

**Technical Manual for
Multiple Source
Gamma Calibrator
Model 1000B**

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eberline

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CERTIFIED CALIBRATION REPAIR

Eberline Instrument Certified Calibration Call Service Center for prices
 Other Manufacturer Instrument Certified Calibration \$100.00 each
 Repair Rate above Calibration plus Parts at List Price \$60.00/hour
 Contractual rates are available on periodic repair and/or calibration. Contact Service Center for prices.

THREE (3) YEAR EXTENDED WARRANTY

This includes Certified Calibration plus Parts

1. Eberline Instruments, FOB Eberline Instrument Repair and Calibration Facility \$70.00 each/quarter

MISCELLANEOUS

1. Turn Around Time:
 Calibration: Five (5) working days on Eberline instruments.
 Repair: Twelve (12) working days on Eberline instruments unless parts have to be ordered.
2. FOB Santa Fe, New Mexico, or West Columbia, South Carolina
3. Instruments for warranty repair, repair, or calibration must be sent to:

Instrument Repair and Calibration
 Eberline Instrument Corporation
 P.O. Box 2108, Airport Road
 Santa Fe, New Mexico 87504-2108
 Telephone: (505) 471-3232

Instrument Repair and Calibration
 Eberline Instrument Corporation
 312 Miami Street
 West Columbia, South Carolina 29169
 Telephone: (803) 796-3604

4. In addition, the following Customer Service Centers are available for customers outside the United States.

Thermo Electron, Ltd.
 Woolborough Lane
 Crawley, West Sussex
 England, RH10 2AQ
 Telephone: (44) 293-544811

Safety Supply Canada
 214 King Street E
 Toronto, Ontario
 Canada M5A 1J8
 Telephone: (416) 364-3234

Prices at these locations will vary from U.S. prices. Please contact the facilities for current price and delivery information.

EBERLINE INSTRUMENTS STANDARD WARRANTY

One Year Warranty: Seller warrants to replace or repair, at its option, any products or parts thereof (excluding tubes, crystals and batteries [tubes and crystals 90 days]) which are found defective in material or workmanship within one year from date of shipment. Seller's obligation with regard to such products or parts shall be limited to replacement or repair, FOB seller's factory or authorized repair station, at seller's option. The aforesaid warranty does not cover normal life-end failure of components and will be voided if repair has been attempted by other than seller's authorized personnel. In no event shall seller be liable for consequential or special damages, transportation, installation, adjustment, work done by customer or other expenses which may arise in connection with such defective product or parts.

Exclusion of Warranties and Limitation of Liability: **The foregoing warranty is expressly made in lieu of any and all other warranties express or implied including the warranties of merchantability and fitness for a particular purpose. Under no circumstances shall seller be liable for any indirect, special, incidental or consequential damages to customer or to any third party.**

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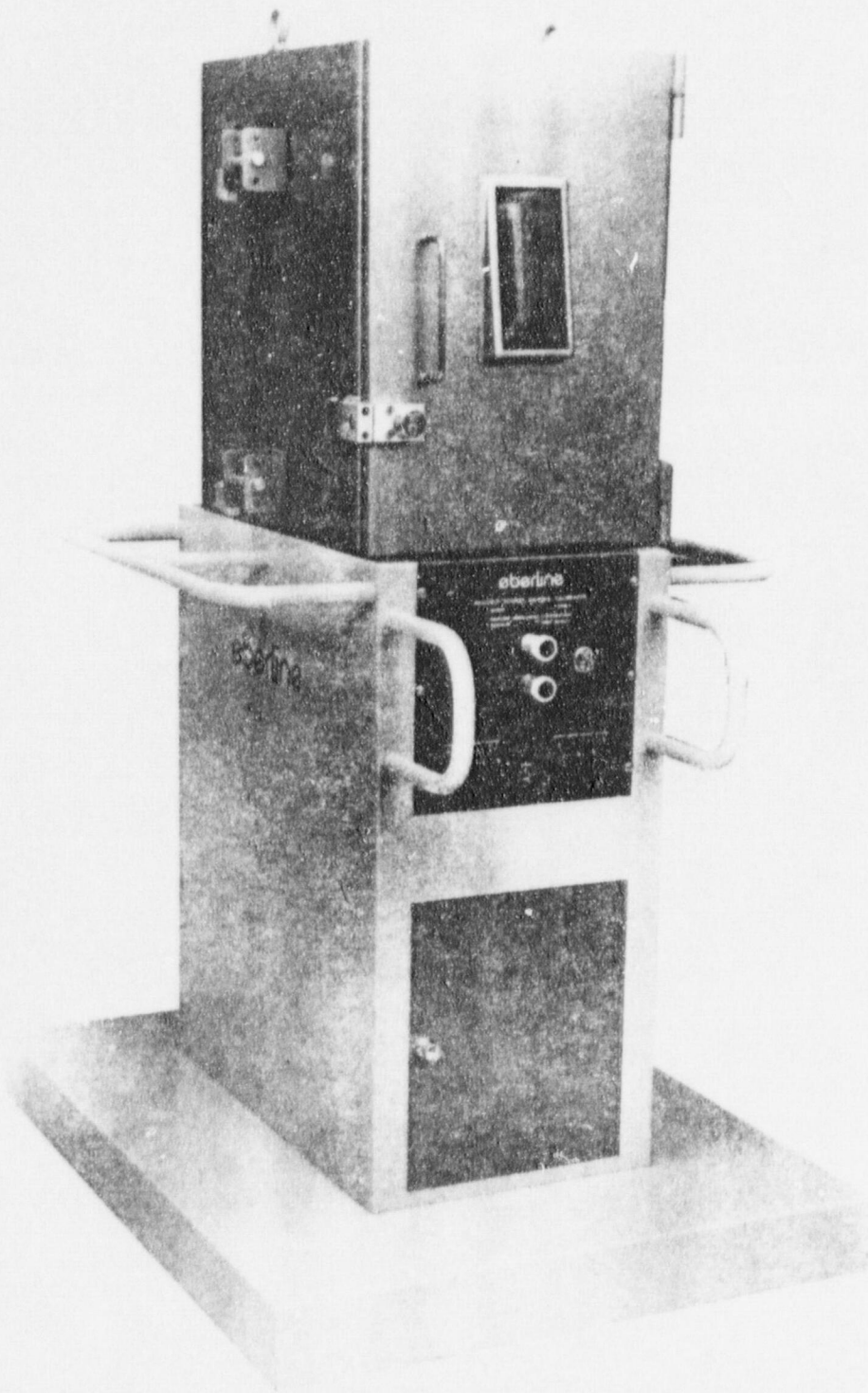


Figure 1-1. Multiple Source Gamma Calibrator, Model 1000B

SECTION I

GENERAL

A. PURPOSE AND DESCRIPTION

The Model 1000B Multiple Source Gamma Calibrator is a nuclear device designed to provide a self-contained, variable intensity beam of gamma radiation for the calibration of radiation detection instruments. It consists essentially of three parts:

1. A lead shielded compartment or safe for enclosing instruments to be calibrated.
2. A multiple source storage shield and radiation collimating device.
3. A casted platform which supports the calibration compartment and source shield at a convenient elevation.

When assembled, the device has a base dimension of 34 inches x 44 inches (86 x 112 cm) and stands approximately 65 inches (165 cm) high. Its gross weight is approximately 2965 pounds (1345 kg): 1460 pounds (662 kg) in the safe, 1030 pounds (467 kg) in the shield and source assembly, and 475 pounds (215 kg) in the supporting components. Shipping weight is approximately 3100 pounds (1406 kg).

B. SPECIFICATIONS

1. Source Shield

The cylindrical source shield is a lead filled, carbon steel container, 12 inches (30.5 cm) in diameter x 24-21/32 inches (62.6 cm) in length. The shield is penetrated axially and horizontally from one end only by two cavities, each of which houses a movable source drawer. Each drawer contains up to four ^{137}Cs sources of varying gamma intensity. Both cavities pass perpendicularly through the axis of a radiation beam collimator which penetrates the shield halfway radially. This arrangement permits the incremental withdrawal of the source drawers to position a pre-selected source at the collimator and direct a radiation beam upward into the shielded instrument compartment.

2. Source Drawers

The upper source drawer consists of 0.688 inch (1.7 cm) o.d. by 0.632 inch (1.6 cm) i.d. 304SS tubing closed at both ends with plugs and containing up to four

^{137}Cs sources. The lower source drawer consists of 0.812 inch (2.06 cm) o.d. x 0.756 inch (1.92 cm) i.d. 304SS tubing closed at both ends with plugs and containing up to four ^{137}Cs sources. Sources are appropriately spaced and shielded by 0.630 inch (1.6 cm) diameter and 0.750 inch (1.90 cm) diameter high density, solid metallic inserts. Drawer actuation is provided by attached 3/8 inch x 3/8 inch (0.95 x 0.95 cm) SS rods which pass through holes in the front plate of the shield and terminate in knobs at the control panel. The holes in the front plate are of different diameter from the source drawers, thus serving as a source withdrawal stop.

The source drawer actuators are interlocked with the instrument compartment access door by means of a single key, dual lock system to prevent the opening of the safe door while either of the source drawers is in the withdrawn position.

3. Instrument Compartment

The safe or instrument compartment is a 1460 pound (622 kg) steel clad, lead shielded cell with 4 inches (10 cm) of shielding at the top and 2 inches (5 cm) on all other sides. The front is comprised of a hinged door which provides access for the installation of instruments. A 4 inch (10 cm) lead glass window permits viewing instruments during calibration.

The safe has four penetrations: a 4 inch (10 cm) hole in the base which aligns with the primary shield collimator, two 1-1/8 inch (2.85 cm) holes in the left side at internal elevations of 1 inch (2.54 cm) and 17 inches (43.1 cm) to permit the insertion of detection probes and a 3/8 inch (0.95 cm) penetration for a 110 V (lamp) cord.

Except when in use with detection probes, the two holes in the left side are closed with solid steel plugs and secured with padlocks.

The instrument compartment door and the source drawers are secured by means of a single key, dual lock system. The common key is removable from the lock assembly only at such times as both the safe door and the source drawers are locked in the SAFE position.

SECTION II

OPERATION

A. RADIOLOGICAL SAFETY

Before being placed into service, the Model 1000B Multiple Source Gamma Calibrator should be introduced to plant radiological safety personnel for study of the mechanical characteristics, calibration procedures and associated radiation exposure hazards. Upon inspection it will be readily apparent that there are three areas of particular concern: the number of keys in circulation, calibration procedures requiring open ports in the instrument compartment, and equipment maintenance which requires removal of the source drawer lock assembly. Failure to administer precautionary measures in these regards could result in the exposure of operating personnel to relatively high levels of radiation. Therefore, the manufacturer of this equipment considers adherence to the following specific procedures necessary for safe operation:

1. Only trained and specifically authorized personnel should use this calibration equipment.

2. Keep only one key in circulation. The spare key should remain in the master key file to be issued exclusively to the Radiological Safety Officer upon written justification.

3. The use of the key to port padlocks should be administered by the Radiological Safety Officer.

4. Maintenance requiring removal of the front control panel necessitates strict safety officer attendance. The seals on the lock assembly should be broken prior to maintenance and subsequently replaced by the Radiological Safety Officer. He should secure the safe and keep all keys in his possession until the source drawer lock has been reactivated and sealed.

5. Leak test wipes may be taken on the source door pull rods. This should be done with the source drawers in the EXPOSED position.

B. USING THE INSTRUMENT

The source is manually adjusted to the EXPOSED position as follows:

1. Plug power cord into 115 VAC outlet. Turn on the POWER switch. SAFE light should illuminate.

2. Using provided key, open chamber door.

NOTE

Before proceeding, a lead plug (used for shipping purposes only) must be lifted and removed from

the beam collimating hole. This is accomplished by removing screws from retainer plate, removing retainer and then lifting out tapered lead plug by use of an eye screw. Retain shipping plug, retainer plate and screws in lower storage compartment for future use.

3. Place instrument to be calibrated above beam port using appropriate fixture and direct the light and mirror so that the instrument meter scale is clearly visible. ✓

4. Close door and remove key.

5. Place key into source drawer lock and actuate. SAFE light should go out and EXPOSED light come on.

6. Pull out desired source drawer actuation rod until appropriate source indicator is illuminated.

7. The source is now EXPOSED.

8. Note instrument reading.

9. The source is returned to a safe position by pushing IN on the actuation rod.

10. The source drawers are locked into a safe position by the actuating key. SAFE light should illuminate.

11. Remove key, open chamber door as above and adjust instrument per manufacturer's calibration instructions.

12. This cycle may be repeated as necessary or a new instrument placed in chamber.

C. CALIBRATION CHAMBER FITTINGS AND ACCESSORY EQUIPMENT LIST

The shielded chamber is equipped with instrument fixture support brackets, arranged at one-inch increments of elevation, and a magnetic base high intensity lamp. Additional accessories packed within the chamber are as follows:

- ✓ 1- Magnetic base articulate mirror for viewing instrument dials.
- ✓ 1- PIC-6A calibration fixture.
- ✓ 1- E-520 calibration fixture.
- ✓ 1- RO-1, RO-3 calibration fixture.
- ✓ 1- RO-2 calibration fixture.
- ✓ 1- G-M probe support fixture.
- 1- Teletector holder. ? (not found)

NO.	QUANTITY	DESCRIPTION	REMARKS
1	1	ASSY. LAMP ASSEMBLY	
2	1	SAFE ASSEMBLY	
3	1	PLUG	
4	2	PIN	
5	2	PADLOCK & KEY	
6	8	SHELF SUPPORTS	
7	1	CORE PLUG	
8	1	TELEVECTOR PLUG	
9	1	PROTECTIVE HOUSING	
10	4	STEEL HEX BOLTS, 3/8-16 X 4" LG.	
11	1	BASE ASSEMBLY	
12	1	ACCESS DOOR & STORAGE AREA	
13	AR	INSTRUMENT CALIBRATION FIXTURE	
14	1	SHIPPING PLUG	
15	4	STEEL SCREWS, #10-32 RH X 3/8" LG.	
16	4	STEEL HEX BOLTS, 9/16"-12 X 1" LG.	
17	4	STEEL LOCK WASHERS, 9/16"	
18	1	CONTROL PANEL	
19	6	STEEL SCREWS, #8-32 OH X 1/2" LG.	
20	5	CUP WASHERS, #10	
21	2	DRUMMER ANGLES WITH #10 SET SCREW	
22	1	PANEL BRACKET	
23	4	STEEL SCREWS, #10-32 RH X 3/8" LG.	
24	4	STEEL LOCK WASHERS, #10	
25	2	STEEL EYEBOLTS, W/ 3/8-16 THREAD	
26	1	SOURCE SHIELD ASSEMBLY	
27	4	STEEL HEX BOLTS, #1/2-13 X 1 1/4" LG.	
28	4	STEEL HEX NUTS, #1/2-13	
29	4	STEEL LOCK WASHERS, 1/2"	
30	1	FIXTURE HOLDING BLOCK	

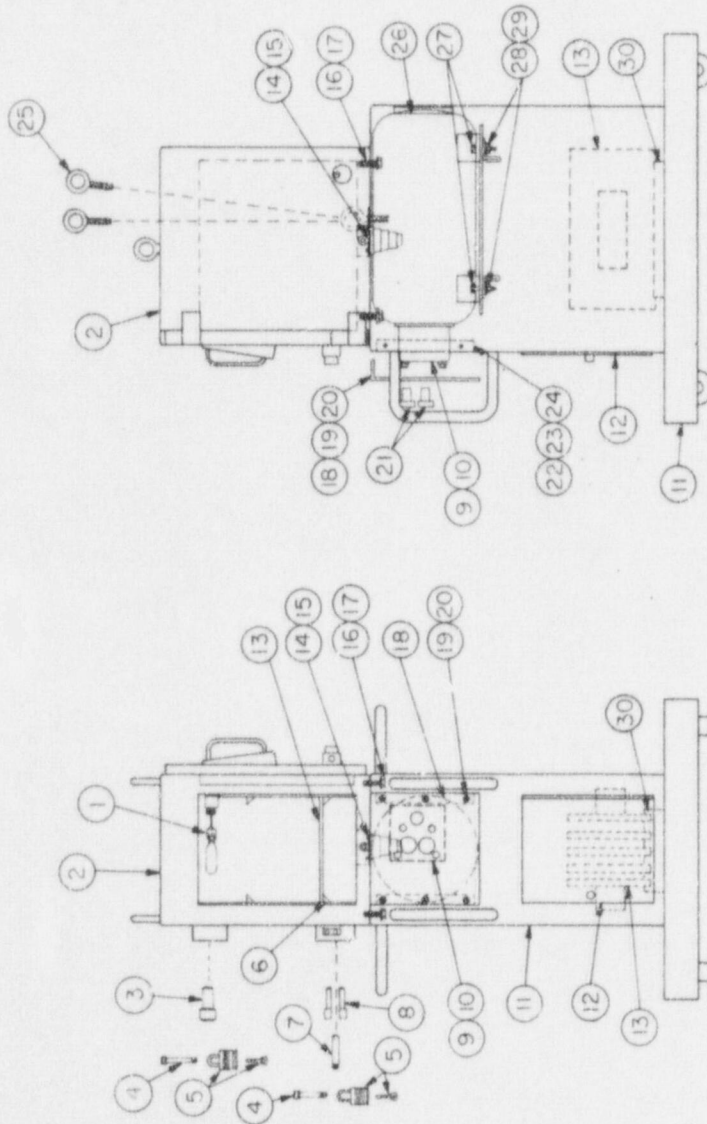


Figure 3-1. Gamma Calibrator Assembly

SECTION III MAINTENANCE

A. UNCRATING AND IN HOUSE ASSEMBLY INSTRUCTIONS

CAUTION

In off-loading a Multiple Source Gamma Calibrator from transport vehicle, use only a forklift truck or hoist having a capacity of 4000 pounds when in use with long forks or boom. Weight distribution within the crate is such that it must be maintained in essentially an upright position at all times.

The Model 1000B Multiple Source Gamma Calibrator is shipped in three parts. The safe and base are each bolted to a separate pallet and are both enclosed in a plywood box. The source shield assembly is shipped in a cylindrical plywood overpack which is bolted to a skid. Upon receiving the device and prior to uncrating, it should be placed near its permanent location in an open area which is accessible to a forklift or hoist. Proceed as follows:

Large Crate (Base)

1. Remove the wood screws from around the base and lift off the top.
2. Remove the wood screws and support blocks, and lift the base assembly off the pallet.
3. Remove the six screws, cup washers and the front panel. Remove the four screws, lock washers and front panel mounting brackets (items 18 - 24 of Figure 3-1).

Cylindrical Crate (Source Shield)

1. Remove the sixteen hex nuts from the top of the crate and lift off the top.
2. Hoist the source shield out of the crate. A chain is provided with shackles on each end.
3. Lay the source shield horizontally and remove the chain. Install two eye bolts to the top plate of the shield and tighten.
4. Hook the chain to the eye bolts and hoist the source shield into the base upper shelf. Align the mounting holes; install four bolts, four lock washers and four hex nuts (items 27 - 29 of Figure 3-1). Tighten.

5. Remove chain and eye bolts and store them in the base compartment.

6. Remove the four bolts from the front end of the source shield (items 9, 10 of Figure 3-1). Very carefully remove the cover so that it will not snag any wires.

Small Crate (Safe)

1. Remove the wood screws from around the base and lift off the top.
2. Remove the four bolts which connect the safe to the pallet.

3. Hoist the safe onto the base, align mounting holes and install four 9/16-12 hex bolts and lock washers from inside the base top (items 16, 17 of Figure 3-1). Tighten.

Final Assembly

1. Unlock the safe door and remove items that were shipped inside.
2. Remove the metal plate from the magnetic base of the lamp and attach the lamp to the safe inside wall in the upper right hand corner (item 1 of Figure 3-1). Feed the lamp wire down through a hole at the bottom right rear of the safe and connect the end lugs to the terminal strip on the left front of the source shield. The wires and terminal strip are numbered.
3. Remove wire and lead seal from drawer lock (see Figure 3-2).
4. Reinstall the front panel mounting brackets, four screws and lock washers (items 22-24 of Figure 3-1).
5. Connect the front panel wires to the terminal strip on the left front of the source shield. The wires are color coded and the terminal strip is numbered.
6. Reinstall front panel, six screws and cup washers (items 18-20 of Figure 3-1).
7. Reinstall the two knobs to the drawer shafts and tighten set screws onto the small circular flats on the bottom side of the shafts (item 21 of Figure 3-1).
8. In the center floor of the safe is a 4 inch diameter hole. Remove four screws from the plate and lift out the plate and shield plug. Store the plug and screws in the base compartment (items 14, 15 of Figure 3-1).

B. PREVENTIVE MAINTENANCE

1. Lamp, Switch and Socket Replacement

Refer to parts listing here included.

2. Source Position Indicator Switches

It is expected that at infrequent intervals these devices consisting of micro switches and associated roller lever actuators will fail and require attention. Because of the difficulty of replacement and since position lights are not requisite to operational safety, it is suggested that corrective maintenance be postponed until two or more switches have failed. A simple pointer and mark system of indicating source position serves well in lieu of position lights.

Four position switches are associated with and mounted on each of the guide blocks which support source drawer pull rods in precise rotational and linear alignment relative to switch actuators. The guide blocks are permanently mounted on two inch centers to the source shield.

NOTE

The guide block assembly does not serve the purpose of safety stop for source drawer withdrawal and may be safely removed from the shield for maintenance purposes.

Micro switches and actuators are attached in pairs to mounting brackets. Two brackets, each holding two switches, bolt to opposite sides of each guide block in such a position as to enable switches to be actuated by grooves machined in the source drawer pull rods.

This arrangement of switches, mounting brackets, pull rod guide blocks, and associated wiring is located directly behind the control panel.

3. Replacement Procedure

a. Removal of Control Panel

1) Loosen set screws on the underside of drawer knobs and remove knobs

2) Remove the six screws and front panel.

3) Electrical leads are sufficiently long as to permit control panel relocation without disconnecting from source position switches. Electrical leads need not be removed to adjust position switches; however, 110V power must be turned off and proper adjustment ascertained by use of an ohm-meter.

b. Switch Replacement

1) Locate the malfunctioning switch (or switches) and unsolder lead wires.

2) Remove switches and actuators from bracket and replace. Note rubber spacers or shims between switches and bracket. Replace in same order as new switches are installed.

3) Install switch and actuator and observe action of rollers in grooves upon withdrawal of source pull rod.

4) Attach test meter to terminals and test on and off functions before replacing lead wires to lugs.

5) After observing proper action of all switches, resolder leads, test, return control panel, and knobs in reverse order of steps described, making sure that no wires are pinched between control panel or shroud and frame.

4. Calibration

All Multiple Source Gamma Calibrator sources are evaluated in their respective devices under normal conditions of use by the Multiple Source Gamma Calibrator manufacturer. Calibration curves which plot dose rate as a function of elevation in inches from the floor of the Multiple Source Gamma Calibrator instrument shield are included in the owner's technical manual.

Dose rate data points, corrected for temperature and pressure, are obtained by use of an ionization chamber and ionization probes. Certification of electrical meter and probes calibration traceability to the National Bureau of Standards is also provided.

The manufacturer claims $\pm 6\%$ limit of error on Multiple Source Gamma Calibration data indicating dose rates in excess of 20 mR/hr. However, because of increased difficulty and diminished accuracy in evaluating low strength sources in the Multiple Source Gamma Calibrator using this system, the manufacturer places a $\pm 10\%$ limit of error on data indicating dose rates less than 20 mR/hr.

It should be noted that the dose rate data points are valid only for a detecting element of the same size and energy response as the ionization probe used for calibration. Potential errors are relatively small, but the manufacturer recommends that a cross-calibration to a free air or large beam field be done at least once for detectors of large size or that exhibit a non-flat energy response.

Accuracy for $\leq 20 \text{ mR/hr} = 6\%$
for $> 20 \text{ mR/hr} = 10\%$

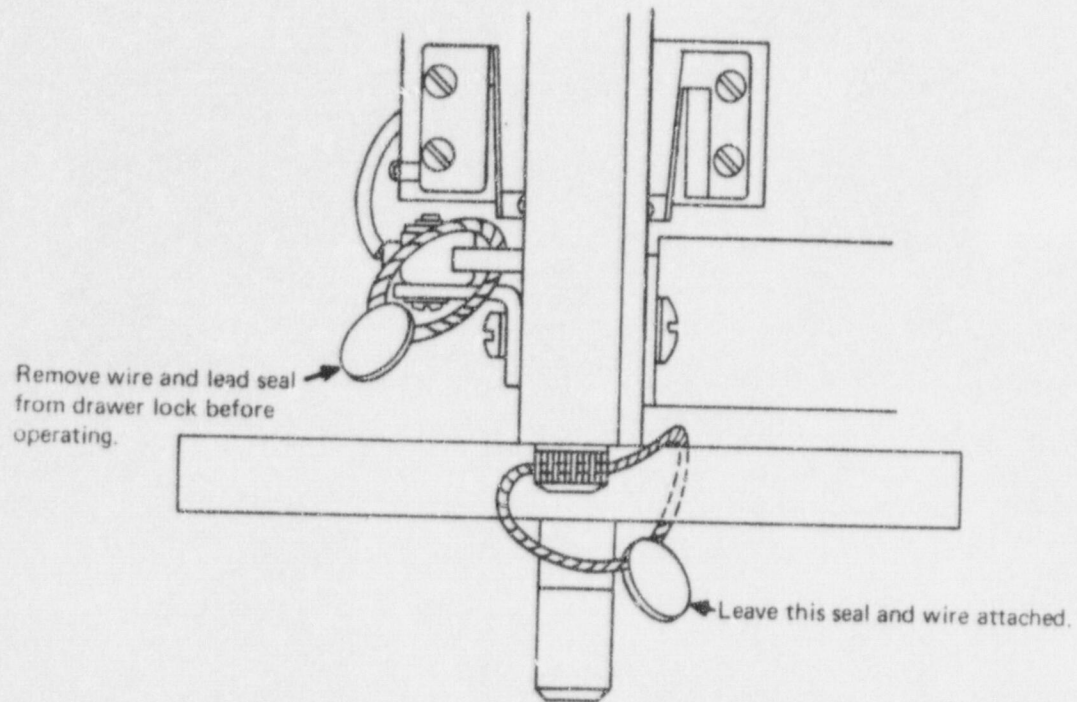


Figure 3-2. Source Drawer Interlock Seal

SECTION IV
PARTS LIST

<u>QUANTITY</u>	<u>DESCRIPTION</u>	<u>MANUFACTURER</u>
8	Cartridge Indicators	Chicago Miniature #CML 63-032-6 (Yellow)
1	Cartridge Indicator	Chicago Miniature #CML 63-032-1 (Red)
1	Cartridge Indicator	Chicago Miniature #CML 63-032-2 (Green)
1	Cartridge Indicator	Chicago Miniature #CML 63-032-4 (Blue)
9	Switches	Micro Switch # 11SM1-S
8	Actuators	Micro Switch # JS-5
9	Actuator	Micro Switch # JS-2
1	Lock & Key	Eberline 10807-B80
1	Lock & Key	Eberline 10807-B81
1	Inspection Mirror	McMaster Carr # 1018T15
1	Utility Light	McMaster Carr # 1525K11
1	Toggle Switch	Alco MTA-106D

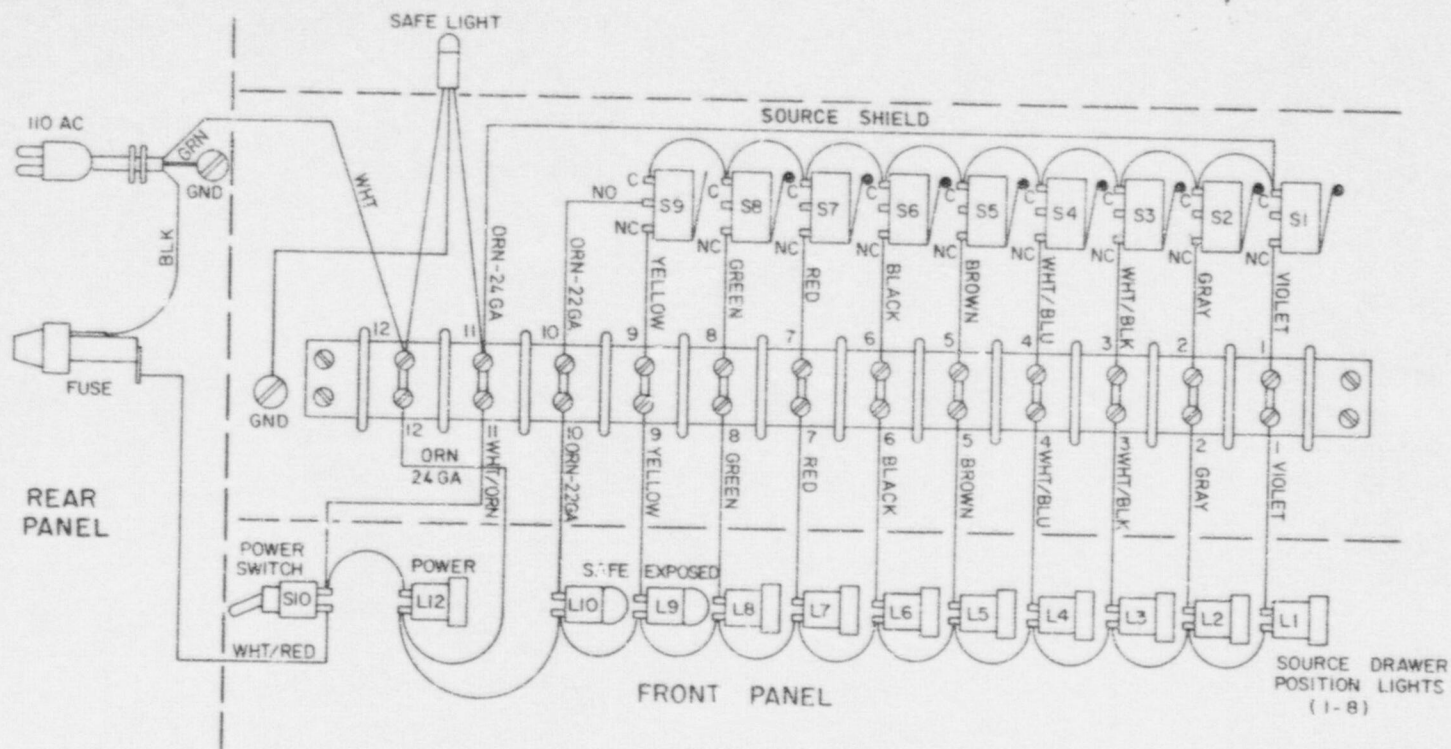


Figure 5-1. Wiring Diagram for Model 1000B