D E P A R T M E N T  O F  T H E  A R M Y  T E C H N I C A L  M A N U A L

# OPERATOR, ORG., DS, GS, AND DEPOT MAINTENANCE MANUAL:

# INFRARED TEST SET 4931-895-3894 (SECONDARY REFERENCE)

*H E A D Q U A R T E R S ,  D E P A R T M E N T  O F  T H E  A R M Y*

*N O V E M B E R  1 9 6 7*

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 27 *June 1973*

**Operator, Organizational, Direct Support
General Support and Depot
Maintenance Manual:**

**INFRARED TEST SET 4931-895-3894
(SECONDARY REFERENCE)**

TM 9-4931-387-15, 15 November 1967, is changed as follows:

1. New or changed material is indicated by a bold star.

| *Remove pages* | *Insert pages* |
|---|---|
| i, B-1, and B-2 | i and B-1 |

2. File this change sheet in front of the publication for reference purposes.

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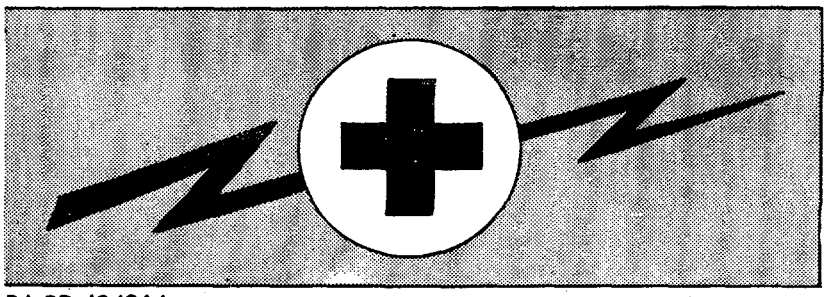
**WARNING**



RA PD 404264

**HIGH VOLTAGE**
(over 500 volts)

is used in the operation of this equipment

**DEATH ON CONTACT**

may result if personnel fail to observe safety precautions

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When the technician is aided by operators, he must warn them about dangerous areas.

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Take particular care to ground every capacitor likely to hold a dangerous potential. When working inside the equipment, after the power has been turned off, always ground every part before touching it.

Be careful not to contact high-voltage connections when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

**EXTREMELY DANGEROUS POTENTIALS**

**Warning:**

**Do not be mislead by the term "low voltage." Potentials as low as 50 volts may cause death under adverse conditions.**

For Artificial Respiration, refer to FM 21-11.

TECHNICAL MANUAL
No. 9-4931-387-15

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *15 November 1967*

**INFRARED TEST SET 4931-895-3894**

# CHAPTER 1
# INTRODUCTION

## Section I. GENERAL

### 1-1. Scope

*a.* These instructions are published for the information and guidance of personnel to whom the infrared secondary reference test set 4931-895-3894 is issued (fig. 1-1).

*b.* This manual contains description, theory of operation, and information on operation and preventive maintenance for use by depot personnel.

*c.* Appendix A, B, and C are contained in this technical manual. Appendix A contains a list of current references, including supply catalogs, technical manuals, and other available publications applicable to the test set. Appendix B lists the basic issue items available for operation. Appendix C contains the maintenance allocation charts which list maintenance responsibilities allocated to each echelon of maintenance.

### 1-2. Maintenance Technique.

*a.* In all cases where the nature of repair modification or adjustment is beyond the scope or facilities of the using personnel, the responsible maintenance unit should be informed in order that trained personnel with suitable tools and equipment may be provided or other proper instructions issued.

*b.* These instructions are intended for maintenance specialists who have been thoroughly trained in electronics field and depot maintenance practices and have had previous experience in performance testing, alignment and adjustment procedures on similar types of materiel.

*c.* The maintenance. technique, IROAN (Inspect, Repair, Only as Necessary), will be used to restore this materiel to serviceable condition. IROAN is the systematic isolation and remedy of a malfunction or defective component through tests, diagnosis, and singular repair. No segment of the materiel will be disassembled before the definite need to do so has been systematically established.

### 1-3. Forms and Records

*a. Reports of Maintenance and Unsatisfactory Equipment.* Use equipment forms and records in accordance with instructions given in TM 38-750.

*b. Report of Damaged or Improper Shipment.* Fill out and forward DD Form 6 (Report of Damage or Improper Shipment) as prescribed in AR 700-58 (Army), NAVSAANDA Publication 378 (Navy), and AFR 71-4 (Air Force).

*c. Reporting of Equipment Manual Improvements.* Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to: Commanding General, U.S. Army Missile Command, ATTN: AMSMI-MFPE, Redstone Arsenal, Alabama 35809.

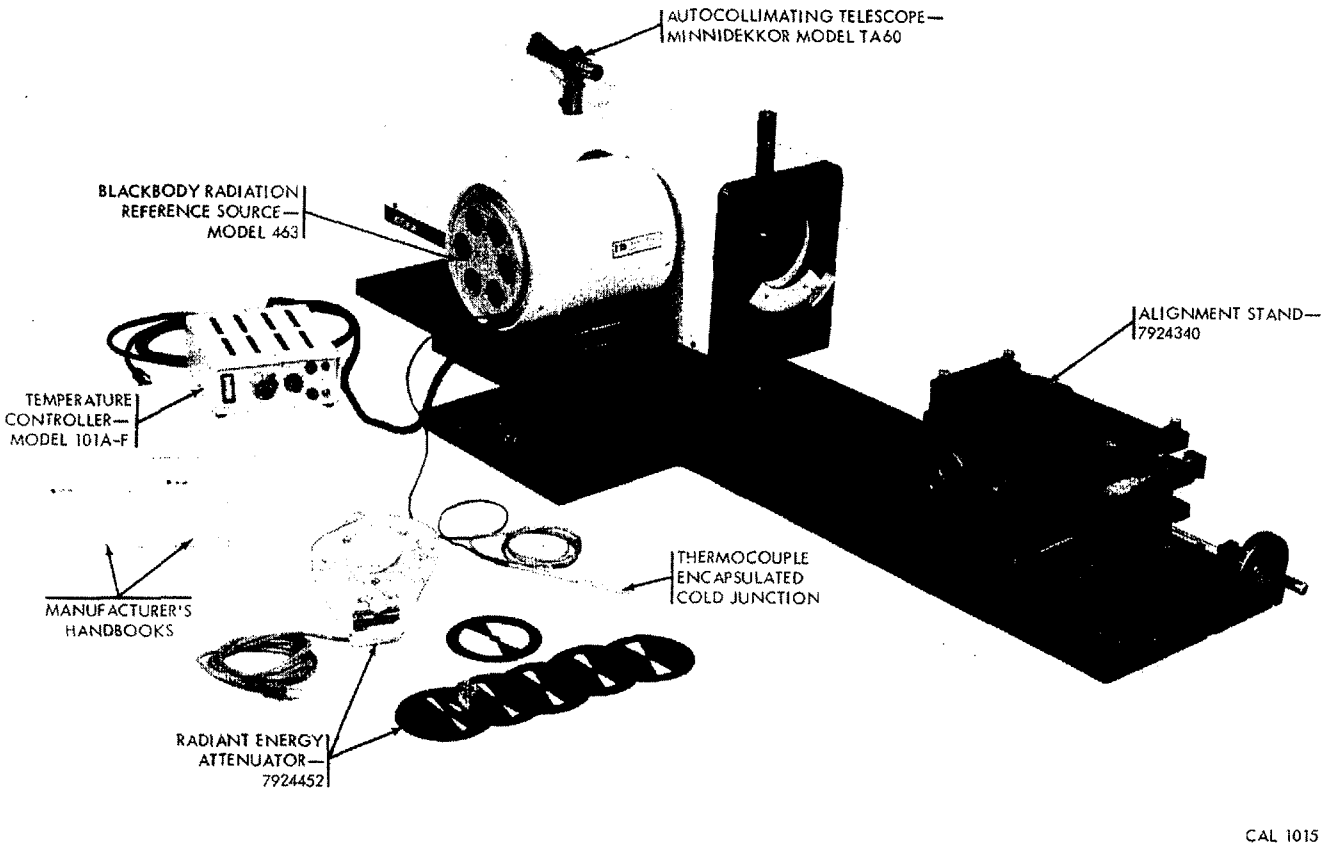



**Figure 1-1. Infrared secondary reference test set 4931-895-3894.**

## Section II. DESCRIPTION AND DATA

### 1-4. Description

*a. General.* The infrared secondary reference test set will hereafter be referred to as the test set. It is a standard for calibrating the infrared secondary transfer set 4931-895-3886. The test set and the secondary transfer test set comprise the infrared calibration system for calibration of the AN/TSM-54 and AN/TSM-82 Guided Missile Tests Sets hereafter referred to as the GMTS. Designed for operation .in a laboratory-type environment at an Army secondary reference calibration laboratory, the test set consists of the following (fig, 1-1): (1) a precision alignment stand - 7924340; (2) a matched, pre-calibrated temperature controller Model 101A-F and blackbody radiation reference source - Model 463; (3) a matched pre-calibrated off-axis collimator - Model 230A and radiant energy attenuator - 7924452; (4). an autocollimating telescope - Minnidekkor Model TA 60; and (5) manufacturer's handbooks for the temperature controller, blackbody radiation reference source, and collimator. A general description of each test set component is presented below. Separate coverage is provided in the form of manufacturer's handbooks.

*b. Alignment Stand - 7924340.* The alignment stand (fig. 1-2) provides a 'means for precise optical alignment positioning of the instrument under calibration test with the test set off-axis collimator. A machined aluminum base plate includes three legs for mounting on an optical bench. Three removable recessed foot pads located on the top surface of the base plate ensure proper positioning of the collimator during preoperational setup. The alignment stand adjustment mechanism includes adapters for mounting the infrared secondary transfer test set radiometer optical unit during calibration testing. It is capable of four degrees of freedom, lateral .and vertical translation, and rotation about the lateral and vertical axes. A 4-inch circular handle at the side of the stand provides major vertical translation; a 2-inch circular handle on the front of the stand provides major lateral translation. Precise calibration alignment of the mounted instrument under test with the collimator is accomplished by dial settings of two micrometers.

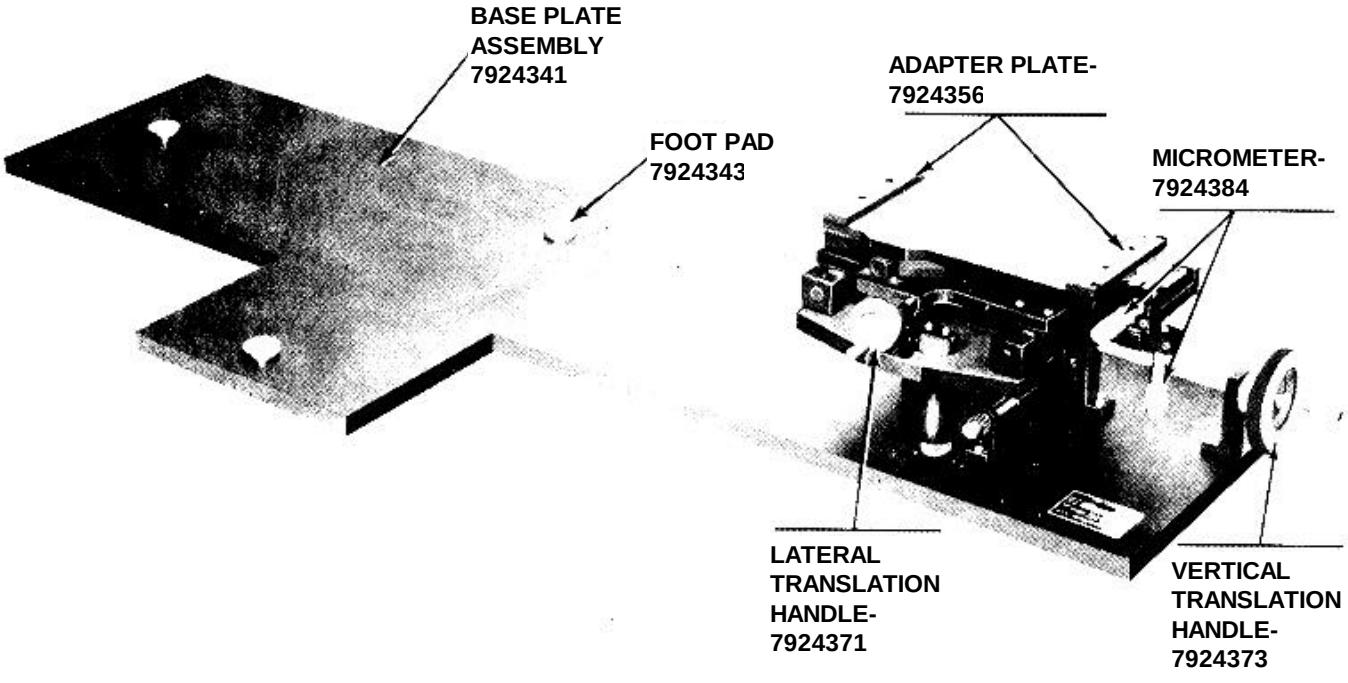



**Figure 1-2. Alignment stand - 7924340-front view.**

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c. *Temperature Controller - Model 101A-F* The temperature controller (fig. 1-3). is a portable unit designed for bench operation with a specific blackbody radiation reference source. It accurately controls and maintains the blackbody operating temperature to a pre-selected value. A front panel contains the necessary controls for system operation. A receptacle at the rear of the unit receives the connecting cable from the blackbody radiation reference source. The power cord for plug-in to an electric outlet supplying 117 VAC ± 10 % 50-60 Hz is also located at the rear of the set.

*d. Blackbody Radiation Reference Source Model 463.* The blackbody radiation reference source (fig. 1-4) mounts on the off-axis collimator base plate 90 degrees clockwise from the collimator optical axis (fig. 1-1). An attached connecting cable routes input voltages from the temperature controller. An attached thermocouple containing an encapsulated cold junction provides a means to determine source temperature. Because it is factory-calibrated with a specific temperature controller, , accuracy of the blackbody unit is dependent on operation with the particular temperature controller unit issued with it. The two units form a precalibrated set replaceable only with another precalibrated set. For operation with the test set, the aperture and baffle assembly issued with the unit is removed and stored.

*e. Off-Axis Collimator - Model 230A.* The off-axis collimator mounts on the alignment stand base plate by means of three adjustable legs tapered to fit the alignment stand foot pad receptacles (figs. 1-1 and 1-5). The instrument includes (1) a support post which provides for attachment of the autocollimating telescope; (2) a tubular mirror housing which directs the line of sight from the mounted telescope to the test instrument alignment mirror during alignment sighting; (3) an aperture wheel which contains indexed openings of varying degrees and which is adjustable to a pre-selected setting by means of a spring de tent; and (4) an adjustable iris and iris control scale. A base plate provides the means to support the blackbody radiation reference source

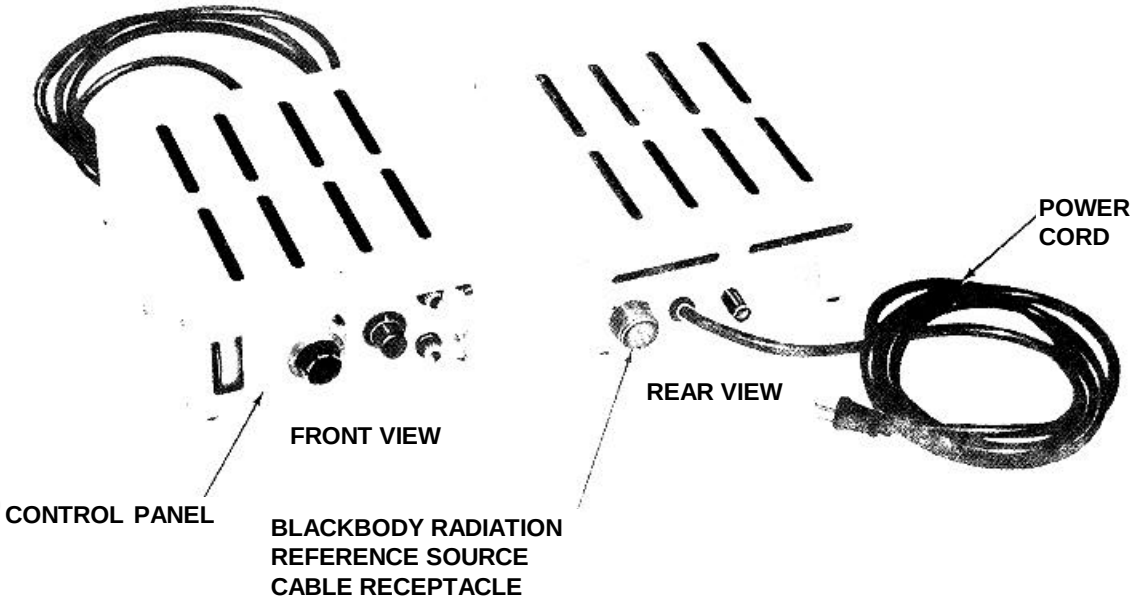


**Figure 1-3. Temperature controller - Model 101A-F-front and rear views.**

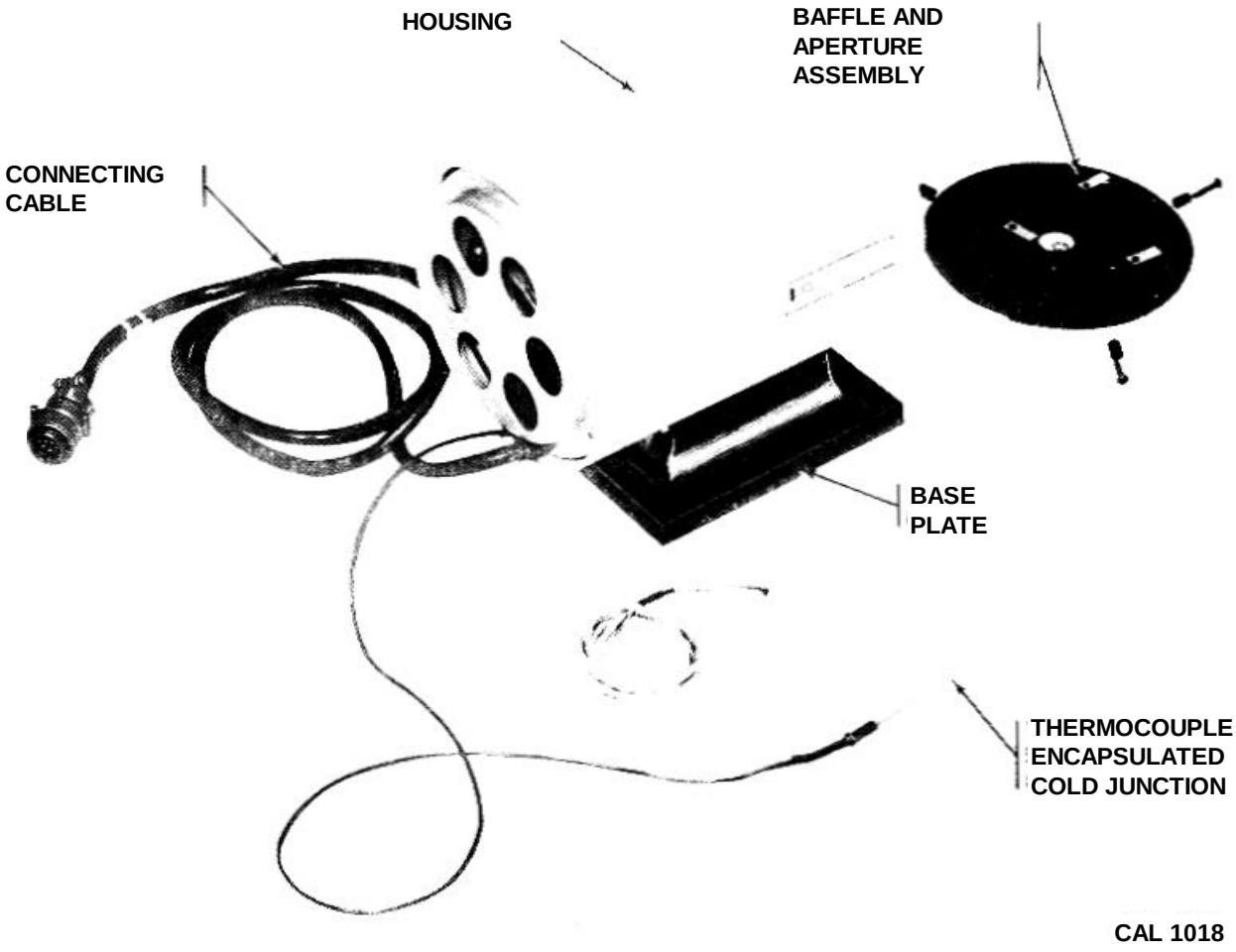


**Figure 1-4. Blackbody radiation reference source - Model 463 with aperture and baffle assembly removed.**

and properly align it with the collimator optical axis.

*f. Radiant Energy Attenuator - 7924452.* The radiant energy attenuator (fig. 1-6) is a test set instrument calibrated for operation with a specific off-axis collimator. The unit mounts on the forward adapter tube of the test instrument under calibration by means of a spring tension cast mounting cap. A motor driven driver pulley fiction-drives the selected attenuator during test set operation. Two idler pulley's secured by a mounting plate, maintain positioning of the rotating attenuator. One GMTS Block I and five GMTS Block III attenuators are supplied with the instrument. A power toggle switch is located at the rear of the motor cover. The power cord for -plug-in to an electric outlet supplying 117 VAC $\pm$ 10%. 50-60 Hz is located on the bottom of the motor cover.

*g. Autocollimating - Telescope - Minnidekkor Model TA 60.* The autocllimating telescope (fig. 1-7) is a small, lightweight autocollimator used during precalibration test setup for precise optical alignment of the test instrument with the off-axis collimator. It measures horizontal and vertical angular displacement simultaneously by means of a graticule scale with divisions of one minute of arc. The eyepiece is placed at an angle of 90 degrees

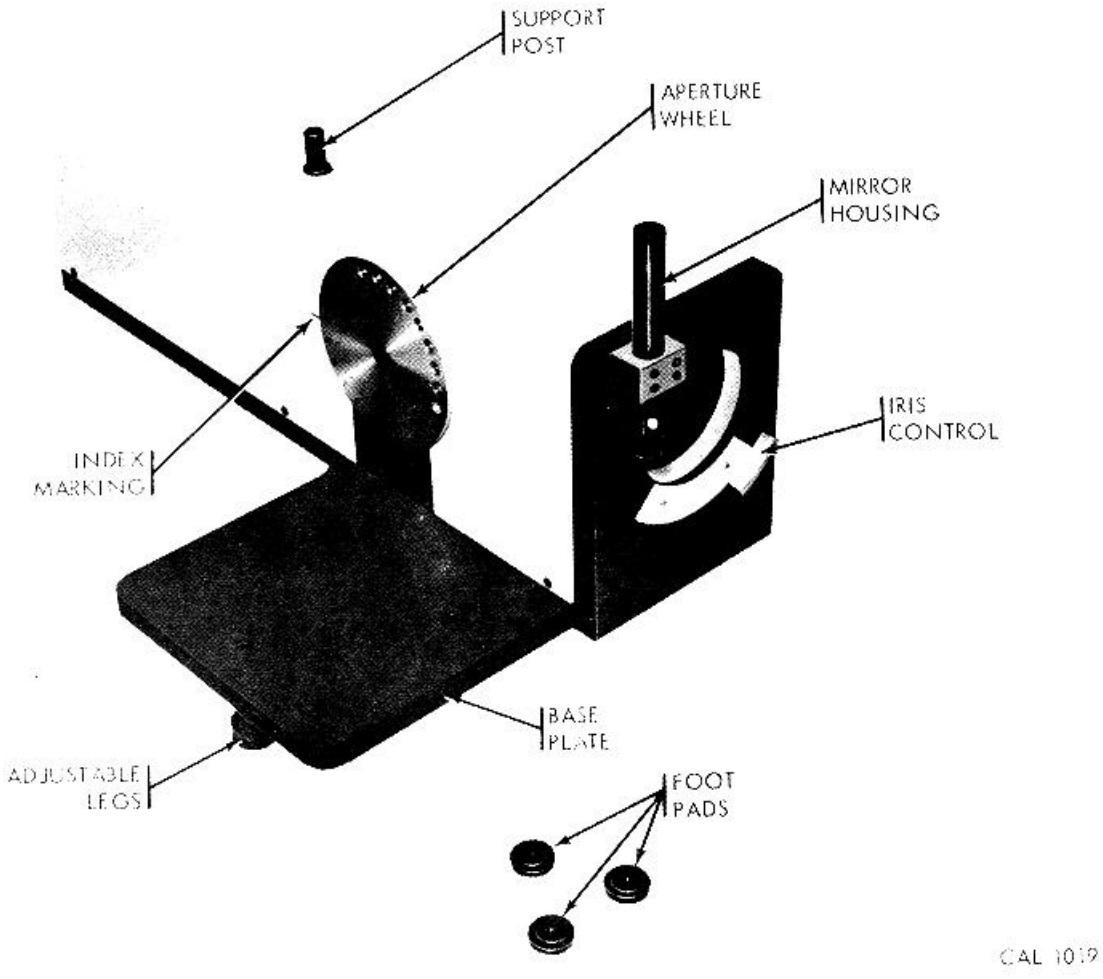


**Figure 1-5. Off-axis collimator - Model 230A.**

to the tube. Rotation of the tube about its horizontal axis allows proper positioning of the eyepiece for operator alignment sighting. Vertical line-of-sight adjustments are secured with a clamp. The telescope is secured to the collimator support post by a locking clamp. A light source at the rear of the tube illuminates the telescope during alignment sighting (the light source is supplied with the secondary transfer test set 4931-895-3886).

## 1-5. Tabulated Data

The test set characteristics and data are listed in table 1-1.

**Table 1-1. Characteristics and Data**

| Characteristic | Data |
|---|---|
| Alignment stand - 7924340: | |
| Lateral translation..... | 3/4 inch |
| Horizontal rotation | Approximately ± 2-1/2 degrees |
| Vertical translation..... | 1-1/4 inches |
| Vertical rotation ..... | Approximately ± 2-1/2 degrees |
| Overall dimensions: | |
| Height . ..... | 10-1/8 inches |
| Width ..... | 22-7/8 inches |
| Length..... | 64-5/8 inches |
| Weight | 170 pounds |

**Table 1-1. Characteristics and Data-Continued**

| Characteristic | Data |
|---|---|
| Temperature controller and blackbody radiation reference source: | |
| Temperature control range | 50°C to 1000°C |
| Temperature control stability | ± 0.5°C (for 5 hours), ± 0.1°C (for 1 hour) |
| Type of control | Electronic proportional, set point adjustable with a resolution of 0.1°C |
| Sensing element | Platinum resistance thermometer |
| Thermocouple | Reference grade platinum/platinum 10% rhodium with encapsulfated cold injection |
| Cavity type | Conical with 20° recessed cone |
| Cavity emissivity | A minimum of .99 |
| Standard aperatures | .200, .100, .050, .025, .012 inch diameters ± 1%, mounted on aperture wheel |
| Power requirement | 117 VAC ± 10% 50-60 Hz, 8.0 amp, maximum |
| Maximum controller output | 1000 watts, maximum set by adjustable current limit |
| Warmup time to 1000°C | 1/2 to 1 hour depending upon setting of current limit |
| Source housing temperature | 10° C above ambient maximum at 1000°C |
| Operating environment: | |
| Temperature controller | 0 to 40°C |
| Blackbody radiation reference source | -60°C to +60°C |
| Overall dimensions: | |
| Temperature controller: | |
| Height | 3-5/8 inches |
| Width | 7-5/8 inches |
| Length | 9-11/16 inches |
| Blackbody radiation reference source: | |
| Height | 10 inches |
| Width | 8 inches |
| Length | 11-3/8 inches |
| Weight: | |
| Temperature controller | 5-1/2 pounds |
| Blackbody radiation reference source | 13-1/2 pounds |
| Manufacturer | Infrared Industries, Inc. Santa Barbara, Calif. |

**Table 1-1. Characteristics and Data--Continued**

| Characteristic | Data |
|---|---|
| Manufacturer's identification: | |
| Temperature controller | Model 101A-F |
| Blackbody radiation reference source | Model 463 |
| Off-axis collimator: | |
| Optical layout | Off-axis Newtonian (reflective) |
| Focal length | 25 inches (nominal) |
| Primary mirror | 5.0 inch diameter off-axis paraboloid |
| Diagonal mirror | 1.125 inch diameter flat |
| Mirror coatings | Reflecting surfaces aluminized and overcoated with silicon monoxide |
| Optical reflectance | Typical reflectance of silicon monoxide coated aluminized surface vs wavelength |
| Resolution | 0.2 milliradians, minimum |
| Entrance aperature diameters | 0.0079, 0.0137, 0.0250, 0.0433, 0.079, 0.137, 0.250 inch mounted on indexing aperture wheel |
| Overall dimensions: | |
| Height | 14-3/4 inches |
| Width | 19-1/2 inches |
| Length | 31-3/4 inches |
| Height to optical axis | 10.75 inches, adjustable |
| Weight | 60 pounds |
| Manufacturer | Infared Industries, Inc. Santa Barbara, Calif. |
| Manufacturer's identification | Model 230A |
| Radiant energy attenuator - 792442: | |
| Power requirement | Model VAC + 10% 50-60 Hz, 0.5 amp. maximum |
| Overall dimensions | |
| Height | 7-1/2 inches (disk installed) |
| Width | 6-1/4 inches |
| Length | 4-1/8 inches |
| Weight | 2 pounds |
| Autocollimating telescope: | |
| Objective lens aperture | 0.65 inch |
| Objective lens focal length | 4 inches |
| Focal length of eyepiece | 20 mm |

Table 1-1. Characteristics and Data-Continued

| Characteristic | Data |
|---|---|
| Graticule scale | Divisions of 1 minute of arc. Capable of estimating to 30 seconds |
| Accuracy | 30 seconds of arc over total measuring range of 6 seconds over any one minute interval |
| Maximum measuring range | 60 x 60 minutes of arc |
| Maximum working distance | 12 feet |

**Table 1-1. Characteristic and Data-Continued**

| Characteristic | Data |
|---|---|
| Dimensions: | |
| Height | 4 inches |
| Width | 2.5 inches |
| Length | 7 inches |
| Weight | 1 pound |
| Manufacturer | Engis Equipment Company, Morton Grove, Illinois |
| Manufacturer's identification | Minnidekkor Model TA 60 |

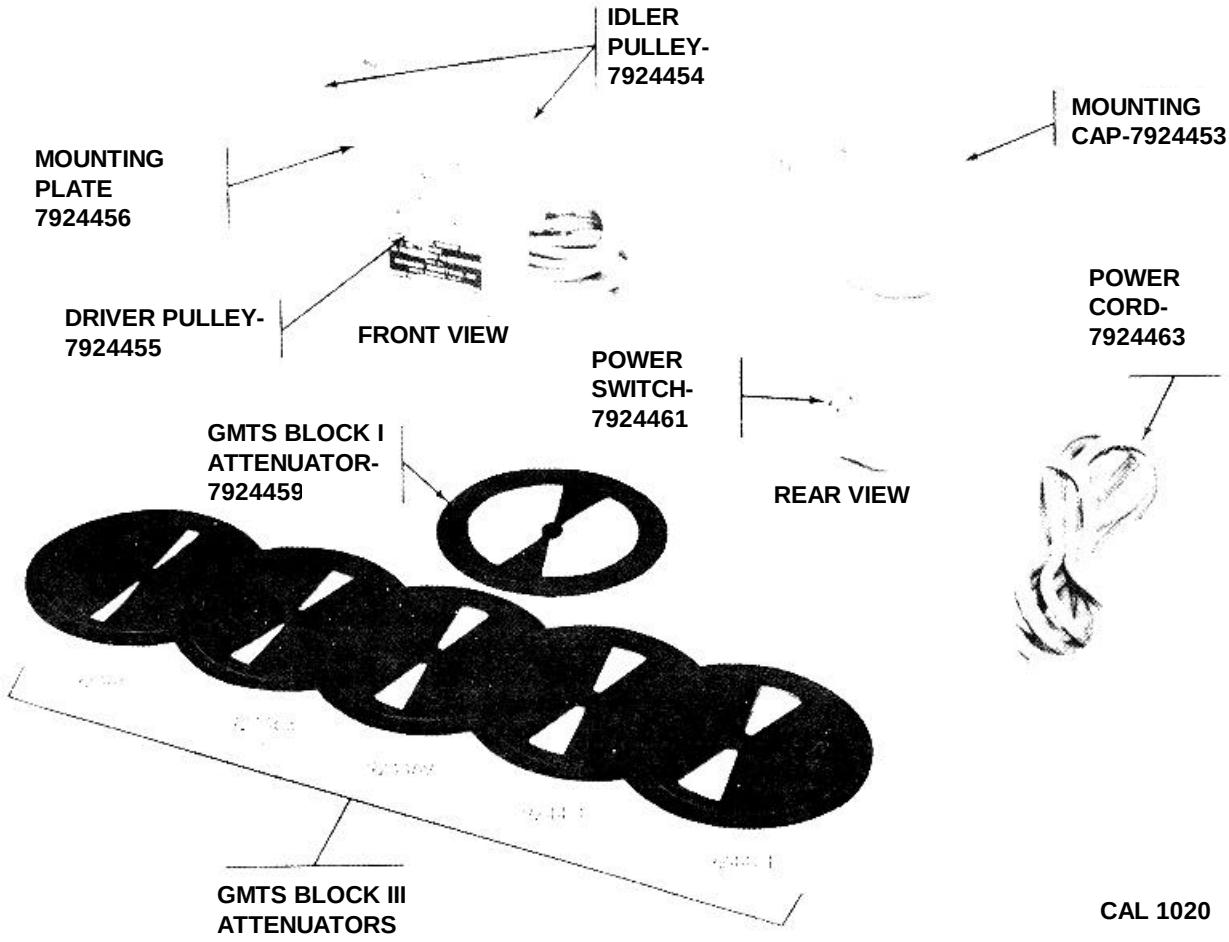


**Figure 1-6. Radiant energy attenuator - 7924452-front and rear views.**

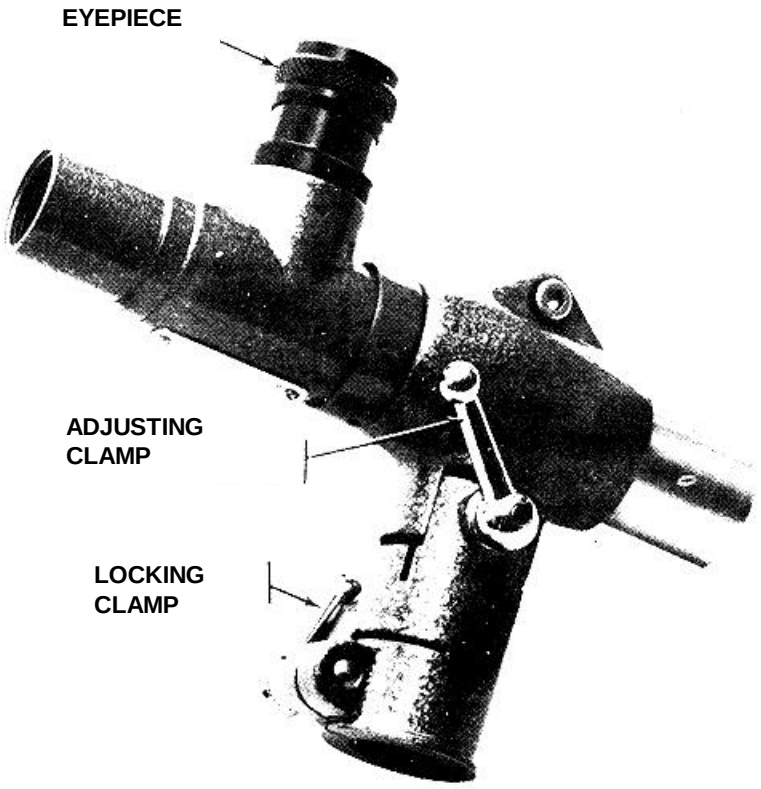


**Figure 1-7. Autocollimating telescope - Minnidekkor Model TA 60.**

# CHAPTER 2

# THEORY OF OPERATION

## Section I. GENERAL OPERATION

### 2-1. Fundamental Principle

The test set performs the function of a laboratory standard of known energy emission to which' infrared systems designed to measure energy radiation may be compared and/or calibrated. The test set converts radiant energy emitted from a known temperature source into a collimated beam. It then directs the radiant energy through a preselected attenuator which defines the energy flux (corresponding to the GMTS requirements) into the entrance optics of an infrared instrument, optically aligned to receive the beam. The functional diagram (fig. 2-1) illustrates the fundamental principle.

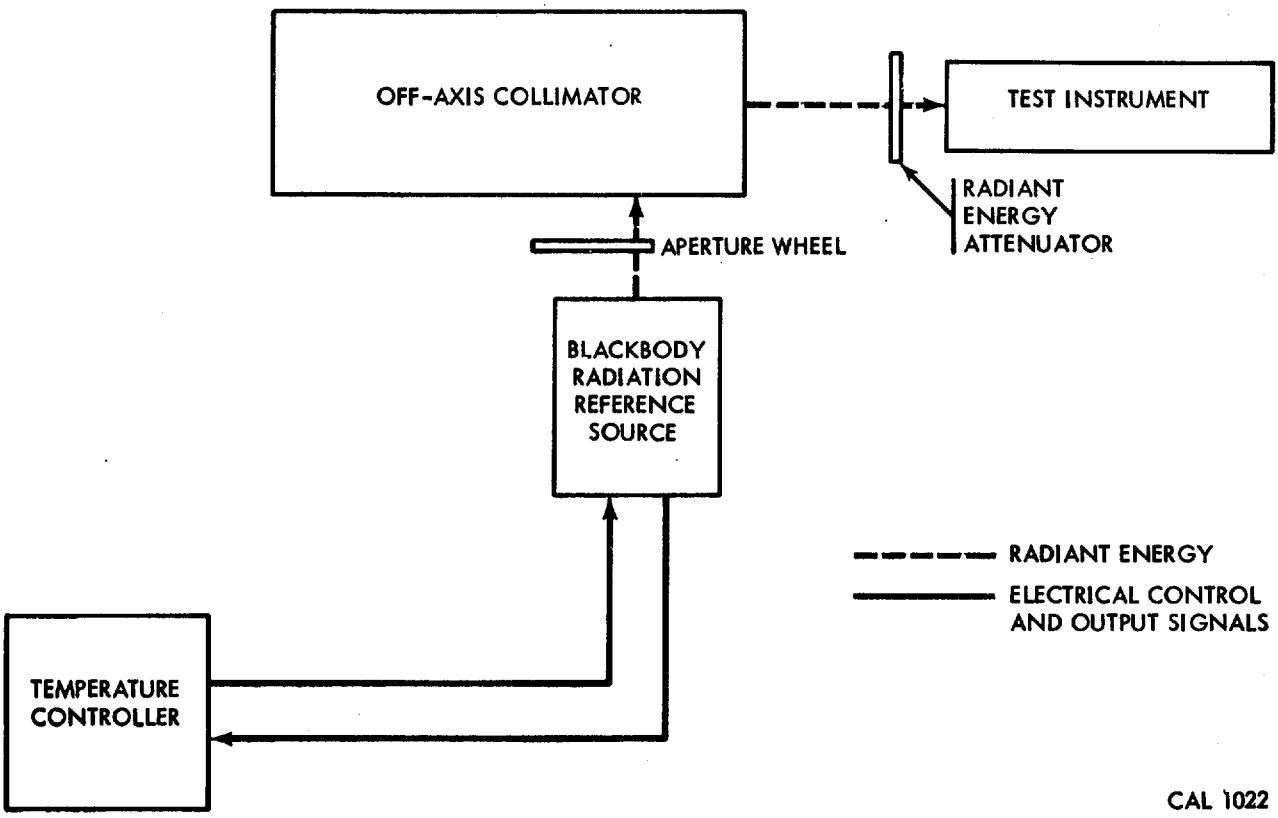


**Figure 2-1. Infared secondary reference test set 4931-895-3894 functional block diagram.**

## Section II. FUNCTIONAL DESCRIPTION

### 2-2. Temperature Controller-Model 101A-F

*a.* The temperature controller accurately controls the temperature of the blackbody , radiation reference source at the selected point to ensure both the spectral distribution and total radiation stability of the reference source during system operation. The instrument maintains a preselected temperature by comparing the temperature of the reference source, as measured by a platinum resistance thermometer, against the desired temperature as preset by a COARSE SELECTOR dial setting. The magnitude of the difference between the measured temperature and the desired temperature causes more or less power to be delivered to the heating element of the reference source to maintain a nearly constant temperature.

*b.* Electrically, the platinum resistance thermometer and the COARSE SELECTOR temperature dial are in the same arm of a bridge, causing a need for more or less resistance in the platinum resistance thermometer to maintain the bridge in a near-balanced condition (fig. 2-2). This configuration causes the thermometer to be operated under constant current conditions which results in maximum thermometer sensitivity. When the temperature controller is controlling at a steady state temperature, the bridge will be nearly balanced, but just enough out of balance to develop a significant input signal to the preamplifier. The extent of unbalance is sufficient to maintain the desired temperature of the reference source. If the source were to cool slightly, or if the temperature controller COARSE SELECTOR dial were set to a slightly higher temperature, the bridge would become more unbalanced. This increase in voltage would cause an increase of output power from the temperature controller to heat the reference source and the platinum resistance thermometer until the resistance of the platinum restored the bridge to a near-balanced condition. If the reference source becomes too hot, or if the temperature dial is set to a lower temperature, the bridge voltage decreases, passes through a null, and again increases with a 180 phase change. An open circuit condition in the thermometer circuit will cause the preamplifier to shut off the heater power. The decrease in voltage will reduce the power to the heater, and the out-of phase increase in voltage will shut it off regardless of its magnitude.

*c.* The basic system operation, as illustrated by the functional block diagram of figure 2-2 is as follows:

(1) DC signal voltage from the bridge is fed to a preamplifier which amplifies and routes the signal to a postamplifier.
(2) The preamplifier compares the bridge signal, as determined by the thermometer and the COARSE SELECTOR, against a reference signal, amplies the difference, and feeds this amplified difference signal to the meter and the postamplifier.
(3) The postamplifier adds current limit capability, and feeds the amplified difference signal to the firing circuit.
(4) The firing circuit changes the amount of power into the blackbody radiation reference source heater by changing the time of firing of the SCR within each half-cycle of power frequency.
(5) The SCR performs the firing function and delivers the 'power to the blackbody radiation reference source heater.

### 2-3. Blackbody Radiation Reference Source-Model 463

*a.* The blackbody radiation *reference* source is an accurate, stable infrared radiation standard of known spectral distribution and radiant intensity. It produces a divergent beam of radiated energy which is directed into the off-axis collimator through the collimator aperture wheel.

*b.* The major functional components of the Model 463 blackbody unit are the radiator, the aperture and baffle assembly, and the thermocouple (fig. 2-3). For operation with the test set, the aperture and baffle assembly are removed from the unit prior to mounting on the collimator base plate.

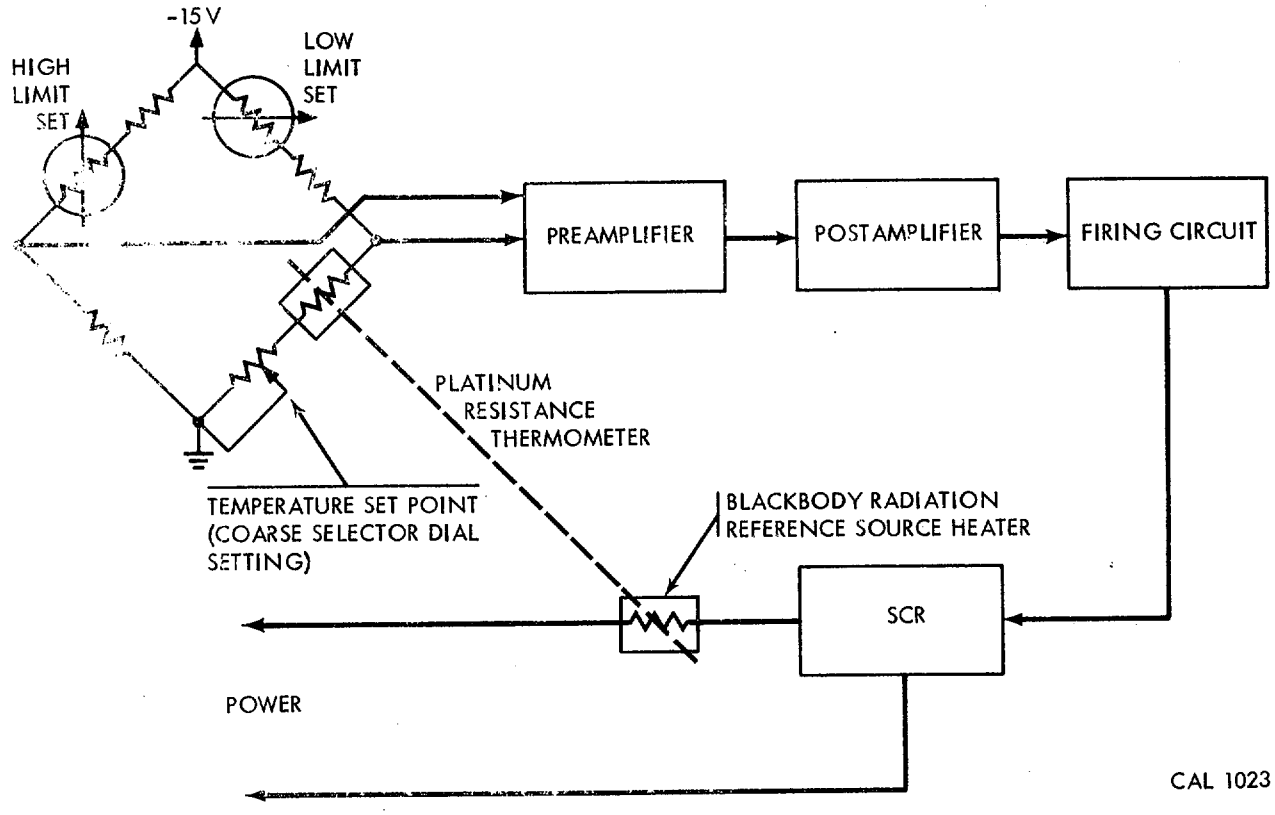


**Figure 2-2. Temperature controller-Model 101A-F functional block diagram.**

(1) *Radiator.* The radiator consists of a cylinder containing a 20-degree recessed conical cavity (fig. 2-3) with a surface treated to produce a uniform layer of oxidation. The high emissivity the oxidized surface and the, geometrical form of the cavity produce an effective cavity emmissivity very nearly approaching unity. The cylinder is heated by means of a resistance heating element with power supplied by the temperature controller. The platinum resistance thermometer sensing element of the temperature controller is located between the cylinder and the resistance heater.
Its placement is adjusted to produce optimum temperature control and warmup time. The heater is wound in a pattern which produces a uniform temperature across the cavity with no apparent temperature gradient.

(2) *Thermocouple.* The thermocouple is used to monitor the actual temperature of the cavity during operational checks of the system. An encapsulated reference cold junction is employed; thermocouple output is read on a millivolt potentiometer.

*c.* The blackbody outer housing contains a fan which draws air from the front, between the inner and outer cases (fig. 2-3), and exhausts to the rear. This air circulation keeps the outer case within a 10°C rise above ambient, even at the maximum cavity temperature.

## 2-4. Off-Axis Collimator and Radiant Energy Attenuator

*a.* A collimator represents an infrared radiation source at infinity. The radiation from this source consists of essentially parallel rays. For laboratory use the collimator provides a convenient source of parallel radiation from a known temperature source. The Model 230A

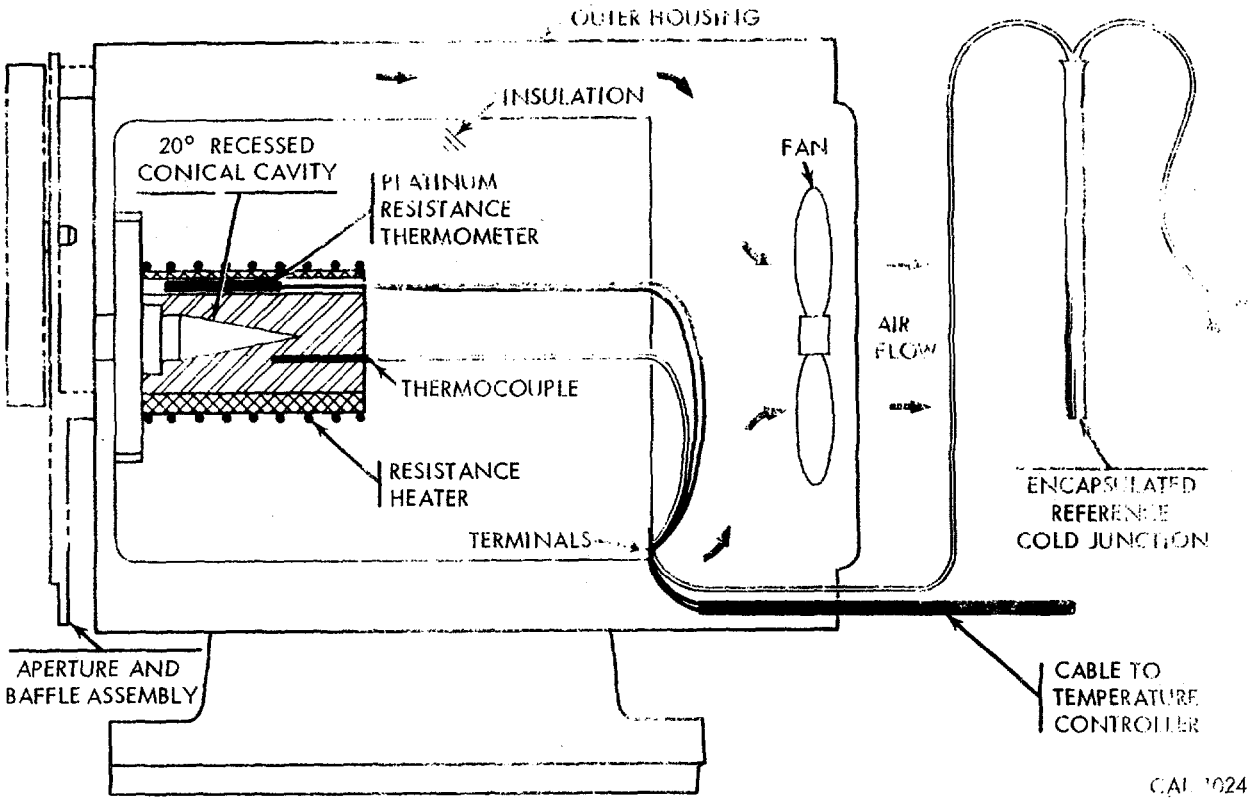


**Figure 2-3. Functional diagram of radiation reference source-Model 463.**

collimator issued with the test set employs a of-axis parabolic reflective optical system which focuses radiant energy, emanating from a blackbody radiant reference source located at tile focal point, into a parallel, or collimated beam, which is required for the calibration and testing of radiometric instruments.

*b.* Functionally, the Model 230A collimator utilizes an off-axis parabola system with an accurately selected set of apertures placed art the focus of the parabola, a secondary front surface mirror, a primary mirror, and an exit aperture iris diaphragm. The exit iris, adjustable by an iris control located at the front of the collimator, allows stepping down of the beam cross section emanating from the collimator. However, adjustment of this iris is not required for proper test set operation: the collimator iris control is set for maximum iris opening at all times during test set operation. A radiant energy attenuator is used with the test set to limit radiating energy from the collimator to values corresponding to GMTS requirement. This attenuator is factory-calibrated with the specific collimator with which it is issued.

*c.* A functional schematic diagram of the off-axis collimator and radiant energy attenuator system is shown by fig. 2-4. System operation is as follows:

(1) Radiant energy emitted front blackbody radiation reference source illuminates an entrance aperture of preselected size as defined by setting of the collimator aperture wheel at the focus of the parabola.

(2) The radiant energy is directed through the entrance aperture to an off-axis secondary mirror, reflected to a primary mirror, and projected out through the exit aperture. This off-axis reflective system presents a

clear exit aperture with no intervening obstruction.

(3) The parallel radiation projected from the collimator is directed through a radiant energy attenuator, which defines the energy flux for various F values of the GMTS by limiting the collimated beam, and 'into the entrance optics of the test instrument. Basically, since emitted collimator flux density is in excess of that required for the GMTS, the attenuator serves to step down the beam to nominal values equivalent to GMTS attenuator settings by means of attenuator disks of various blockages corresponding to both the Block I and Block III GMTS requirements. The attenuator disks are rotated during calibration testing to average out variations in the energy beam emanating from the collimator prior to entrance in the test instrument optical
system.

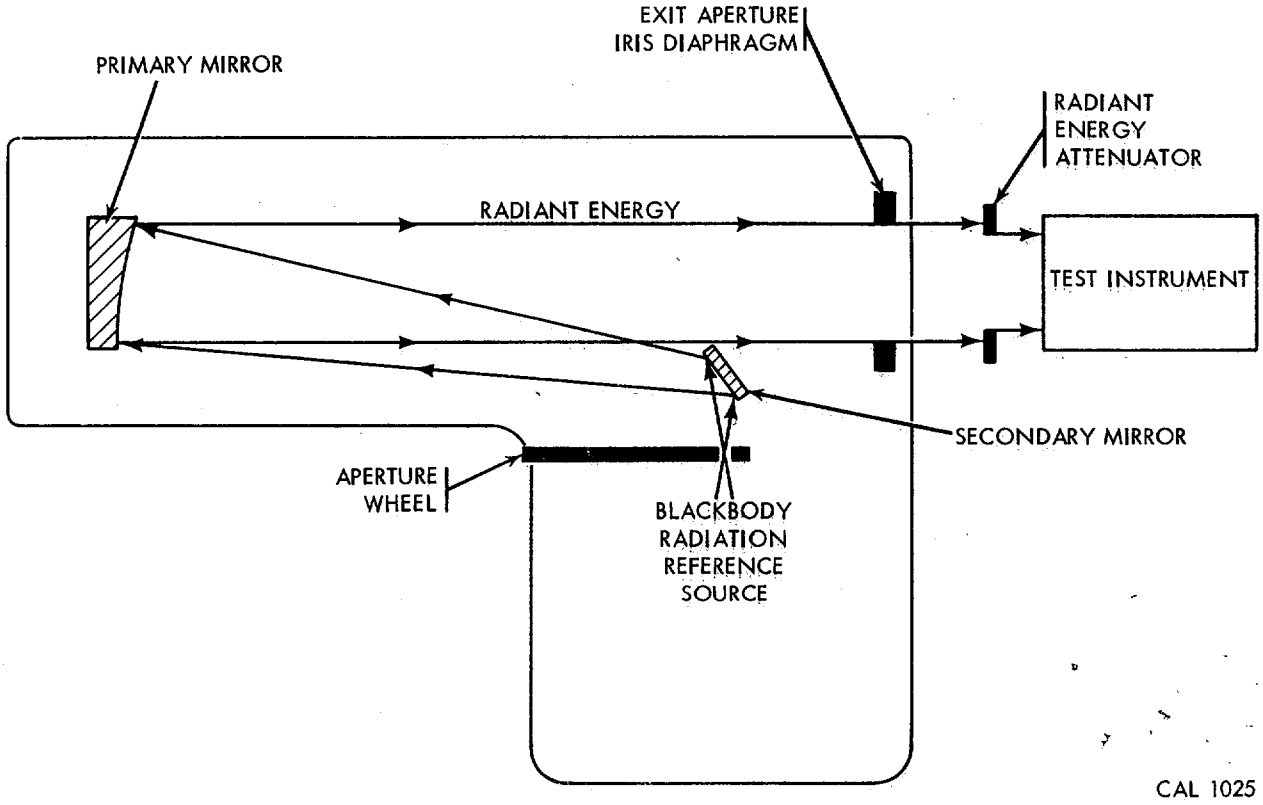


**Figure 2-4. Off-axis collimator Model 230A and radiant energy attenuator-7924452 functional schematic diagram.**

# CHAPTER 3
# OPERATING INSTRUCTIONS

## Section I. SERVICE UPON RECEIPT OF TEST SET

### 3-1. General

When a new or reconditioned test set is received by the Using personnel, it is the responsibility of the officer-in-charge to determine whether the materiel has been properly prepared for service by the supplying organization and to be sure it is in condition to perform its assigned mission when placed in service. For this purpose, inspect all major units, assemblies, subassemblies, and equipment to make sure that they are properly assembled, secured, cleaned, and correctly adjusted and lubricated. Check all equipment against Appendix B, Basic Issue Items List, to be sure every item is present and determine that they are in good condition, clean, and properly mounted and stowed.

### 3-2. Inspection of Instruments

*a. General Requirements.*
- (1) All cases and covers must be in good condition.
- (2) Instruments must be examined for evidence of abuse.
- (3) Instruments must be clean and free from grit.
- (4) Check for evidence of loose hardware inside instruments.
- (5) Cords and cables must be free from kinks and worn or frayed insulation and properly anchored at both ends.
- (6) Inspect for evidence of burned or carbonized cord insulation.
- (7) Inspect for high voltage arcs or short circuits.
- (8) Cord and cable plugs and receptacles must be clean and intact.
- (9) Plug caps must be attached when plugs are not in use.

*b. Temperature Controller.*
- (1) The manufacturer's serial number on the temperature controller must be identical to that of the blackbody radiation reference source.
- (2) The power switch and pilot light must function normally.
- (3) The coarse and fine temperature selector knobs must operate smoothly without binding or rough motion.
- (4) Indicator meter movement must not stick at any point.
- (5) Overload fuses must be properly installed.

*c. Blackbody Radiation Reference Source.*
- (1) The manufacturer's serial number on the blackbody radiation reference source must be identical to that of the temperature controller.
- (2) The blackbody aperture plate, aperture mounting plate, and associated hardware, supplied with the blackbody unit but not required for operation of. the test set, should be properly stored.

*d. Off-Axis Collimator.*
- (1) Alignment sighting mirrors and the iris aperture window must be free from such, so matches, pits, dirt, chips, and breaks as will interfere with or affect the optical performance of the instrument.
- (2) The iris control must function smoothly with no binding or rough motion.

(3) The aperture plate must rotate without binding and provide proper indexing with the spring detent.
(4) The adjustable legs must be securely mounted in the collimator base. Foot pads, supplied with the collimator but not required for operation of the test set, should be properly stored.
(5) Inspect the autocollimating telescope support post for nicks, burs, or other damage.

*e. Radiant Energy Attenuator.*
(1) The manufacturer's serial number on the radiant energy attenuator must be identical to that of the off-axis collimator.
(2) The power switch must function normally.
(3) Attenuators and idler pulleys must rotate freely with no binding when energized.
(4) Inspect for nicks and/or distortion of attenuator openings on all attenuators.
(5) The driver pulley must be firmly secured to the motor drive shaft.
(6) Inspect all Block III attenuators to ensure proper cement bonding of attenuator overlays - to carrier disks.
(7) The line cord must be securely anchored to the motor cover.

*f. Autocoollimating Telescope.*
(1) Inspect the eyepiece lens and front window for scratches, pits, dirt, chips, and breaks which will interfere with or affect the optical performance of the instrument.
(2) Eyepiece focus adjustment must operate to produce a well-defined scale reading.
(3) With the instrument lamp energized, illumination must be sufficient for the scale numerals and markings to be clearly distinguishable, and proper projection of the cross hair target.

*g. Specific Inspection Requirements.* The condition of the test set may be determined by using the operational check procedure (par. 7-3 and 7-4) and the test set operating procedures (par. 3-10).

## 3-3. Inspection of Mechanical Components of Test Set

*a. Completeness.* Inspect the test set to see that all component parts are present. Inspect for missing or loose hardware such as nuts, bolts, and screws. Check for completeness of instrument accessory items not used for test set operation.

*b. Appearance.* The overall appearance of the test set will indicate its general condition and reflect the type of treatment it has received. Inspect for dented surfaces, bent or broken parts, fungus growth, moisture, and corrosion. Especially examine for any indications of substandard rework and evidence of damage which might require correction or repair. Brackets, nuts, screws, and lock washers must a p)pear sufficiently secure.

*c. Functioning of Mechanical Components.* Mechanical components must operate smoothly without binding or rough motion. Parts must be free from grit and must be properly lubricated. Check general condition of wearing surfaces such as alignment stand bearings, sleeves, slides, and gears for evidence of excessive or uneven wear, excessive play, or backlash.

*d. Name Plates, Scales, and Indexes. In*spect scale numbers, divisions and indexes, and lettering on name and direction plates, to see that they are clearly defined and easily read.

*e faint and Finish.* Inspect for bare spots or damaged finish which expose bare metal surfaces and lead to corrosion.

*f. Lubrication.* Bearings, sliding surfaces, and other moveable parts must be clean, properly lubricated, and free from foreign matter. Check to see that the materiel is properly lubricated in accordance with paragraph 4-6.

*g. Cracks.* Plates and castings should be inspected for cracks and breaks.

*h. Nicks and Burs.* Inspect all mounting surfaces for nicks and burs.

## 3-4. Condition of Spare Parts and Materiel

*a. General.*
(1) Check all spare parts and equipment against Appendix B, Basic Issue Items List to determine completeness.

(2) Check for properly maintained hand tools.
(3) Check spare parts for general condition and method of storage. Spot check selected items against inventory records to evaluate the accuracy and efficiency of unit supply procedure.

*b. Inspection.* Refer to paragraphs 3-2 and 3-3 for inspection requirements and procedures.

### 3-5. Service Upon Receipt of Reconditioned Materiel

*a. General.* Upon receipt of reconditioned materiel, it is the responsibility of the officer-in-charge to determine the condition of : .the materiel.

*b. Inspection.* Refer to paragraphs 3-2 and 3-3 for inspection requirements and procedures. Examine any rework revealed by maintenance records to see that it conforms to the highest standards of workmanship.

## Section II. CONTROLS

### 3-6. General

This section describes, locates, and illustrates the various controls provided for operation of the test set.

### 3-7. Temperature Controller

*a. COARSE SELECTOR Dial.* The COARSE SELECTOR dial (fig. 3-1) is a 10-turn counting dial used for selecting the desired temperature setting at which the blackbody radiation reference source is to be controlled. The scale is graduated from 0 to 100 in 10 major divisions. Each major division has 10 minor divisions. A total of 1000 divisions is obtainable over 10 dial turns.

*b. FINE SELECTOR Knob.* The FINE SELECTOR knob (fig. 3-1) provides a change in temperature of approximately 1 degree each side of the COARSE SELECTOR setting. An indexing scale from 0 to 5 clockwise provides temperature increase; a scale from 0 to 5 counterclockwise provides temperature decrease.

*c. Indicator Meter.* The indicator meter (fig. 3-1) provides a visual indication of the controlling circuit. Values above null (0) indicate the reference source temperature is above specified operating temperature; values below null indicate the temperature is below specified operating temperature. An approximate null reading indicates proper operating temperature. The scale is graduated from 0 to 100 in 2 major division on either side of null. Each major division has 5 minor divisions.

*d. POWER Switch.* The POWER toggle switch (fig. 3-1) applies line voltage to energize the instrument.

*e. Pilot Light.* The neon pilot light (fig. 3-1) provides a visual indication when the test set is energized.

*f. Overload Fuses.* Circuit overload protection for the temperature controller unit and the blackbody radiation reference source is provided by two overload fuses, F201 and F202.

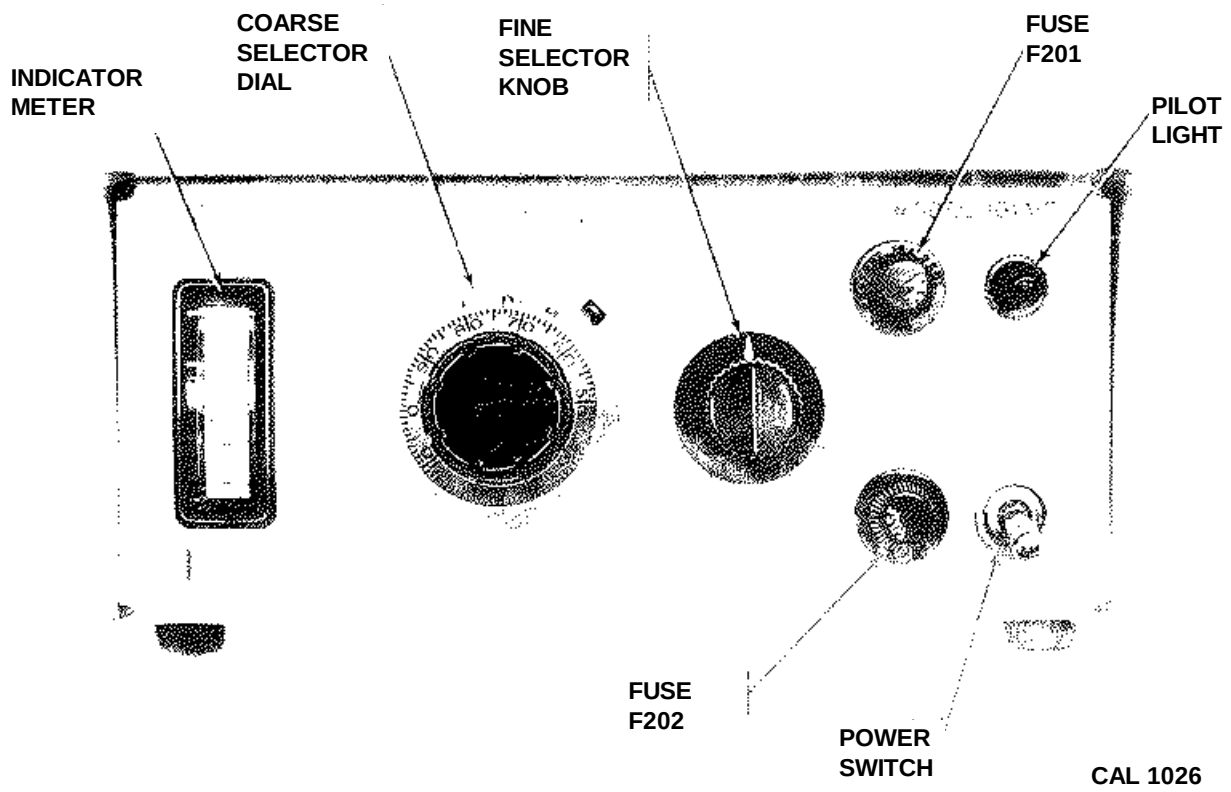


**Figure 3-1. Temperature controller-Model 101A-F controls.**

## Section III. OPERATION UNDER USUAL CONDITIONS

### 3-8. General

This section describes the procedure for normal operation of the test set. It is assumed that the set is free from maintenance problems, and has passed the inspection requirements outlined in paragraphs 3-2 and 3-3. Review the information in preceding sections of this chapter.

**Note.**

**The sequence of operation given in this section is necessary for correct functioning of the test set.**

### 3-9. Preparation for Use

a. Place the alignment stand on a flat, level surface at a point of minimum vibration. The surface must be clean and free of obstacles to ensure a firm footing for the stand.

*b.* Install the threaded adjustable legs of the collimator into the collimator base legs (fig. 3-2). Adjust the height of the legs to level the collimator and lock by tightening the leg lock nuts. Mount the collimator on the alignment stand base plate with the tapered adjustable legs firmly seated in the base plate recessed foot pads. Set iris control setting at front of collimator for maximum iris opening.

*c.* Clamp the autocollimating telescope on the collimator support post (fig. 3-2). Connect the telescope light source to the telescope and connect the light source cord to the adjustable line transformer. Plug the transformer

cord into an electric outlet that supplies 117 VAC ± 10% 50-60 Hz.

**Note.**

**The autocollimating telescope light source and adjustable line transformer are not supplied with the test set. These items are supplied with the secondary transfer test set 4931-895-3886.**

*d.* The autocollimator telescope may be aligned by placing an optical flat mirror so that it will intercept both the collimator and autocollimator beams. Sight through an open aperture wheel position with a microscope in the position normally occupied by the blackbody. Adjust the optical flat mirror for the best image (mirror perpendicular to the collimator axis).

*e*. Sight through the autocollimator eyepiece and adjust the telescope position until the cross hair target can be superimposed on the graduated scale. Secure the telescope locking clamps and seal these clamp positions. The flat mirror and microscope can then be removed.

*f.* Mount the blackbody radiation reference source on the collimator base and secure with mounting bolts four places (fig. 3-2).

**Note**

**The manufacturer's serial number on the blackbody radiation reference source must be identical with the serial number of the temperature controller. The aperture and baffle assembly (fig. 1-4) must be removed and stored before mounting the unit on the collimator base.**

*g.* Place the temperature controller on a flat, level working surface and connect the cable from the blackbody radiation reference source (fig. 3-2). Plug the temperature controller line cord at the rear of the instrument into an electric outlet that supplies 117 VAC ± 10% 50-60 Hz.

*h.* Attach the alignment stand adapter plates to the test instrument housing adapter legs with adapter bolts in four places. Install the test instrument on the alignment stand rotating table by securing the adapter plates to the rotating table with locking screws in four places (fig. 3-2).

**Note.**

**The test instrument forward and aft GMTS adapter tubes must be installed prior to mounting the test instrument on the alignment stand. The forward adapter tube contains the sighting mirror used in alignment procedures; the aft adapter tube provides a balance weight to ensure proper spring tension on the alignment stand tilt translation mechanism.**

### 3-10. Operating Procedures

*a*. Set the temperature controller 10-turn COARSE SELECTOR dial (fig. 3-1) to the desired operating temperature setting as determined by the instructions given in paragraph 3-11.

*b*. Turn the FINE SELECTOR knob (fig. 3-1) to 0.

*c*. Switch the toggle POWER switch to ON position.

*d.* Allow the blackbody radiation reference source time to reach a stable operating temperature. A reading of approximately 0 on the indicator meter (fig. 3-1) indicates a stable operating temperature. Proceed as follows while a stable operating temperature is being reached.

*e.* Set the collimator aperture wheel to the opened spring detent setting by aligning the selected value on the aperture wheel with the index marking (fig. 1-5) on the collimator housing.

*f.* Actuate the line transformer to illuminate the autocollimatilng telescope. With the , lamp lit, the internal cross hair target of the autocollimating telescope will be projected on the autocollimating mirror of the test instrument and reflected back to the eyepiece.

*g.* Mount radiant energy attenuator on forward end of the test instrument forward adapter tube (fig. 3-2). Plug attenuator line cord into an electric outlet that supplies 117 VAC ± 10, % 50-60 Hz.

**Note.**

**The manufacturer's serial number on the radiant energy attenuator must be identical with the serial number on the collimator.**

### 3-11. Blackbody Calibration Chart

The purpose of the blackbody calibration chart is to define the correct COARSE SELECTOR dial setting required to obtain a desired operating temperature. A sample chart is shown by figure 3-3.

**Note.**

**The blackbody calibration chart applies only to the precalibrated blackbody radiation. reference source and temperature controller set with which it is issued. The calibration curve differs for each particular set of instrument**

The blackbody calibration chart (fig. 3-3) plots the values of dial numbers against temperature. Values of temperature are found at

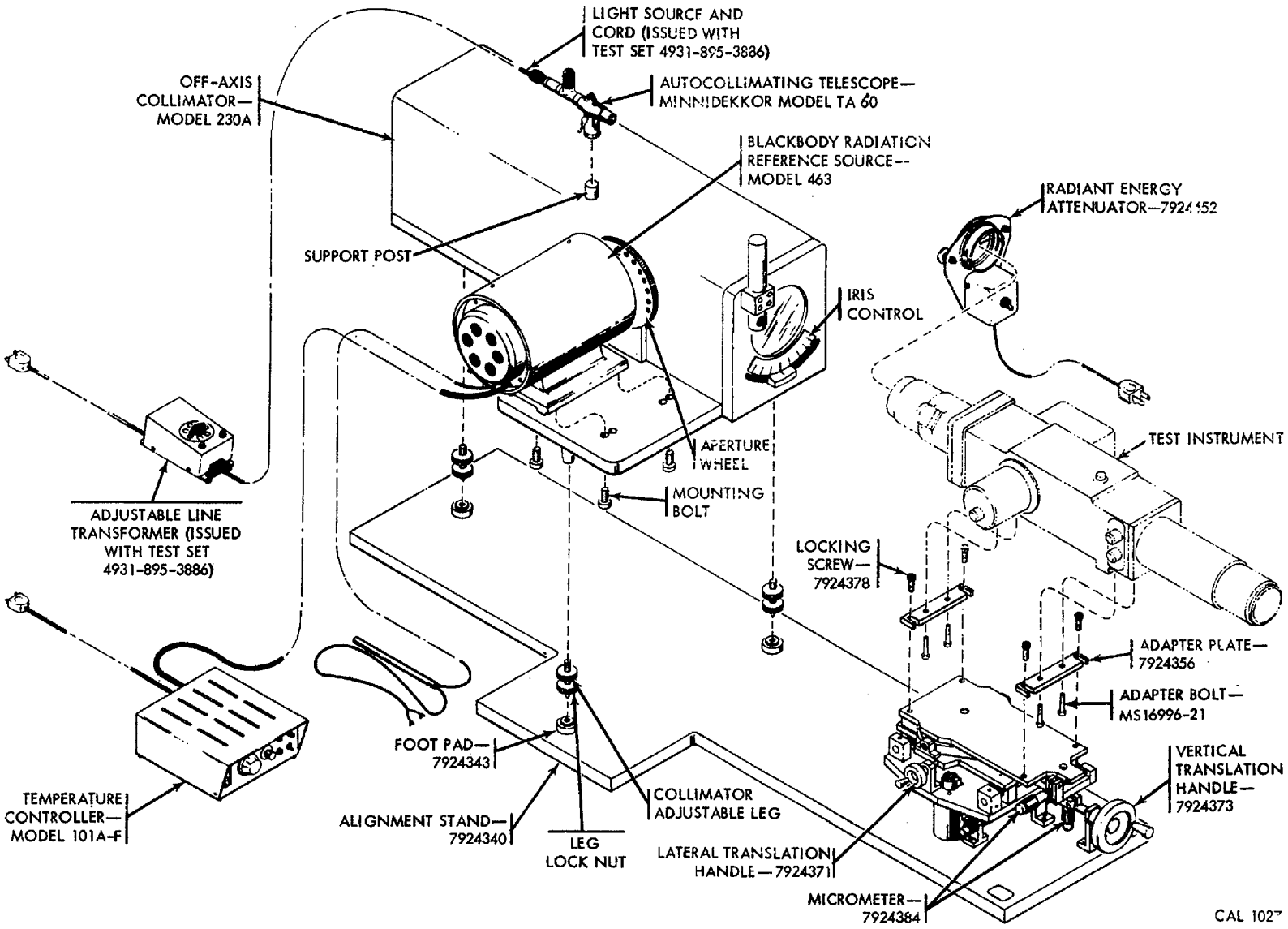


**Figure 3-2. Test set operational setup.**

the top and bottom of the chart and values of dial numbers are found at the left and right of the chart. To convert the desired operating temperature into the proper COARSE SELECTOR dial setting; find the desired temperature !at the top or bottom of the chart, follow a vertical line until it intersects the calibration curve, then follow a horizontal line left or right to read the value to which the COARSE SELECTOR dial should be set.

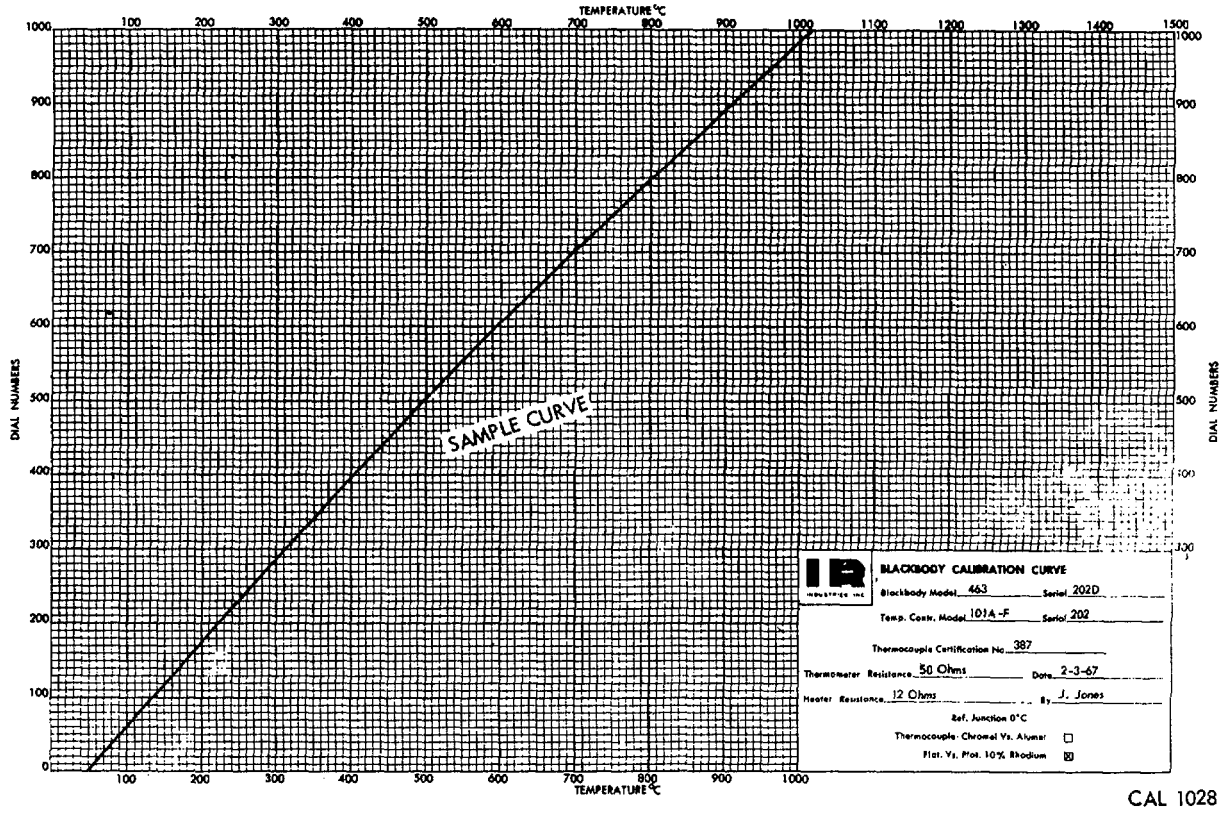


**Figure 3-3. Sample blackbody calibration chart.**

## Section IV. PREPARATION FOR TRAVEL

### 3-12. Reshipment and Storage

To prepare the test set for travel, dismantle as follows:

*a.* Deenergize the temperature controller, radiant energy attenuator, and autocollimating telescope.

*b.* Remove the radiant energy attenuator from test instrument forward adapter tube.

c. With test instrument removed, secure adapter plates and locking screws to alignment stand rotating table.

*d.* Remove light source from autocollimating telescope and remove telescope from collimator support post. Store telescope light source and line transformer in applicable secondary transfer test set 4931-895-3886.

*e.* Unplug blackbody radiation reference source cable from rear of temperature controller. Remove four mounting bolts securing blackbody unit to collimator base plate and remove blackbody unit.

*f.* Remove collimator from alignment stand base plate and remove collimator threaded adjustable legs.

### 3-13. Packaging for Shipment

For test set packaging and packing information, refer to paragraph 10-3.

# CHAPTER 4

# OPERATOR'S MAINTENANCE INSTRUCTIONS

## Section I. PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR OPERATORS

### 4-1. General

Tools, equipment, and spare parts are issued to the using personnel for operating and maintaining the materiel. Spare parts and equipment should not be used for purposes other than prescribed and, when not in use, should be properly stored in the containers provided for them.

### 4-2. Parts

Spart parts are supplied to the using personnel for replacement of those parts most likely to become worn, broken, or otherwise unserviceable, if such operations are within the scope of their maintenance functions. Spare parts and equipment supplied for the test set are listed in Appendix B, Basic Issue Items List.

### 4-3. Special Tools and Equipment

No special tools and equipment *are* required for operator maintenance.

## Section II. PREVENTIVE MAINTENANCE SERVICES

### 4-4. Responsibilities and Intervals

Preventive maintenance services, as prescribed by Army Regulations, are a function of the using personnel. They consist generally of services required before operation, during operation, after operation, weekly, monthly, and before traveling, performed by the operators and include the scheduled services to be performed at designated intervals. Intervals are based on normal 8-hour day operation. Reduce intervals for abnormal operations or severe conditions. Intervals during inactive periods may be extended accordingly.

### 4-5. Operator Maintenance

*a. Purpose.* To ensure efficiency and dependability, it is necessary that the materiel be inspected systematically at the specified intervals, in order that defects may be discovered and corrected before they result in serious damage or failure. Any defects or unsatisfactory operating characteristics beyond the scope of the operator or organizational mechanic to eject, must be reported at the earliest opportunity to the supporting maintenance unit for correction.

*b. Services.* Preventive maintenance services for operators are listed in table 4-1. The scheduled intervals set forth for the frequency of performance (interval time) of the periodic maintenance procedures have been based upon normal operating conditions.

## Table 4-1. Preventive Maintenance Checks and Services

| Interval and sequence no. | | | | Item to be Inspected | Procedure | Paragraph and figure reference |
|---|---|---|---|---|---|---|
| Before operation | During operation | After operation | Before travel | | | |
| 1 | | 43 | | Alignment stand: Base plate | Check for cleanliness, breaks, cracks, and chipped paint. Clean/spot paint when required. | Paragraphs 1-4*b*, 3-2a, 3-3*e*, 3-3*g*, 4-7. Figure 1-1, 1-2, 8-2 |
| 2 | | | | | Inspect rest buttons to ensure solid mounting on optical bench during test set operation. | Paragraphs 1-4*b*, 3-9*a*. Figure 8-2. |
| 3 | | | | | Check positioning of the foot pads to ensure proper seating of the tapered collimator legs. | Paragraph 1-4*b*. Figures 1-2, 3-2, 8-2. |
| 4 | | 44 | | Adjusting mechanism..... | Check for accumulation of dirt and foreign material. Clean when | Paragraphs 1-4*b*, 3-2*a*, 4-7. Figures 1-1, 1-2, 8-1, |
| 5 | | 45 | | | Check mechanism for freedom and ease of movement, and grease buildup. Clean and lubricate postguides, bearing surfaces, and gears if required. | Paragraphs 1-4*b*, 3-2*a*, 3-3*c*, 3-3f, 4-6*a*, 4-6b, 4-7. Figures 1-1, 1-2, 3-2, 8-1, 8-2. |
| 6 | | 46 | | | Inspect all plates and castings for breaks and cracks. Check for chipped paint. Spot paint when required. | Paragraphs 1-4*b*, 3-2*a,* 3-3e, 3-3*g*. Figures 1-1, 1-2. |
| 7 | | 47 | | | Check to ensure the adjustment mechanism is securely mounted on the base plate. | Paragraph 1-4*b*. Figures 1-1, 1-2, 3-2, 8-1, 8-2. |
| 8 | | 48 | | | Check spring tension of the tilting table. Replace spring if required. | Paragraph 8-12*b.* Figure 8-1. |
| 9 | | 49 | | Micrometers ..... | Inspect horizontal and vertical adjustment micrometers for security of attachment, freedom of movement, and proper spring tension. Adjust clamp screws for proper tension if required. | Paragraph 1-4b. Figures 1-1, 1-2, 3-2, 8-1. |

**Table 4-1. Preventive Maintenance Checks and Services -Continued**

| Interval and sequence no. | | | | Item to be inspected | Procedure | Paragraph and figures references |
|---|---|---|---|---|---|---|
| Before operation | During operation | After operation | Before travel | | | |
| | | | | Alignment stand: Continued | | |
| 10 | | 50 | | Mounting surfaces..... | Check adapter plate and rotating table mounting surfaces for cleanliness, nicks, and burs. Clean and remove nicks if required. | Paragraphs 1-4*b*, 3-2*a* 3-3*h*, 4-7 Figures 1-1, 1-2, 3-2, 8-1 |
| 11 | | 51 | | Screws and nuts ..... | Check all external screws and nuts for tightness. Replace missing screws and nuts. | Paragraph 3-2*a*. Figures 1-1, 1-2, 3-2, 8-1, 8-2. |
| | | | | Temperature controller:..... | | |
| 12 | | 52 | | Case | Check for dirt and grease. Clean when required. | Paragraphs 1-4*c,* 3-2*a,* 4-7. Figures 1-1, 1-3. |
| 13 | | 53 | | Controls and indicator..... | Inspect controls, indicator meter, and power switch for cleanliness, ease: of operation, and breakage. Clean when required. Notify supporting maintenance unit of malfunctions. | Paragraph 1-4*c*, 3-2*a*, 3-2*b*, 4-7 Figure 1-2, 1-3, 3-1. |
| 14 | | 54 | | Pilot light..... | Check neon pilot light. Replace lamp if required. | Paragraph 3-2*b*. Figures 1-3, 3-1. |
| 15 | | | | Fuses ..... | Check for proper amperage, contact, and continuity. Replace if blown or improper size. | Paragraphs 3-2*a*, 3-2*b*. Figures 1-3, 3-1. |
| 16 | | 55 | | Power cable..... | Check for frayed or worn sports, loose connectors, dirt, grease, and bent pins. If required, clean and tighten connectors, straighten pins, or replace cable. | Paragraphs 1-4*c,* 3-2*a*, 4-7. Figures 1-3, 3-1. |
| 17 | | 56 | | Power and test..... receptacles. | Check for dirt, dust, grease, and corrosion including cap and retaining chain. Check for tightness and breakage. | Paragraphs 1-4*c,* 3-2*a*, 4-7. Figure 1-3. |

**Table 4-1. Preventive Maintenance Checks and Services-Continued**

| Interval and sequence no. | | | | Item to be inspected | Procedure | Paragraph and figure references |
|---|---|---|---|---|---|---|
| Before operation | During operation | After operation | Before travel | | | |
| | | | | Blackbody radiation reference source: | | |
| 18 | | | 74 | Serial number | Check to determine that the manufacturer's serial number on the unit is identical to that of the temperature controller unit being used in the test setup. Do not operate the test set if the serial numbers are not identical. Replace the blackbody unit and temperature controller with a precalibrated matched set. | Paragraphs 1-4d, 3-2c. Figures 1-1, 1-4. |
| 19 | | 57 | | Housing | Check for cleanliness, breaks, cracks, and chipped paint. Clean/spot paint where required. | Paragraphs 1-4d, 3-2c, 3-3e, 3-3g, 4-7. Figures 1-1, 1-4. |
| 20 | | 58 | | Cabling | Check for proper anchorage to blackbody unit. Check for frayed or worn spots, loose connectors, dirt, grease, and bent pins. If required, clean and tighten connectors, straighten pins, or replace cable. | Paragraphs 1-4d, 3-2a. Figures 1-1, 1-4 , 3-2. |
| 21 | | | 75 | | Perform an operational check to determine if the blackbody radiation reference source is performing properly. | Paragraphs 2-3, 3-2*g*, Figure 7-1. |
| 22 | | | | Mounting | Check to ensure the unit is securely mounted on the collimator base. Check mounting bolts for tightness. | Paragraph 1-4d. Figures 1-1, 3-2. |
| | | | | Off-axis collimator: | | |
| 23 | | 59 | | Housing | Check for cleanliness, breaks, cracks, and chipped paint. Clean/spot paint when required. | Paragraphs 1-4*e*, 3-2*a,* 3-3*e,* 3-3*g,* 4-7. Figures 1-1, 1-5. |

**Table 4-1. Preventive Maintenance Checks and Services-Continued**

| Interval and sequence no. | | | | Item to be inspected | Procedure | Paragraph and figure references |
|---|---|---|---|---|---|---|
| Before operation | During operation | After operation | Before travel | | | |
| | | | | Blackbody radiation reference source: Continued | | |
| 24 | | 60 | | Mirrors and window | Check alignment sighting mirrors for cleanliness. Clean if required. Notify supporting maintenance unit of any scratches, pits, or breaks | Paragraphs 1-4e, 3-2d, 4-7. Figures 1-1, 1-5, 3-2. |
| 25 | | 61 | | Aperture wheel | Check aperture wheel for freedom of rotation and proper indexing. Notify supporting maintenance unit of any malfunction. | Paragraphs 1-4e, 3-2a, 3-2d. Figures 1-1, 1-5, 3-2. |
| 26 | | 62 | | Iris control | Check iris control for freedom of movement Notify supporting maintenance unit of any binding or rough motion. | Paragraphs 1-4e, 3-2d, Figures 1-1, 1-5, 3-2. |
| 27 | | 63 | | Support post | Check autocollimating telescope support post for nicks and burs. Remove if required. | Paragraphs 1-4e, 3-2a, 3-3h. Figure 1-5. |
| 28 | | | | Positioning | Check to ensure proper positioning of the collimator on the alignment stand. Check tightness of adjustable leg lock nuts. Tighten' if loose. If required, adjust height of legs to level collimator. | Paragraphs 1-4e, 3-2d. Figures 1-1, 3-2. |
| | | | | Radiant energy attenuator: | | |
| 29 | | | 76 | Serial number | Check to determine that the manufacturer's serial number on the unit is identical to that of the collimator unit being used in the test setup. Do not operate the test set if the serial numbers 'are not identical. Replace the attenuator unit and collimator with a precalibrated matched set. | Paragraphs 1-4f, 3-2e. Figures 1-1, 1-6. |

**Table 4-1. Preventive Maintenance Checks and Services-Continued**

| Interval and sequence no. | | | | Item to be inspected | Procedure | Paragraph and figure references |
|---|---|---|---|---|---|---|
| Before operation | During operation | After operation | Before travel | | | |
| | | | | Radiant energy attenuator:-Continued | | |
| 30 | | 64 | | Pulleys..... | Check idler pulleys for security of attachment and freedom ofrotation. Tighten/replace if required. Clean if required. | Paragraphs 1-4f, 3-2*e*. Figures 1-1, 1-6, 3-2, 8-3. |
| 3! | | 65 | | | Check driver pulley attachment to drive motor shaft. Tighten set screw if loose. | Paragraphs 1-4*f*, 3-2*e*. Figures 1-1, 1-6, 3-2, 8-3. |
| 32 | | 66 | | Mounting cap..... | Check mounting capfor dirt and grease, clean if required. | Paragraphs 1-4*f*, 4-7. Figures 1-1, 1-6, 3-2, 8-3. 1 |
| 33 | | 67 | | | Check mounting surface and edges for nicks and burs. Remove if required. | Paragraphs 1-4*f*, 3-3*h*. Figures 1-1, 1-6, 3-2, 8-3. |
| 34 | | 68 | | | Check spring tension to ensure proper mounting on the testinstrument adapter tube. Inspect for cracks. Replace if required. | Paragraphs 1-4*f*, 3-3*g*. Figures 1-1, 1-6, 3-2, 8-3. |
| 35 | | 69 | | Power cable..... | Check for proper anchorage to motorhousing. Check for evidence of worn or burned insulation. Remove kins. Replace if required. | Paragraphs 1-4*f*, 3-2*a*, 3-*21e.* Figures 1-1, 1-6, 3-2, 8-3. |
| 36 | | | | Power switch..... | Check power switch for proper functioning. Replace if required. | Paragraphs 1-4*f*, 3-2*a*. Figures 1-6, 8-3. |
| 37 | | | | Motor..... | Energize motor to determine proper functioning. Replace if required | Paragraph 1-4*f*. Figures 1-1, 1-6. |
| 38 | | 70 | | Attenuators..... | Check attenuators for nicks, scratches, or deformities. Check Block III attenuators for proper bonding. Replace if required. | Paragraphs 1-4*f*, 3-2*a*, 3-2*e*. Figures 1-1, 1-6, 3-2, 8-3. |
| | | | | Autocollimating telescope: | | |
| 39 | | 71 | | Housing..... | Check for accumulated dirt and grease. Clean when required. Inspect mounting surface for nicks and burs. Remove ifrequired. | Paragraphs 1-4*g*, 3-2*a*, 3-3*h*, 4-7. Figures 1-1, 1-7, 3-2. |

**Table 4-1. Preventive Maintenance Checks and Services-Continued**

| Interval and sequence no. | | | | Item to be inspected | Procedure | Paragraph and figure references |
|---|---|---|---|---|---|---|
| Before operation | During operation | After operation | Before travel | | | |
| | | | | Autocollimating telescope:-Continued | | |
| 40 | | 72 | | Lens - | Checks lens for cleanliness, scratches, pits, and breaks. Clean if required. Replace if lens are damaged. | Paragraphs 1-4*g*, 3-2*a*, 3-2*e*, 4-7. Figures 1-1, 1-7. |
| 41 | | 73 | | Clamps | Check mounting and adjusment clamps for proper functioning with unit mounted on collimator support post. Replace if required | Paragraph 1-4*g*. Figures 1-1, 1-7, 3-2. |
| 42 | | | | Illumination | Energize telescope and inspect for proper illumination, projection, and focusing. Replace if required. | Paragraphs 3-2*f,* 3-12*d*- Figure 3-2. |

## 4-6. Lubrication

*a.* To prevent corrosion and allow for easy operation, clean and lubricate the alignment stand post guides (fig. 8-2) with a soft cloth on which a few drops of : instrument oil, MIL-L-6085, have been spread. This should be done daily or whenever vertical translation of the alignment stand becomes difficult. No oil should be applied directly to surfaces since even a small amount will catch dust.

*b.* Apply a small amount of instant grease, MIL-G-15793, to the threaded surfaces of the alignment stand worm gears and gear racks (fig. 8-2) when adjustments become difficult to operate.

## 4-7. Cleaning

*a.* Clean the alignment stand adjustable mechanism in accordance with the procedure of paragraph 4-6a.

*b.* Clean superficial dust from lens, mirrors, and windows with a fine camel's hair brush. To clean accumulated grease or finger marks use a soft, lint-free cotton cloth saturated in full strength alcohol (not denatured) or an approved lens cleaning solution.

*c.* Clean external surfaces of the reference set instruments using volatile mineral spirits or dry cleaning solvent applied with a soft, lint-free cloth.

*d.* Volatile mineral spirits and dry cleaning solvent are flammable and should not be used near an open flame. A fire extinguisher should be provided when these materials are used. Use only in well-ventilated places.

*e.* Cleaning solvents evaporate quickly and have a drying effect on the skin. If used without gloves, they may cause cracks in the skin and may result in mild irritation or inflammation.

*f.* Avoid getting dry cleaning solvent on rubber parts of the instrument, this causes rubber to deteriorate.

## 4-8. Care in Handling Instruments

*a.* The test set contains sensitive instruments suited for the designed purpose. They will not stand rough handling and abuse. Inaccuracy or malfunctioning will result from mistreatment.

*b.* Unnecessary 'turning of screws or other parts not required in the use of the instruments is forbidden.

*c.* Keep the instruments as dry as possible. If an instrument is wet, dry it carefully before covering.

*d.* When not in use, instruments must be covered and protected from dust and moisture.

# CHAPTER 5

# DEPOT MAINTENANCE INSTRUCTIONS

## 5-1. Introduction

*a.* The remainder of the manual, except for chapter 10, describes the procedures to be followed by maintenance personnel in performing depot level maintenance upon the materiel.

*b.* These procedures include the various technical inspections to detect unserviceable or failing materiel; troubleshooting to locate the source of trouble within each faulty item; and adjustment, repair, or overhaul as necessary to restore the materiel to serviceability.

## 5-2. General Information

No special tools or test equipment are authorized to maintenance personnel for the test set.

## 5-3. Parts

Maintenance parts will be procured in accordance with SB 9-170.

## 5-4. Standard Tools and Equipment

Standard tools and equipment having general application are authorized by T/A and T/OE.

# CHAPTER 6

# INSPECTION

## Section I. GENERAL

### 6-1. Scope

This chapter provides specific instructions for the technical inspection by maintenance personnel of the test set when received for repair in ordnance shops. This chapter also defines the in-process inspection of materiel during repair or overhaul and the final inspection after repair and overhaul has been completed. Troubleshooting information is incorporated in chapter 7 and is a normal phase of inspection.

### 6-2. Purposes of Inspection

Inspection is primarily for the purpose of determining the condition of an item, i. e., serviceable or unserviceable, recognizing conditions which would cause failure, assuring proper application of maintenance policies at prescribed levels, and determining the ability of a unit to accomplish its maintenance and supply mission.

### 6-3. Categories of Technical Inspection

In general, there are five categories of inspection performed by maintenance personnel:

*a*. *Overall Inspection*. This is an overall inspection performed periodically. It is performed on materiel received for repair in depot maintenance shops. Upon completion of an inspection for serviceability, materiel will be declared either serviceable or unserviceable. Detailed procedures are presented in sections II and III.

*b*. *Pre-embarkation Inspection*. This inspection is performed on materiel in the hands of personnel alerted for overseas duty to ensure that such materiel will not become unserviceable or worn out in a relatively short time. It prescribes a higher percentage of remaining usable life in serviceable materiel to meet a specific need beyond minimum serviceability. Detailed instructions are presented in section IV.

*c. In-Process Inspection*. This inspection is performed by the repair technician and/or floor inspector in the process of repairing or overhauling the materiel and its components. It ensures that all parts conform to prescribed standards, that the workmanship is in accordance with approved methods and procedures, and that deficiencies not disclosed by the technical inspection are found and corrected. Detailed instructions are contained in chapter 8.

*d. Final Inspection*. This is an acceptance inspection performed by a final inspector, after repair or overhaul has been completed, to ensure that the materiel is acceptable according to established standards. Detailed instructions are contained in chapter 9.

*e. Spot-Check Inspection*. This is an overall inspection performed periodically on only a percentage of the materiel in each unit to determine the adequacy and effectiveness of organizational and field maintenance.

### 6-4. Classification of Materiel

All materiel, after inspection, is classified as follows:

*a. Serviceable*. Serviceable property consists of all new or used supplies which are in condition for issue for the purpose ,intended and all supplies which can be placed in such condition through pre-issue tests or inspections, in-storage deprocessing, installation of accessories, correction of minor deficiencies which

have developed since the item was last classified as serviceable, application of modification work orders for which parts are available or assembly of available components.

*b. Unserviceable*. Unserviceable property consists of all supplies which are not serviceable (i. e., do not satisfy the definition in *a* above). The definition of unserviceable property is further broken down into the following sub-classifications: Property which is unserviceable but economically repairable, property which is unserviceable and not economically repairable.

## Section II. INSPECTION OF TEST SET IN THE HANDS OF USING PERSONNEL

### 6-5. General

This section provides specific instructions for the technical inspection by calibration personnel of the test set. Also this section amplifies the general instructions contained in TM 9-1100 insofar as the instructions pertain to inspection of the test set. Personnel making this inspection will acquaint themselves with the test set operational check (par. 7-3 and 7-4), operational procedures (par. 3-10), and the troubleshooting chart malfunctions which are the most common deficiencies of the test set. Personnel will also acquaint themselves with the defects noted in paragraphs 3-2 and 3-3. In general, if the test set is complete and performs its intended function properly, and if all defects disclosed by the inspection have been corrected, the test set may be considered serviceable.

*a. Forms and Reports*. Authorized forms and reports for technical inspections are prescribed in TM 9-1100. Also, refer to paragraph 1-3. Preventive maintenance logs, if available, will be examined to determine the general maintenance background of the materiel. A record of progressive repairs may indicate a defective unit, while a record of regular preventive maintenance may indicate the unit is in excellent condition.

*b. Modification Work Orders*. All urgent modification work orders must have been applied. Check on application of all authorized modifications to see that no unauthorized alterations have been made, or that work beyond the authorized scope of the unit is being attempted. Check the index in DA PAM 310-4 for any modification work orders.

### 6-6. Performance Test

Equipment in the hands of using personnel cannot be classified serviceable unless it functions successfully according to the prescribed operational check (par. 7-3 and 7-4) and operating procedures (par. 3-10). It must function successfully with whatever system of equipment it is associated.

## Section III. MAINTENANCE SHOP INSPECTION

### 6-7. General

Technical inspection performed by the maintenance repair shop upon receipt of materiel turned in for repair determines the extent of repairs required, and provides the basis for requisitioning the parts, assemblies, or supplies necessary to accomplish the repairs. Often this inspection in the shop may be the same as that performed by inspectors in the field. It may disclose additional necessary repairs not indicated by the using organization.

### 6-8. Inspection of the Test Set

Inspect the mechanical and electrical components of the test set as described in paragraphs 3-2 and 3-3.

## Section IV. PRE-EMBARKATION INSPECTION

### 6-9. General

Inspection for outward appearance of the test set is of importance as well as inspection of mechanical condition. Where any doubt exists as to the utility of an assembly, that assembly must be replaced by a truly serviceable item. Equipment, when inspected, must approach new equipment standards of operation and appearance, and the workmanship and quality of the end product must reflect the highest standards obtainable. To assure that all items, insofar as practicable, possess original appearance, it is desired that items normally painted be repainted.

### 6-10. Inspection

*a. Modification Work Orders*. All current modification work orders except those designated as optional must have been applied. For modifications required but not yet accomplished, requisitions shall be submitted to the appropriate agency for the necessary materials. Materials will then be forwarded to the unit when available.

*b. Operation*. The test set must perform all its functions adequately as outlined in the operating procedures (par. 3-10). If the test set fails to meet any of the operational requirements, appropriate-corrective action must be taken.

*c. Special Instructions*. Compare the preventive maintenance log and records of previous inspections to see that all unsatisfactory conditions have been corrected. Compare the record of periodic inspections to see that every part and condition has been adequately inspected within a reasonable length of time. Examine any rework revealed by maintenance records to see that workmanship conforms to the highest standards.

# CHAPTER 7

# TROUBLESHOOTING

## Section I. GENERAL

### 7-1. Purpose

Troubleshooting is a systematic isolation and remedy of malfunctions and defective components by observation of symptoms and tests. The tests and remedies provided herein are governed by the scope of the level of maintenance. A troubleshooting chart indicates procedures for locating defective components of the test set. Refer to table 7-1.

**Table 7-1. Troubleshooting Chart.**

| Malfunction | Probable causes | Corrective action |
|---|---|---|
| Alignment stand: | | |
| Alignment stand binds in vertical translation. | Improper gear lubrication. | Lubricate threaded surfaces of worm gears and gear racks with instrument grease. (par. 4-6) |
| | Post guides bind. | Lubricate post guides with instrument oil. (par. 4-6) |
| Precise vertical translation adjustments cannot be made with micrometer setting. | Test instrument not properly balanced on alignment stand. | |
| | Damaged micrometer. | Replace micrometer. |
| Precise lateral adjustments cannot be made with micrometer setting. | Lateral adjustment spring faulty or missing. | Replace spring. |
| | Damaged micrometer. | Replace micrometer. |
| Blackbody radiation reference source and temperature controller: | | |
| Temperature controller pilot light does not light. | Blown fuse. | Check fuses and replace if necessary. |
| | No power available from line. | Check line voltage. |
| | Pilot light burned out | Check and replace if necessary. |
| Temperature controller indicator meter does not achieve a null reading on warm-up. | Load circuit fuse blown. | Check fuse and replace. |
| | Failed SCR. | Turn control dial over its range and determine if blackbody is warming up at any point over this range. Replace temperature controller and blackbody. |
| | Open connection between temperature controller and blackbody. | Check interconnecting cable and connectors for continuity in heating circuit. |
| | Blackbody heater opened up. | Check continuity through cable, if open circuit, replace temperature controller and blackbody. |
| | Thermometer circuit open. | Check circuit resistance through cable. Should be approximately 50 ohms at room temperature, higher when hot. |

**Table 7-1. Troubleshooting Chart-Continued.**

| Malfunction | Probable causes | Corrective action |
|---|---|---|
| Temperature controller indicator meter does not achieve a null reading on cool-down. | Short circuit in platinum thermometer circuit. | Check blackbody temperature; if going up shut off power and replace temperature controller and blackbody. |
| | Blackbody temperature not dropping because of shorted SCR. | Check blackbody temperature; if going up, regardless of blackbody temperature, shut off immediately and replace controller and blackbody. |
| Blackbody radiation reference source does not get warm. | Temperature controller 10-turn COARSE SELECTOR dial not properly set. | Set COARSE SELECTOR dial to required temperature setting. |
| | No power available from line. | Check line voltage. |
| | Blackbody radiation reference source cable not connected to temperature controller receptacle. | Connect cable. |
| Blackbody radiation reference source does not come up to maximum temperature. | Line voltage below 105 volts. | Check line voltage. |
| Off-axis collimator: | | |
| Collimator does not function properly. | Aperture wheel not properly indexed. | Turn aperture wheel to required setting. |
| | Collimator not level or properly positioned on alignment stand. | Adjust and lock collimator legs. Position legs properly in alignment stand foot pad receptacles. |
| | Blackbody radiation reference source not properly positioned and secured to collimator base. | Secure blackbody on collimator base with mounting bolts and washers in 4 places. |
| | Faulty optics or iris control. | Replace collimator. |
| Radiant energy attenuator: | | |
| Drive motor does not operate. | No power available from line. | Check line voltage. |
| | Faulty toggle switch. | Check and replace toggle switch if necessary. |
| Attenuator does not rotate. | Drive pulley loose from motor shaft. | Tighten drive pulley setscrew. |
| | Idler pulley stuck. | Check pulley attachment. Replace if necessary. |
| | Pulleys misaligned or loose. | Check pulleys and tighten attachment. |
| Unit does not mount firmly on adapter tube. | Faulty mounting cap - no spring tension. | Replace mounting cap casting. |
| Auto-collimating telescope: | | |
| Auto-collimating telescope does not illuminate. | Lamp burned out. | Replace lamp. |
| | No power available from line. | Check line voltage. |
| | Faulty transformer. | Replace transformer. |
| Auto-collimating telescope projected cross hair target not reflected back. | Auto-collimating telescope improperly positioned on collimator support post. | Adjust telescope line-of-sight path. |
| | Test instrument not properly balanced on alignment stand. | Attach aft adapter tube to test instrument. |
| | Alignment mirror housing not securely clamped to collimator housing. | Position mirror housing and tighten clamp screw. |

### 7-2. Special Test Equipment

No special test equipment is requited for the operational check or troubleshooting of the test set. Test equipment required for the operational check will be .available in the laboratory which is responsible for the support of the test set.

## Section II. OPERATIONAL CHECK

### 7-3. General

The operational check of the test set consists of a temperature test of the blackbody radiation reference source. If the requirement of the operational check is not met, perform the steps described in the troubleshooting chart (table 7-1).

### 7-4. Blackbody Temperature Test

*a*. Energize the temperature controller and blackbody radiation reference source (par. 3-10*a* through *d*).

*b*. Insert the blackbody thermocouple encapsulated reference cold junction into an ice bath as illustrated by figure 7-1.

*c*. Connect the leads from the ice bath reference junction to a Minneapolis Honeywell Model 2781 laboratory potentiometer or equivalent (fig. 7-1).

*d*. The potentiometer should indicate a temperature reading identical to the desired blackbody radiation reference source operating temperature as preset with the 10-turn COARSE SELECTOR dial of the temperature controller.

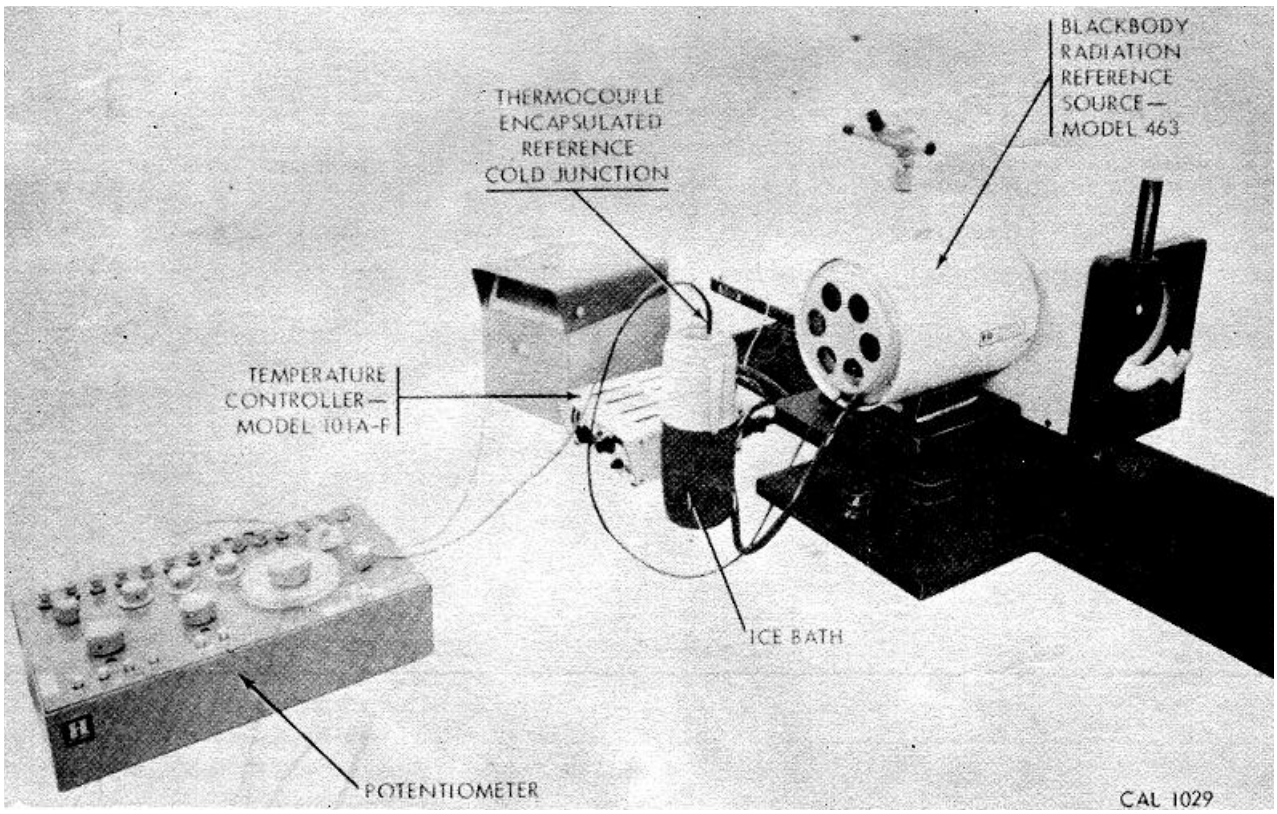


**Figure 7-1. Operational check of the blackbody radiation reference source.**

## Section III. TROUBLESHOOTING

### 7-5. General Procedure

Before troubleshooting the test set the technician should become familiar with the description (par. 1-4), inspection procedures (par. 3-2 and 3-3), operational check (par. 7-3 and 7-4), and operating procedures (par. 3-10). A familiarity with the operating procedures will help prevent the appearance of trouble symptoms resulting from incorrect operation. If the test set fails any performance test or a malfunction is observed during use, this indicates that some part of the test set requires adjustment or replacement.

### 7-6. Troubleshooting Chart

The principal aid to troubleshooting is given !in the troubleshooting chart (table 7-1). The troubleshooting chart indicates methods for identifying and correcting malfunctions which may be encountered in the test set

# CHAPTER 8

# REPAIR AND OVERHAUL

## Section I. PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR FIELD AND DEPOT MAINTENANCE

### 8-1. General

Tools and equipment and maintenance parts, over and above those available to the using personnel, are supplied to depot for maintaining and repairing the materiel.

### 8-2. Parts

Maintenance parts will be procured in accordance with SB 9-170.

### 8-3. Common Tools and Equipment

Standard and commonly used tools and equipment having general application are authorized for issue by T/A and T/O & E.

### 8-4. Special Tools and Equipment

No special tools and equipment are authorized to maintenance personnel for the test sets.

## Section II. GENERAL MAINTENANCE

### 8-5. General

*a.* This section contains general and specific maintenance instructions for the corrective maintenance of the test set. In the following sections, repair and overhaul procedures are described. The test set is restored to a serviceable condition by removal of defective components, by inspection, by application of repair procedures, followed by installation of serviceable components, and final inspection.

### 8-6. Handling of Disassembled Parts

*a.* A parts tray or suitable receptacle should be provided so that parts, as removed, can be placed in their respective positions in relation to the assembled instrument. Always keep the relative position of parts until the instrument is completely assembled. This is especially important where there is a possibility of a different man assembling the unit.

*b.* Large assemblies should be kept on the workbench and carefully placed so as to prevent loss or breakage. Mechanical parts should be cleaned, inspected, and lubricated if further maintenance is necessary. If parts are to remain disassembled for any length of time, protect them with a bench cover.

*c.* Mechanical parts must be marked for clear identification and carefully stored to prevent damage. If they are to be stored for a few days before assembly, the old grease should not be removed, as a perfectly clean metal part may soon become corroded. Be sure to identify each part or group of parts with the instrument of which it is a component.

### 8-7. Marking of Metal Components

Metal components should be marked as the instrument is disassembled in order to simplify accurate assembly. The alignment of such marks permits the instrument repairman to replace mating parts in their original relationship to each other, thus greatly facilitating assembly and adjustment. In some instances, original assembly by the manufacturer is

done with special jigs and fixtures not available to the repairman. In these cases, proper marking of mating parts may be the only way that proper and satisfactory assembly can ever be accomplished. Use a scriber and, if possible, a steel rule or straightedge to mark the mating parts. Make the marks small but legible, and as simple as possible. Never scribe marks on threads or bearing surfaces.

### 8-8. Cleaning Metal Parts

Use volatile mineral spirits or dry cleaning solvent for metal parts cleaning indicated in the following sections. Clean with a stiff-bristled brush of suitable size. Remove the part from the solvent and dry thoroughly as soon as practicable. Parts that have been cleaned should not be left unprotected and exposed to oxidation or accumulation of dust and dirt. Lubricate the part, if required, with the proper protective compound before installing it in the assembly. It must be remembered that volatile mineral spirits and dry cleaning solvents are inflammable and applicable precautions should be observed while using them. Refer to TM 9-850.

### 8-9. Lubrication

*a*. The alignment stand adjustable mechanism must operate smoothly without binding or sticking. Refer to paragraph 4-6 for lubrication procedures.

*b*. Where difficulty arises during assembly of parts without the use of any lubricant, some form of assembly lubrication is considered necessary. Prime factors to be considered under assembly of parts are as follows:

(1) Presence of dirt resulting from improper cleaning of metallic parts, improper shop storage and handling practices, and dirty surroundings during assembly.

(2) Accumulation of dirt, foreign material, and metallic chips resulting from threading components into each other or from assembly of pilot diameters and close fitting parts.

(3) Detrimental effects resulting from improper use or misapplication of grease.

*c*. Apply an extremely light film of grease, merely sufficient to seal the metallic pores. The grease is to be lightly applied and then removed by rubbing vigorously with a clean lint-free cloth.

### 8-10. Removal of Burs

Movable components must operate smoothly and precisely. Small burs can be removed with the aid of a knife-edged oil stone. Care must be observed when honing a bur from the crest or side of a thread to follow the contour of the machined surface, bringing the stone into contact only with the surface of the bur. Short, light strokes should be used. If the bur is large enough to warrant its use, a jeweler's file can be used to reduce its proportions until it is practicable to finish the operations by honing. After the process has been satisfactorily completed, clean the part thoroughly, taking care to remove all particles of metal and abrasive, lubricate, and install the component in the assembly.

## Section III. DISASSEMBLY AND ASSEMBLY

### 8-11. General

Repair and overhaul of test set instruments is limited to disassembly and assembly of the alignment stand, as far as necessary to replace spare parts. The exploded views in this section (figs. 8-1, 8-2, 8-3) show the sequence of disassembly. The parts illustrated are keyed by number callouts to a legend of established nomenclature accompanying the figures.

### 8-12. Disassembly of Alignment Stand Assembly-7924340

*a. Removal of rotating table and related parts (fig. 8-1).*

(1) Remove setscrew (1) and-spring (2).

(2) Remove Nylok screw (3) two washers (4), and spring (5) securing rotating table (6) and remove rotating table from alignment stand.

(3) Unscrew four locking screws (7) securing two adapter plates (8) to rotating table and remove adapter plates.

(4) Remove No-Mar setscrew (9) and jig button (10) from rotating table.

**NOTE**

**Remove jig button (10) only if damaged. Replace if necessary.**

*b. Removal of tilting table and related parts (fig. 8-1).*

(1) Remove teflon ring (11) from tilting table recess.

(2) Unscrew shoulder screws (12) and (13) and remove tilting table (14) from alignment stand.

(3) Remove spring (15), spring guide (16), and two screws (17) securing spring stop (18) to tilting table. Remove spring stop.

(4) Unscrew clamp screw (19) securing upper micrometer and remove micrometer (20). Unscrew two screws (21) securing upper micrometer clamp (22) to tilting table and remove upper micrometer clamp.

*c. Removal of carriage plate and related parts (fig. 8-1).*

(1) Turn 2-inch lateral adjust handle counterclockwise until carriage plate is disengaged from lateral adjust screw.

(2) Unscrew four counterbored screws (19) securing carriage plate to two forward ball bushing blocks. Unscrew four screws (23) securing carriage plate to two rear ball bushing blocks and remove carriage plate (24) from alignment stand.

(3) Unscrew clamp screw (19) securing lower micrometer (20) and remove micrometer. Unscrew two screws (23) securing lower micrometer clamp (25) to carriage plate and remove micrometer clamp.

(4) Unscrew four screws (26) securing two pivot blocks (27) to carriage plate and lift pivot blocks off carriage plate over registry pins (28).

**NOTE**

**Do not remove pins (28) from carriage plate unless damaged. Replace if necessary.**

(5) Remove No-Mar setscrew (9).

*d. Removal of carriage base and related parts (fig. 8-2).*

(1) Unscrew four screws (1) securing two guide post stops (2) to guide post and remove guide post stops.

(2) Remove six screws (3) securing carriage base to two main bearings and lift carriage base (4) over alignment stand guide post and registry pins to remove from alignment stand.

(3) Unscrew two setscrews (5) securing 2-inch handle (6) to lateral adjust screw (7) -and remove handle and lateral adjust screw.

(4) Unscrew two screws (8) securing lateral adjust screw post bearing assembly (7924351) to the carriage plate and remove the post bearing assembly.

**NOTE**

**Do not remove two flanged bearings (9) from lateral adjust screw bearing post (10) unless damaged. Replace if necessary.**

(5) Remove four setscrews (11) from two stationary carriage mounting blocks and slide ball bushing shaft (12) out of carriage mounting blocks and two ball bushing mounting blocks (13).

(6) Remove four retainer rings (14) securing the ball bushings (15) in two carriage mounting blocks and remove ball bushings.

(7) Unscrew four screws (16) securing two stationary carriage mounting blocks (17) to carriage base and remove stationary carriage mounting blocks.

(8) Remove one top setscrew (11) from each of the two adjustable carriage mounting blocks and slide ball bushing shaft (18) out of adjustable carriage mounting blocks and two ball bushing blocks (13).

**NOTE**

**Do not remove two setscrew (11) on either side of adjustable carriage mounting blocks unless damaged. Replace if necessary.**

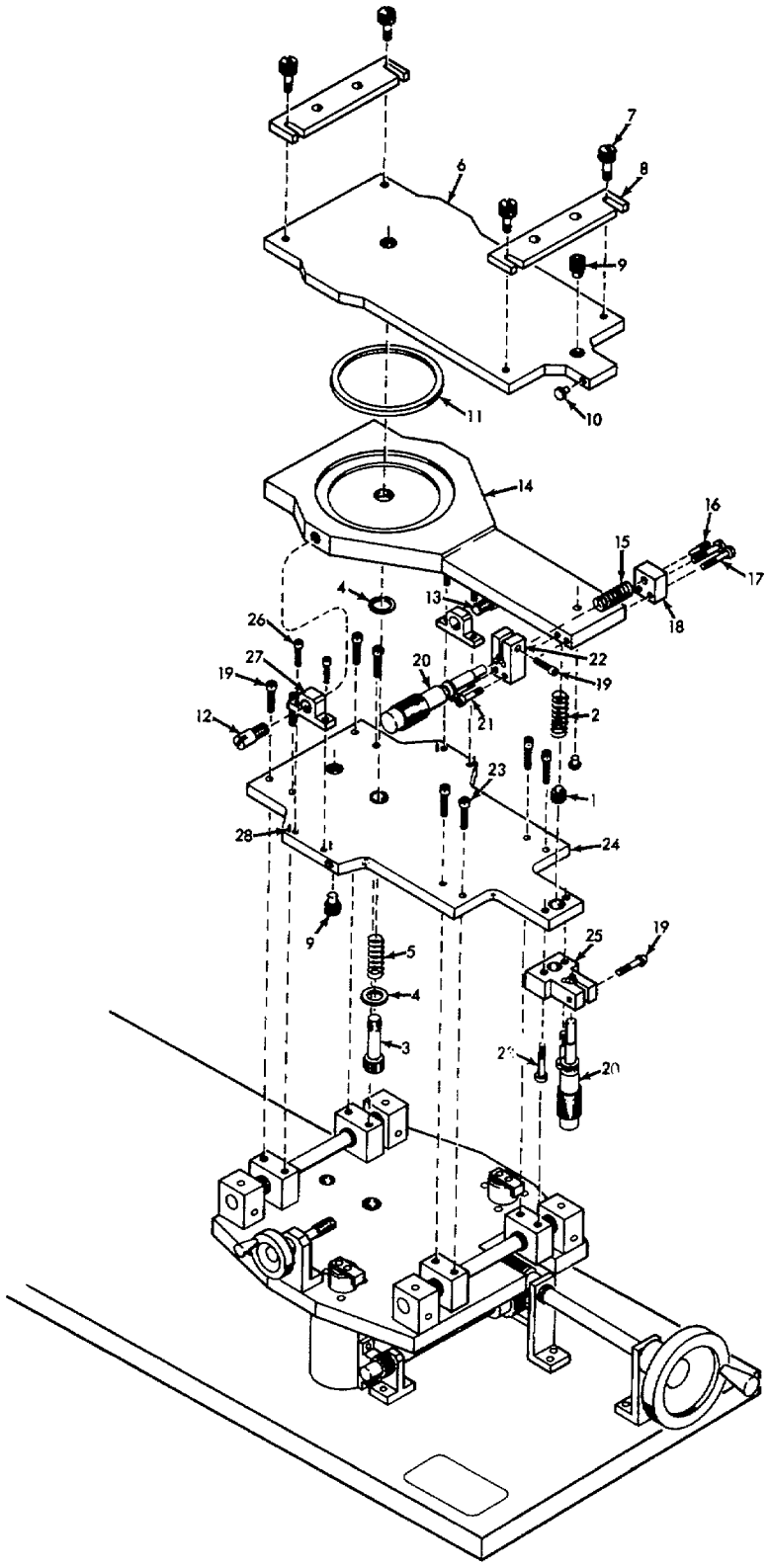


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**Figure 8-1. Removal of alignment stand rotating table, tilting table, and carriage plate-exploded view.**

1 —Setscrew 7924374
2 —Spring 792435(-2
3 —Nylok screw NH1352-8LN36
4 —Flat washer (2) MS16795-318
5 —Spring 7924350-3
6 —Rotating table 7924355
7 —Locking screw (4) 7924378
8 —Adapter plate (2) 7924356
9 —No-Mar setscrew (2) 7924383
10 —Jig button (2) 7924387
11 —Teflon ring 7924369
12 —Shoulder screw 7924372
13 —Shoulder screw 7924386
14 —Tilting table 79241354
15 —Spring 7924350-1
16 —Spring guide 7924377
17 —Screw (2) MS1699-11
18 —Spring stop 7924375
19 —Screw (5) MS16996-12
20 —Micrometer (2) 7924384
21 —Screw (2) MS1699-13
22 —Upper micrometer clamp 7924359
23 —Screw (6) MSlf1996-14
24 —Carriage plate 792.4353
25 —Lower micrometer clamp 7924360
26 —Screw (4) MS16995-19
27 —Pivot block (2) 7924370
28 —Pin (4) MS16555

**Figure 8-1. Continued.**

(9) Remove four retainer rings (14) securing ball bushings (15) in two carriage mounting blocks and remove ball bushings.
(10) Unscrew four screws (16) securing two adjustable carriage mounting blocks (19) to carriage base and remove adjustable carriage mounting blocks.

*e. Removal of gear mechanism and guide posts (fig. 8-2).*

(1) Rotate 4-inch vertical adjust handle clockwise until gear racks are disengaged from spur gears. Lift two bearings (20) from guide posts.

**NOTE**

**Do not remove carriage base registry dowel pins (21) from bushing unless damaged. Replace if necessary.**

(2) Unscrew four screws (22) securing gear racks (23) to bearings (20) and remove gear racks.

**NOTE**

**Do not remove the bushing gear rack dowel pins (24) unless damaged. Replace if necessary.**

(3) Unscrew two screws (25) securing two guide posts (26) to alignment stand base plate assembly and remove guide posts.
(4) Remove coiled pin (27) and setscrew (28) from worm (29), slide worm gear shaft (30) out from bearing post assemblies and remove worm.
(5) Remove two setscrews (31) from 4 inch handle (32) and remove handle from worm gear shaft (30).
(6) Unscrew four screws (3) securing two bearing post assemblies (7924345) to alignment stand base plate assembly and remove bearing post assemblies.

**NOTE**

**Do not remove bearing (33) from bearing post (34) unless damaged. Replace if necessary.**

(7) Remove coiled pin (35) and setscrew (36) from two spur gears (37) and remove from pinion gear shaft.
(8) Unscrew four screws (3) securing two pinion gear post bearing assemblies (7924348) to alignment stand base plate assembly and remove post bearing assemblies.

**NOTE**

**Do not remove bearing (38) from pinion gear bearing post (39) unless damaged. Replace if necessary.**

(9) Remove post bearing assemblies from pinion gear shaft (40).
(10) Remove coiled pin (41) and setscrew (42) from worm gear (43) and remove worm gear from pinion mounting shaft (40).

*f. Disassembly of base plate assembly-7924341 (fig. 8-2).*

(1) Remove screws (44) securing three foot pads (45) to base plate (46) and remove foot pads.

**NOTE**

**Do not remove three rest buttons (47) from base plate (46) unless damaged. Replace if necessary.**

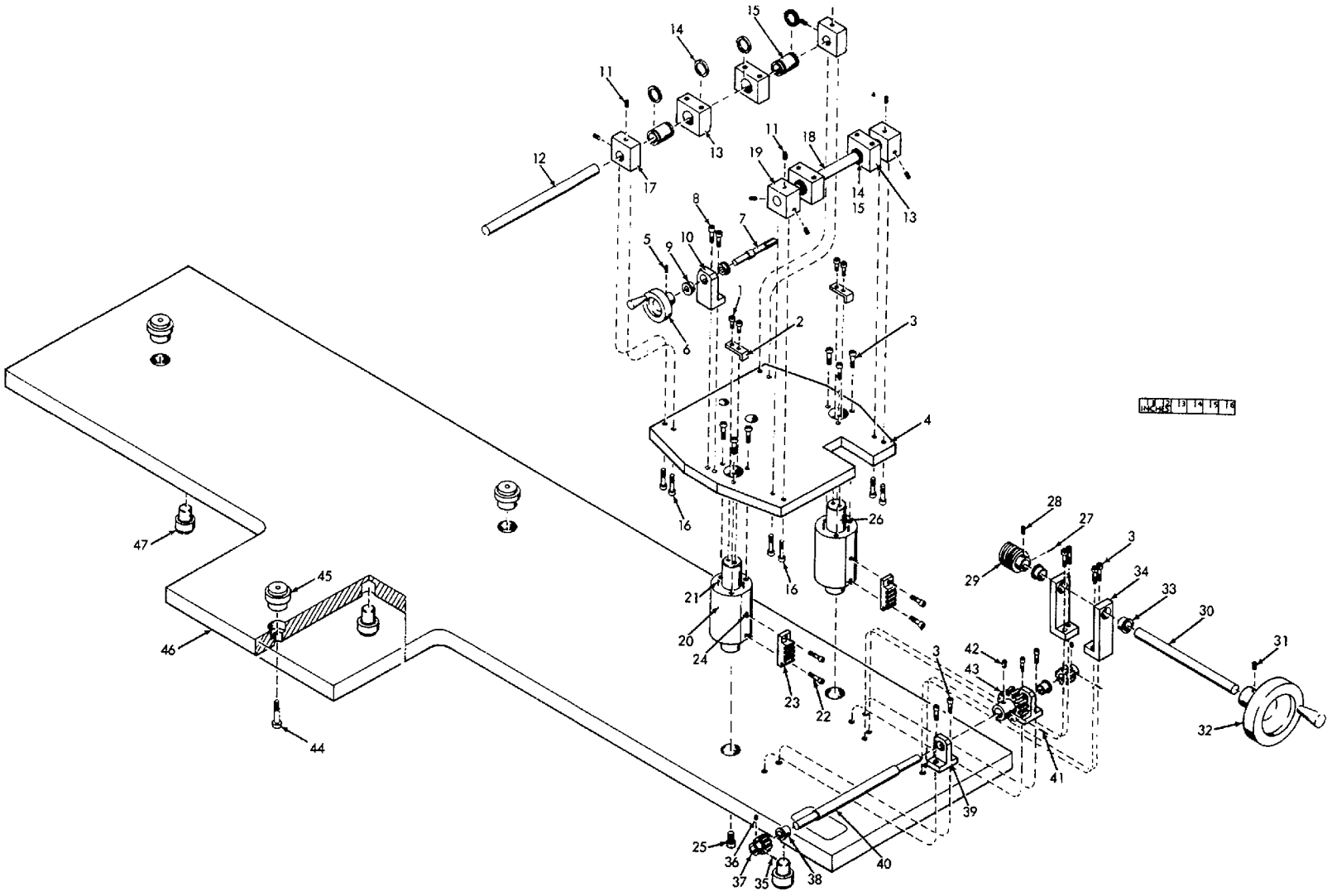



**Figure 8-2. Removal of alignment stand carriage base, gear mechanism and guide posts, and disassembly of base plate assembly-emploded view.**

1 —Screw (4) MS16996-10
2 —Guide post stop (2) 7924376
3 —Screw (14) MS16996-12
4 —Carriage base 7924352
5 —Setscrew (2) MS51021-44
6 —2-inch handle 7924371
7 —Lateral adjust screw 7924361
8 —Screw (2) MS1699611
9 —Flanged bearing (2) 7924347
10 —Lateral adjust screw bearing post 7924328
11 —Setscrew (10) MS51021-45
12 —Ball bushing shaft 7924366
13 —Ball bushing block (4) 7924364
14 —Retainer ring (8) MS9013
15 —Ball bushing (4) 7924385
16 —Screw (4) MS16996-14
17 —Stationary carriage mounting block (2) 792436
18 —Ball bushing shaft 7924366-1
19 —Adjustable carriage mounting block (2) 7024363
20 —Bearing (2) 7924367
21 —Dowel pill (4) MS16555-29
22 —Screw (4) MS16995-18
23 —Gear rack (2) 7924358
24 —Dowel pin (4) MS16555-606
25 —Screw (2) MS16996-40
26 —Guide post (2) 7924368
27 —Coiled pin MS51923-241
28 —Setscrew MS51021-21
29 —Worm 7924380
30 —Worm gear shaft 79267
31 —Setscrew (2) MS51021-9
32 —4-inch handle 7924373
33 —Bearing (2) 7924347-3
34 —Bearing post (2) 7924346
35 —Coiled pin (2) M69253-240
36 —Setscrew (2) MS51021-9
37 —Spur gear (2) 7924381
38 —Bearing (2) 7924347-2
39 —Pinion gear bearing post (2) 7924349
40 —Pinion gear mounting shaft 7924365
41 —Coiled pin NAS1407P8M-20
42 —Setscrew MS-1021-25
43 —Worm gear 7924379
44 —Screw (3) NAS608-6-12
45 —Foot pad (3) 7924343
46 —Base plate 7924342
47 —Rest button (3) 7924644

**Figure 8-2. Continued.**

## 8-13. Disassembly of Radiant Energy Attenuator-794452

**NOTE**

**The numbers shown below in parentheses refer to figure 8-3. One GMTS Block I and five Block II attenuators are supplied as separate items with this unit. For illustrative purposes, a typical Block III attenuator is shown in figure 83.**

*a.* Remove attenuator (1) before proceeding with any disassembly..

**NOTE**

**The GMTS Block III attenuators consist of a carrier disk and a thin (.010 inch) overlay with precision-etched cut-outs, permanently bonded together. Disassembly of these attenuators should not be attempted**

*b*. Remove nuts (2), lock washers (3), and flat washers (4) securing motor cover (5) two places and remove motor cover.

*c*. Remove screws (6), nuts (2), lock washers (3), and flat washers (4) securing spade bolts (7) to motor cover two places and remove spade bolts.

*d*. Unscrew retaining ring securing switch (8) to motor cover. Remove switch from motor cover and unsolder electrical leads to switch.

*e*. Remove cable relief (9) and line cord (10) from motor cover.

*f*. Remove nuts (11), lock washers (12), and flat washers (13) securing motor (14) two places and remove motor.

*g*. Unscrew setscrew (15) securing driver pulley (16) to motor shaft and : remove driver pulley.

*h*. Remove screws (17), nuts (2), lock washers (3), and flat washers (4) securing idler pulleys (18) two places and remove idler pulleys. Remove spacers (19) from idler pulleys.

*i*. Remove screws (20) and flat washers (21) securing mounting cap (22) to mounting plate (23) three places and remove mounting cap.

*j*. Remove grommets (24) from mounting plate three places.

## 8-14. Assembly of Alignment Stand Assembly-7924340

For reassembly of the alignment stand refer to figures 8-1 and 8-2.

**NOTE**

**Replacement of coiled pins is required when gears are removed.**

## 8-15. Assembly of Radiant Energy Attenuator-7924452

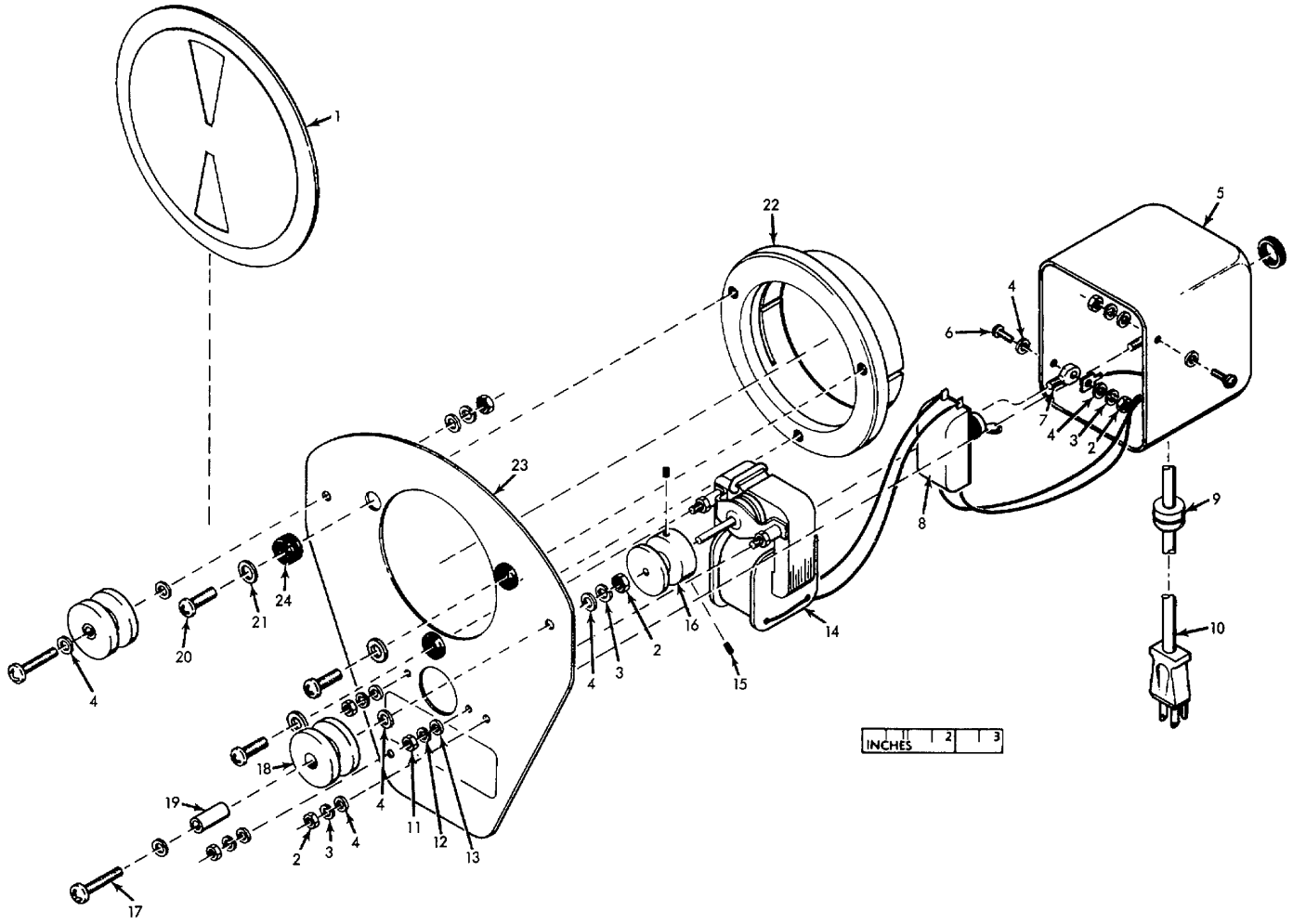
For *reassembly* of the radiant energy attenuator refer to figure 8-3. The circuit wiring diagram is shown by figure 8-4.

## 8-16. Overhaul

*a*. *Overhaul* procedures consist of replacing any part which has been determined unserviceable. No procedures are recommended for restoring any unserviceable parts to good condition. Only total replacement of defective parts is recommended.

*b. Finishes.* Repair bare spots or damaged finishes in accordance with TM 9-254.

*c. Soldering*. Most electrical connections must be soldered to ensure that a good electrical bond is made. The oxidation or corrosion that takes place in an unsoldered joint causes excessive resistance and results in intermittent, or, faulty operation of the circuit. It is very important to make well-soldered joints, since a poorly soldered joint presents a trouble spot very difficult to find. Refer to MIL-S-6872 for correct soldering specifications.




CAL 1032

**Figure 8-3. Disassembly of radiant energy attenuator-7924452-exploded view.**

1 —Attenuator 7924467
2 —Plain nut (4) MS35649-264
3 —Lock washer (4) MS35338-136
4 —Flat washer (4) MS15795-805
5 —Motor cover
6 —Pan head machine screw (2) MS51957-27
7 —Spade bolt (2) 6080-C
8 —Switch 7924461
9 —Cable relief 6P-3
10 —Line cord 7924463
11 —Plain nut (2) MS35649-244
12 —Lock washer (2) MS35338-135
13 —Flat washer (2) MS15795-803
14 —Motor F-5-CW
15 —Setscrew MS51029-3
16 —Driver pulley 7924455
17 —Pan head machine screw (2) MS51957-34
18 —Idler pulley (2) 7924454
19 —Spacer (2) SO 21-8
20 —Pan head machine screw (3) MS51957-43
21 —Flat washer (3) MS15795-807
22 —Mounting cap 7924453
23 —Mounting plate 7924466
24 —Grommet HO 42-F

**Figure 8-3. Continued.**

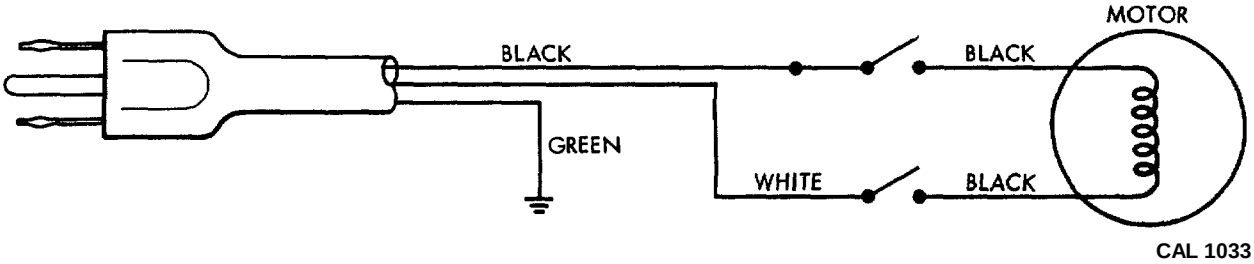



**Figure 8-4. Radiant energy attenuator-7924452-circuit wiring diagram.**

# CHAPTER 9

# FINAL INSPECTION

## 9-1. General

Final inspection is an acceptance inspection performed after repair and overhaul have been completed, to ensure that materiel is serviceable according to established standards. Final inspection procedures for the test set include operational checks and visual inspections as specified in the following paragraphs. When the standards defined by these procedures are met, and when all required MWO's are processed, the test set is classified as serviceable.

## 9-2. Visual Inspection

Check the test set for completeness. Particularly note finish and those areas in which repairs or replacements have been made. Examine all component parts for any evidence of defect or damage. Conduct an inspection of parts in accordance with instructions in paragraphs 3-2 and 3-3.

## 9-3. Operational Check

Conduct a complete operational check as described in paragraphs 3-10, 7-3, and 7-4.

# CHAPTER 10

# SHIPMENT, STORAGE AND DESTRUCTION OF MATERIEL TO PREVENT ENEMY USE

## Section I. SHIPMENT AND STORAGE

### 10-1. General

Commanders are responsible for ensuring that the test set issued or assigned to their command is maintained in a serviceable condition and properly cared for, and that personnel under their command comply with technical instructions. Lack of time, lack of trained personnel, or lack of proper tools may result in a unit being incapable of performing maintenance for which it is responsible. In such case, unit commanders, with the approval of major commanders, may place test sets that are beyond the maintenance capability of the unit, in .administrative storage or return it to supply agencies. When preparing test sets for administrative storage or for shipment, the unit commander will be responsible for processing the equipment in its respective shipping containers to protect them against corrosion, deterioration, and physical damage during shipment or during periods of administrative storage.

### 10-2. Administrative Storage Instructions

*a. Time Limitations*. Administrative storage is restricted to a period of 90 days and must not be extended beyond this time unless test sets are reprocessed in accordance with *b* below.

*b. Storage Procedure*. Disassembly will be limited to that necessary to clean and preserve surfaces. Except as otherwise noted, and to the maximum extent consistent with safe storage, test sets will be placed in administrative storage in as nearly a completely assembled condition as practicable. Equipment will be available for placing in service with a minimum amount of delay.

(1) Store in an area which affords protection from exposure to the elements and adequate drainage.

(2) Perform a quarterly preventive-maintenance (PM) service on test sets intended for administrative storage. This maintenance will consist of inspecting, cleaning, servicing, preserving, lubricating, adjusting, and minor replacement of repair parts if required.

(3) Provide access to permit inspection, servicing, and subsequent removal from storage.

(4) Static dehumidification of test sets in open storage will be accomplished by providing desiccant in the test set containers.

(5) Power cords, miscellaneous parts and manuals will be stored appropriately.

(6) Mark and tab the test set “Administrative Storage” and place tag in a convenient location. Test sets so marked will not be operated while in this category.

*c. Inspection in Administrative Storage.*

(1) Visual inspection in administrative storage must be conducted at least once each month and/or immediately following hard rains, heavy snowstorms, windstorms or other severe weather conditions. Disassembly. will be performed as necessary to ascertain fully the extent of any deterioration

or damage found. A record of these inspections will be maintained and attached to the test set in a conspicuous place.

(2) When rust or deterioration is found on any unpainted area, necessary reprocessing for administrative storage will be immediately accomplished. Damage caused by severe weather conditions will be promptly repaired. Painted surfaces showing evidence of deterioration will be thoroughly cleaned, dried, and repainted, using paint of the same quality and color as the original paint.

### 10-3. Shipping Instructions

*a. Preparation for Shipment*. Preservation and other protective measures for shipment must be sufficient to protect against deterioration and physical damage during shipment. Shipping must be in the best commercial practice. All materiel must be adequately marked prior to shipment.

*b. Army Shipping Documents*. Prepare all Army shipping documents accompanying freight in accordance with AR 725-50.

## Section II. DESTRUCTION OF MATERIEL TO PREVENT ENEMY USE

### 10-4. General

*a.* Destruction of the test sets when subject to capture or abandonment in the combat zone will be undertaken by the using arm only when, in the judgment of the unit commander concerned, such action is necessary in accordance with orders of, or policy established by, the Army Commander.

*b*. The information which follows is for guidance only. Certain portions of the procedures outlined require the use of explosives and incendiary grenades which normally may not be authorized items of issue to the using organization. The issue of these and related materials and the condition under which destruction will be effected are command decisions in each case, according to the tactical situation. Of the several means of destruction, those most generally applicable are: Mechanical-requires axe, pick, mattock, sledge, crowbar, or similar implement. Burning-requires gasoline, oil, incendiary grenades, or other flammables or welding or cutting torch. Demolition requires suitable explosives or ammunition. Gunfire-includes artillery, machine guns, rifles using rifle grenades, and launchers using anti-tank rockets. Hand grenades may not be used. In general, destruction of essential parts followed by burning will usually be sufficient to render the materiel useless. Selection of the particular method of destruction requires imagination and resourcefulness in the utilization of the facilities at hand under the existing conditions. Time is usually critical.

*c*. If destruction to prevent enemy use is resorted to, the materiel must be so badly damaged that it cannot be restored to a usable condition in the combat zone, either by repair or cannibalization. Adequate destruction requires that all parts essential to the operation of the materiel, including essential repair parts, be destroyed or damaged beyond repair. For components with security classification, complete destruction beyond identity is required. However, when lack of time and personnel prevent destruction of all parts, priority is given to the destruction of those parts having a security classification and those parts most difficult to replace. Equally important, the same essential parts must be destroyed on all like materiel, so that the enemy cannot construct one complete unit from several damaged ones.

*d*. If destruction by demolition or gunfire is directed, due consideration should be given to:

(1) Selection of a point of destruction that will cause the greatest obstruction to enemy movement and also prevent hazard to friendly troops from fragments or ricocheting projectiles which may occur incidental to the destruction.

(2) Observance of appropriate safety precautions.

## 10-5. Destruction of the Test Set

*a. General*. Ordinarily, the test set will be located in an Army secondary reference calibration laboratory. The methods of destruction contained herein cover the test set only.

*b. Technical Publications*. All technical publications, schematics, and other flammable material must be completely burned.

**Warning**

**All electrical items should be completely disconnected from sources of electrical energy, to prevent injury to personnel from contact with high-voltage conductors or capacitors holding dangerous voltages or from premature detonation of explosives when destruction is to be accomplished by demolition. In addition, capacitors should be discharged and grounded prior to destruction of the materiel by any method other than gunfire.**

## 10-6. Method No. 1-by Burning

*a*. Using an axe, pick, mattock, sledge, or other heavy implement, smash beyond recognition the vital elements. Since smashing will be followed by burning, it -is not essential to perform all of the smashing recommended in paragraph 10-8.

*b.* Explosive ammunition, if available nearby, should be removed from packing or other protective material. Place ammunition in and about the test set in such a manner as to expose it fully to the fire. Remove any safety devices from the ammunition.

*c.* Place large quantities of combustible material such as rags, paper, or wood in all units of the equipment. Pour gasoline or oil over the combustible material and the equipment.

*d.* Ignite the combustible material by means of an incendiary grenade fired from a safe distance, a burst from a flame thrower, a combustible train of suitable length, or other appropriate means. Take cover immediately. A hot fire is required to render the materiel useless.

**WARNING**

**When igniting gasoline, due consideration should be given to the highly flammable nature of gasoline and its vapors. Carelessness in its use may result in painful burns.**

**NOTE**

**Elapsed time: about 16 minutes.**

## 10-7. Method No. 2--by Demolition

*a*. Prepare several 2-pound demolition charges using 1-pound TNT blocks or equivalent together with the necessary detonating cord to make up each charge. Place the charges adjacent to the test set.

*b*. Connect the charges for simultaneous detonation with the detonating cord.

*c*. Provide for dual priming to minimize the possibility of a misfire.

*d*. Detonate the charges. For complete details on the use of demolition charges, refer to FM 5-25. Training and careful planning are essential. The danger zone is approximately 500 yards.

**NOTE**

**Elapsed time: about 20 minutes.**

## 10-8. Method No. 3-by Mechanical Means

Using an axe, pick, mattock, sledge, crowbar, or other heavy implement, smash thoroughly all electronic and mechanical elements of the equipment. Give priority to the vital elements.

**NOTE**

**Elapsed time: about 20 minutes.**

## 10-9. Method No. 4-by Gunfire

Destroy the test set by gunfire, using artillery, machine guns, rifles using rifle grenades, or launchers using anti-tank rockets. Several hits are usually required for complete destruction unless an intense fire is started, in which case, the equipment may be considered destroyed.

**WARNING**

**Firing artillery at ranges of 500 yards or less should be from cover. Firing rifle grenades or anti-tank rockets should be from cover.**

**NOTE**

**Elapsed time: about 4 minutes.**

# APPENDIX A
# REFERENCES

## A-1. Publication Indexes

The following indexes should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to materiel covered in this manual

Military Publications:
Index of Administrative Publications ..... DA Pam 310-1
Index of Blank Forms ..... DA Pam 310-2
Index of Doctrinal Training, and Organizational Publication ..... DA Pam 310-3
Index of Graphic Training Aids and Devices ..... DA Pam 310-5
Index of Supply Manuals; Ordnance Corps ..... DA Pam 310-29
Index of Technical Manuals, Technical Bulletins, Supply Manuals ..... DA Pam 310-4
(types 7, 8, and 9) Supply Bulletins, Lubrication Orders, and
Modification Work Orders.

## A--2. Supply Catalog

The following Department of the Army supply catalog is pertinent when destroying materiel to prevent enemy use: Ammunition and Explosives (Class 1375 Explosives, Solid propellants, Explosive Devices). SC 1340/98-IL

## A-3. Forms

The following forms pertain to this materiel:
DA Form 9-1, Materiel Inspection Tag
DA Form 9-79, Parts Requisition
DA Form 829, Rejection Memorandum
DA Form 1296, Stock Accounting Record
DA Form 2765-1, Request for Issue or Turn-in
DA Form 2028, Recommended Changes to DA Technical Publications
DA Form 2407, Maintenance Request
DA Form 2408-3, Equipment Maintenance Record (Organizational)
DD Form 6, Report of Damaged or Improper Shipment

## A-4. Other Publications

a. Camouflage.

Camouflage, Basic Principles and Field Camouflage ..... FM 5-20

b. Decontamination.

Chemical, Biological, and Radiological (CBR) Decontamination ..... TM 3-220
Small Unit Procedures in Chemical, biological, and Radiological (CBR) ..... FE 21-40
Operations.

*c. Electronics.*

Basic Theory and Applications of Electron Tubes ..... TM 11-662
cathode-ray Tubes and Their Associated Circuits ..... TM 11-671
Calibration Standards Sets: Maintenance and Supply Support ..... SB 9-170
Electronic Power Supplies ..... TM 11-663
Generation and Transmission of Microwave Energy ..... TM 11-673
Pulse Techniques - ..... TM 11-672
Radar System Fundamentals ..... TM 11-467
Special Purpose Oscillators and Amplifiers ..... TM 11-670
Transients and Waveforms ..... TM 11-669

*d. Destruction to Prevent Enemy Use.*

Explosives and Demolition's ..... FM 5-25
Ordnance Service in the Field ..... FM 9-1

*e. General.*

Accident Reporting and Records ..... AR 385-40
Authorized Abbreviations and Brevity Code ..... AR 320-50
Dictionary of United Sates Army Terms ..... AR 320-5
First Aid for Soldiers - ..... FM 21-11
Military Symbols ..... FM 21-30, AFM .95-3
Ordnance Direct Support Service ..... FM 94-3
Ordnance General and Depot Support Service ..... FM 9-4
Army Equipment Record Procedures ..... TM 38-750

*f. Maintenance.*

Adhesive, Epoxy Resin, Metal to Metal Structural Bonding ..... MIL-A-8623A
Cleaning of Ordnance Materiel ..... TM 9-208-1
Command Maintenance Management Inspections ..... AR 750-8
Finishing of Metal and Wood Surfaces ..... MIL-STD-171B
General Maintenance Procedures for Fire Control Materiel ..... TM 9-254
Lubrication of Ordnance Materiel ..... TM 9-273
Materiel's Used for Cleaning, Preserving, Abrading and Cementing ..... TM 9-247
Ordnance Material; and Related Materials Including Chemicals.
Operator, Organizational, Direct Support and Depot Maintenance: In- ..... TM 94931-387-15
frared Test Set 4031-895-3894 (Secondary Reference).
Operator, Organizational, Direct Support and Dep)t Maintenance: In- ..... TM 9-4931-388-15
frared Test Set 4931-8954-3886 (Secondary Transfer).
Organizational, Policies, and Responsibilities for Maintenance Operation ..... AR 750-5
Primer Coating, Zinc Chromate, Low Moisture-Sensitivity ..... MII-P4-8585A
Painting and Finishing Systems for Fire Control Instruments ..... MIL-STD-194
Painting Insurrections for Field Use ..... TM 9-213
Use and Care or Hand Tools and Measuring Tools ..... TM 9-243

*g. Operations.*

Northern Operations . ..... FM 31-71
Operation and Maintenance of Ordnance Material in Extreme Cold TM 9-207
Weather, 0° to-65°F.
Data Sheets for Ordnance Type Materiel ..... TM 9-500

*h. Shipment and Storage.*

Barrier Materiel, Greasproofed, Waterproofed, Flexible ..... MIL-B-121C
Desiccants Activitid, Bagged. Packing Use and Static DehumidificationMIL-D-3464D
Issue of Supplies and Equipment:
Paper, Lens, Tissue, Antitarnish Wrapping ..... MIL-P-13988

Parts, Equipment and Tools for Ordnance Materiel Packaging of ..... MILP-14232B
Preservation, Methods of ..... MIL-P-116E
Preservation, Packaging and Packing ..... AR 700-15
Report of Damage or Improper Shipment ..... AR 700-58
Requisitioning, Receipt and Issue System ..... AR 7254-50
Standards for Oversea Shipment and Domestic Issue of Ordnance..... TB ORD 385
Materiel -Other Than Ammunition and Army Aircraft.
Storage and Materials Handling ..... TM 743-200-1

## APPENDIX B

★ BASIC ISSUE ITEMS LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST

★ (not applicable)

*U.S. GOVERNMENT PRINTING OFFICE: 1973-769620/1013

# APPENDIX C

# MAINTENANCE ALLOCATION CHART

## Section I. INTRODUCTION

### C-1. General

The Maintenance Allocation Chart (MAC) assigns authorized maintenance functions to each maintenance category. Maintenance functions are assigned to the lowest available maintenance category based upon the following considerations:
Skills available,
Time required,
Tools and test equipment authorized.

### C-2. Use of Maintenance Allocation Chart

The purpose and use of the Maintenance Allocation Chart is as follows:

*a. Column 1, Group Number*. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

*b. Column 2, Functional Group*. Column 2 lists the noun names of components, assemblies, subassemblies and modules on which maintenance is authorized.

*c. Column 3, Maintenance Function*. Column 3 lists the various types of maintenance functions. The definitions of the maintenance functions are as follows:

(1) Inspect. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

(2) Test. To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

(3) Service. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

(4) Adjust. To rectify to the extent necessary to bring into proper operating range.

(5) Align. To adjust specified variable elements of an item to bring to optimum performance.

(6) Calibrate. To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

(7) Install. To set up for use in an operational environment such as an emplacement, site, or vehicle.

(8) Replace. To replace unserviceable items with serviceable assemblies, subassemblies, or parts.

(9) Repair. To restore an item to serviceable condition. This includes, but is not limited to, inspection, cleaning, preserving, adjusting, replacing, welding, riveting, and strengthening.

(10) Overhaul. To restore an item to a completely serviceable condition as prescribed by maintenance serviceability standards using the Inspect and Repair Only as Necessary (IROAN para 2c) technique.

(11) Rebuild. To restore an item to a standard as nearly as possible to original

or new condition in appearance, performance, and life expectancy. This is accomplished through complete disassembly of the item, inspection of all parts or components, repair or replacement of worm or unserviceable elements (items) using. original manufacturing tolerances amid specifications, and subsequent reassembly of the item.

**MAINTENANCE ALLOCATION CHART**
**FOR**
**TEST SET 4931495-3894 (SECONDARY REFERENCE)**

| (1) GROUP NUMBER | (2) Functional Group | (3) Maintenance functions | | | | | | | | | | | (4) Tools and equipment | (5) Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | INSPECT | TEST | SERVICE | ADJUST | ALIGN | CALIBRATE | INSTALL | REPLACE | REPAIR | OVERHAUL | REBUILD | | |
| 1 | Alignment Stand | D | D | D | D | D | -- | D | D | D | D | -- | | 7924341 |
| 2 | Temperature Controller | D | D | D | -- | D | -- | D | D | -- | -- | -- | | Model 101A-F |
| 3 | Blackbody Radiation Reference Source | D | D | D | -- | D | D | D | D | -- | -- | -- | | Model 463 |
| 4 | Off-Axis Collimator | D | D | D | -- | D | -- | D | D | -- | -- | -- | | Model 230A |
| 5 | Radiant Energy Attenuator | D | D | D | D | D | D | D | D | D | D | -- | | 7924452 |
| 6 | Autocollimating Telescope | D | D | D | -- | D | -- | D | D | -- | -- | -- | | Minnidekkor Model TA 60 |

LEGEND: C-- OPERATOR/CREW
O-- ORGANIZATIONAL MAINTENANCE
F-- DIRECT SUPPORT MAINTENANCE
H-- GENERAL SUPPORT MAINTENANCE
D-- DEPOT MAINTENANCE

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By Order of the Secretary of the Army.

HAROLD K. JOHNSON,
*General, United States Army,*
*Chief of Staff*.

Official:

KENNETH G. WICKHAM
*Major General, United States Army,*
*The Adjutant General.*

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USAARMC (1)
ANAD (1)
RRAD (1)
LEAD (7)
PUAD (1.)
TEAD (1)
USAAPSA (1)
Picatinny Arsenal (1)
Joliet Army Ammo Plant (1)
Watervliet Arsenal (1)
Detroit Arsenal (1)
Frankford Arsenal (10)
Harry Diamond Lab (1)
WSMR (1)
Units org under fol TOE:
9-107 (12)

NG: None

USAR: None

For explanation of abbreviations used, see AR 320-50.

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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 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 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 |

**PIN: 022701-000**