – INTRODUCTION

C-1. SCOPE.

This appendix lists components of end item and basic issue items for the SEDME-MR to help you inventory items required for safe and efficient operation.

C-2. GENERAL.

The Components of End Item and Basic Issue Items Lists are divided into the following sections:

a. **Section II.** Components of End Item. This listing is for informational purposes only, and is not authority to requisition replacements, These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts, Illustrations are furnished to assist you in identifying the items.

b. **Section III.** Basic Issue items. These are the minimum essential items required to place the SEDME-MR in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged, Bll must be with the SEDME-MR during operation and whenever it is transferred between property accounts, The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement Bll, based on TOE/MTOE authorization of the end item.

C-3. EXPLANATION OF COLUMNS.

The following provides an explanation of columns found in the tabular listings:

a. **Column (1)** — Illustration Number (Illus, Number], This column indicates the number of the illustration in which the item is shown.

b. **Column [2]** – National Stock Number. Indicates the National stock number assigned to the item and will be used for requisitioning purpose.

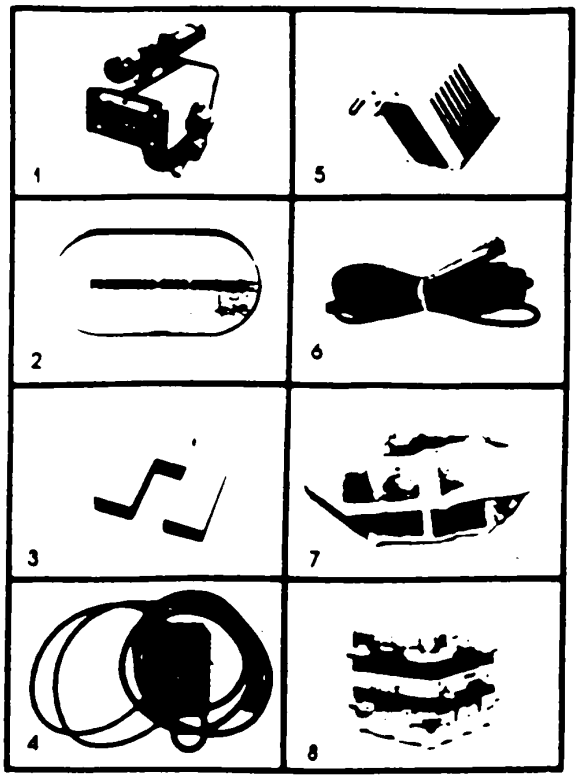
c. **Column (3)** — Description. Indicates the Federal item name, and if required, a minimum description to identify and locate the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

Code	Used On
EAH	SEDME-MR

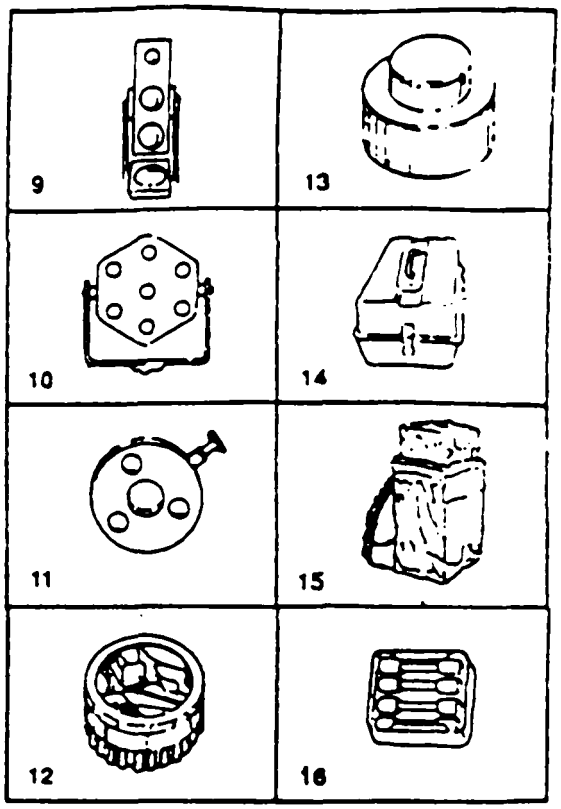
d. **(Column (4) –** Unit of Measure (U/M]. Indicates the measure used in performing the actual operational/maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr].

e. **Column (5)** — Quantity required (Qty. rqr). Indicates the quantify of the item authorized to be used with/on the equipment.

SECTON II -- COMPONENTS OF END ITEM					
(1) Illus No.	(2) National Stock Number	(3) Description FSCM and Part No.	Usable on Code	(4) U/M	(5) Qty. Rqr
1		Meter, Distance (63939) 8300-1110	EAH	ea	1
2	6760-01-233-8483	Cover, Lens (63939) 8300-2000	EAH	ea	1
3	6130-01-233 8276	Pack, Battery (63939) 9300-1105	EAH	ea	2
4	6130-01-233-8376	Charger, Battery (63939) 8300-1106	EAH	ea	1
5	5940-01-234-2183	Adapter, 220 VAC (62676) 273-1401A	EAH	ea	1
6	6150-01-233-8377	Cable, power, Ext. (63939) 8300-1104	EAH	ea	1
7	6675-01-234-6543	Cover, Rain (63939) 8300-2001	EAH	ea	1
8		Case, Instrument (63939) 8300-1301	EAH	ea	1



SECTON II -- COMPONENTS OF END ITEM					
(1) Illus No.	(2) National Stock Number	(3) Description FSCM and Part No.	Usable on Code	(4) U /M	(5) Qty. Rqr
9	6640-01-233-8389	Holder, Triprism (6P229) 015-3004	EAH	ea	2
10	6650-01-233-8390	Holder, Hepta prism (63939) 8300-1302	EAH	ea	2
11		Adapter Prism (63939) 8300-1108		ea	4
12	6650-01-233-8490	Prism (6P229) 015-4001	EAH	ea	20
13	6650-01-233-8275	Cover, Prism (6P229) 100-0116	EAH	ea	20
14		Case, Accessory (63939) 8300-1101	EAH	ea	2
15	6675-01-315-9618	Backpack (63939) 8300-1102 ON BOARD SPARES	EAH	ea	1
16	5920-01-120-3823	Fuse (75915) 21802.5	EAH	ea	5



APPENDIX D
ADDITIONAL AUTHORIZATION LIST

SECTION I — INTRODUCTION

D-1. **SCOPE**
This appendix lists additional items you are authorized for the support of the SEDME-MR.

D-2. **GENERAL**
This list identifies items that do not have to accompany the SEDME-MR and that do not have to be turned in with it. These items are all authorized to you by CTA, MTOE, TDA, or JTA.

D-3. **EXPLANATION OF LISTING**
National stock numbers, descriptions, and quantities are provided to help you identify and request the additional items you require to support this equipment. The items are listed in alphabetical sequence by item name under the type document (i.e., CTA, MTOE, TDA or JTA) which authorizes the item(s) to you.

SECTION II – ADDITIONAL AUTHORIZATION LIST

(1) National Stock Number	(2) Description FSCM and Part Number	(3) U/M	[4] Qty. Auth
6660-00- 078-6368	Altimeter-Barometer EAH	ea	1
6685-00- 174-6235	Thermometer EAH (81349) MIL-T-12625	ea	1

APPENDIX E
EXPENDABLE SUPPLIES AND MATERIALS LIST

SECTION I - INTRODUCTION

E-1 SCOPE.

This appendix lists expendable supplies and materials you will need to operate and maintain the SEDME-MR. These items are authorized- to YOU by CTA 50-970, Expendable Items [Except Medical, Class V, Repair parts, and Heraldic Items).

E-2 EXPLANATION OF COLUMNS

a. Column (1) - Item Number. This number Is assigned to the entry in the listing and Is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, item 5, App. E].

b. Column@ - Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew

O - Unit Maintenance

F - Intermediate Direct support Maintenance

H - Intermediate General Support Maintenance

c. Column (3) - National Stock Number. This is the National stock number assigned to the item use It to request or requisition the item.

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d. Column (4) - Description. Indicates the Federal Item name and, if required, a description to identity the Item. The last line for each item Indicates the Federal Supply Code for Manufacturer (FSCM] in parentheses followed by the part number.

e. Column (5) - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure Is expressed by a two-character alphabetical abbreviation (e.g., ea, In, pr). It the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

SECTION II - EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) Item No.	(1) Level	(3) National Stack No.	(4) Description	(5) U/M U/M
1	C	7920014414517	Brush **Dusting**	EA.
2	C	5920-01-120-3823	**Fuse**	EA
3	C	6240-01-236-3109	**Lamp**	EA.
4	C	6640-00-174-6235	**Tissue, Lens**	PKg

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

R. L. DILWORTH
Brigadier General, United States Army
The Adjutant General

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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