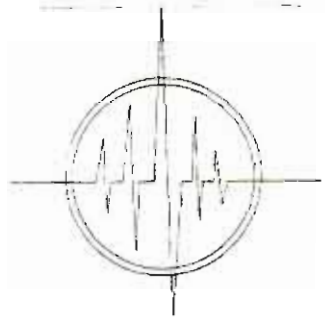

Eurovac

varian
vacuum
division

instructions

auger electron gun
models 981-2454, 981-2455

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GENERAL

The Varian Auger Electron Gun provides an electron beam for use in Auger spectroscopy. Two models of the gun are available which differ only in overall length. Gun Model 981-2454 is 6.48 inches long, measured from the sealing edge of its mounting flange to the end of the gun. Similarly, Gun Model 981-2455 is 9.48 inches long. The two models are otherwise identical (Figure 1).

The gun assembly is mounted on a standard 2-3/4 inch OD ConFlat® Flange, is magnetically shielded, and uses a replaceable plug-in filament assembly. The filament assembly is a tungsten ribbon precisely aligned within an extractor cup.

The heated filament provides a source of electrons which are initially accelerated through an aperture in the extractor cup by the high electrostatic fields between the filament and the first anode (see Figure 2). A lens system focuses the electrons to provide a "spot" at a target approximately 3.5" from the end of the gun. Deflection plates allow the beam to be positioned on the target. Focus is maintained throughout the range of accelerating potentials by programming the focus electrode potential at approximately 4/5 of the electron beam potential.

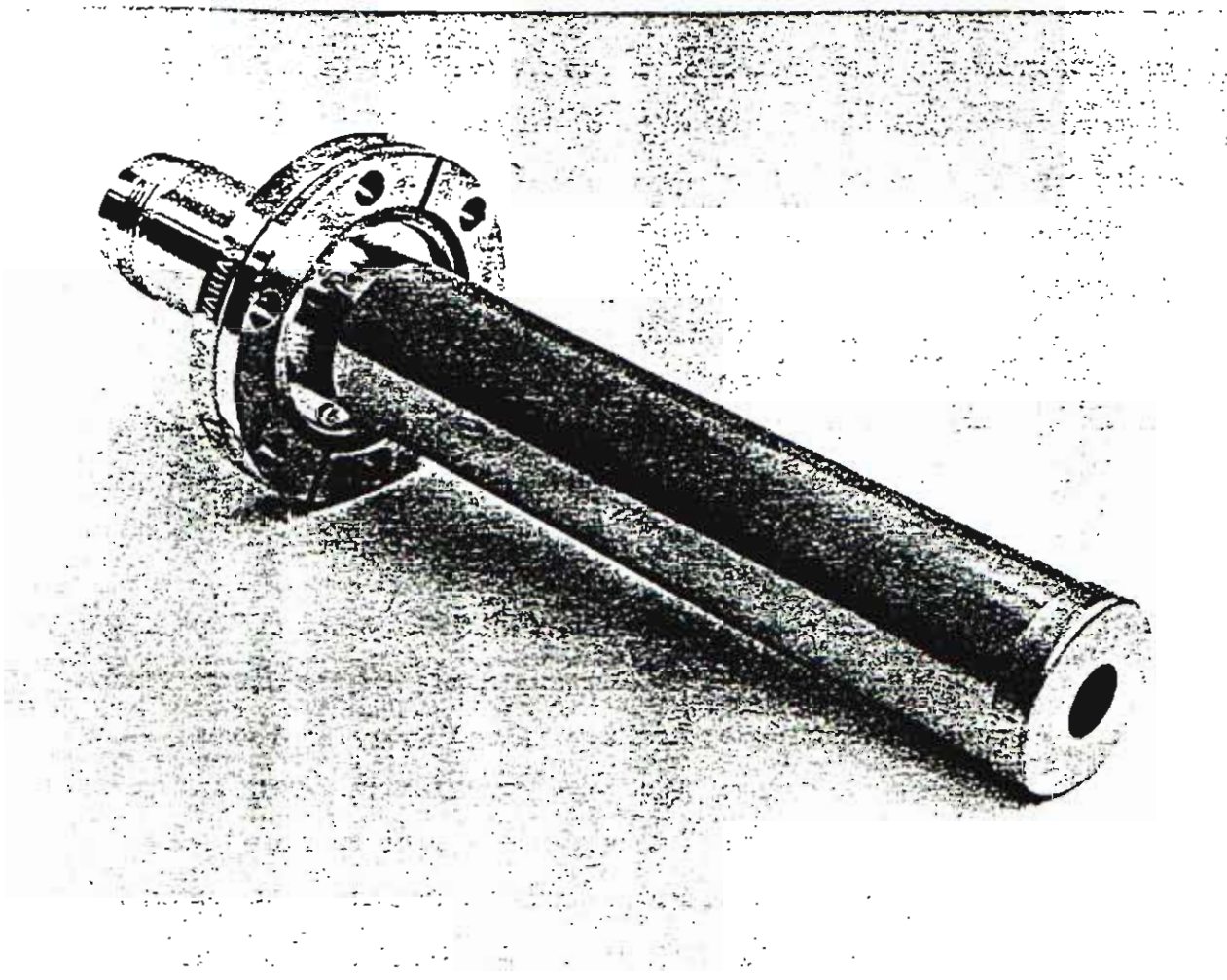

Figure 1. Auger Electron Gun

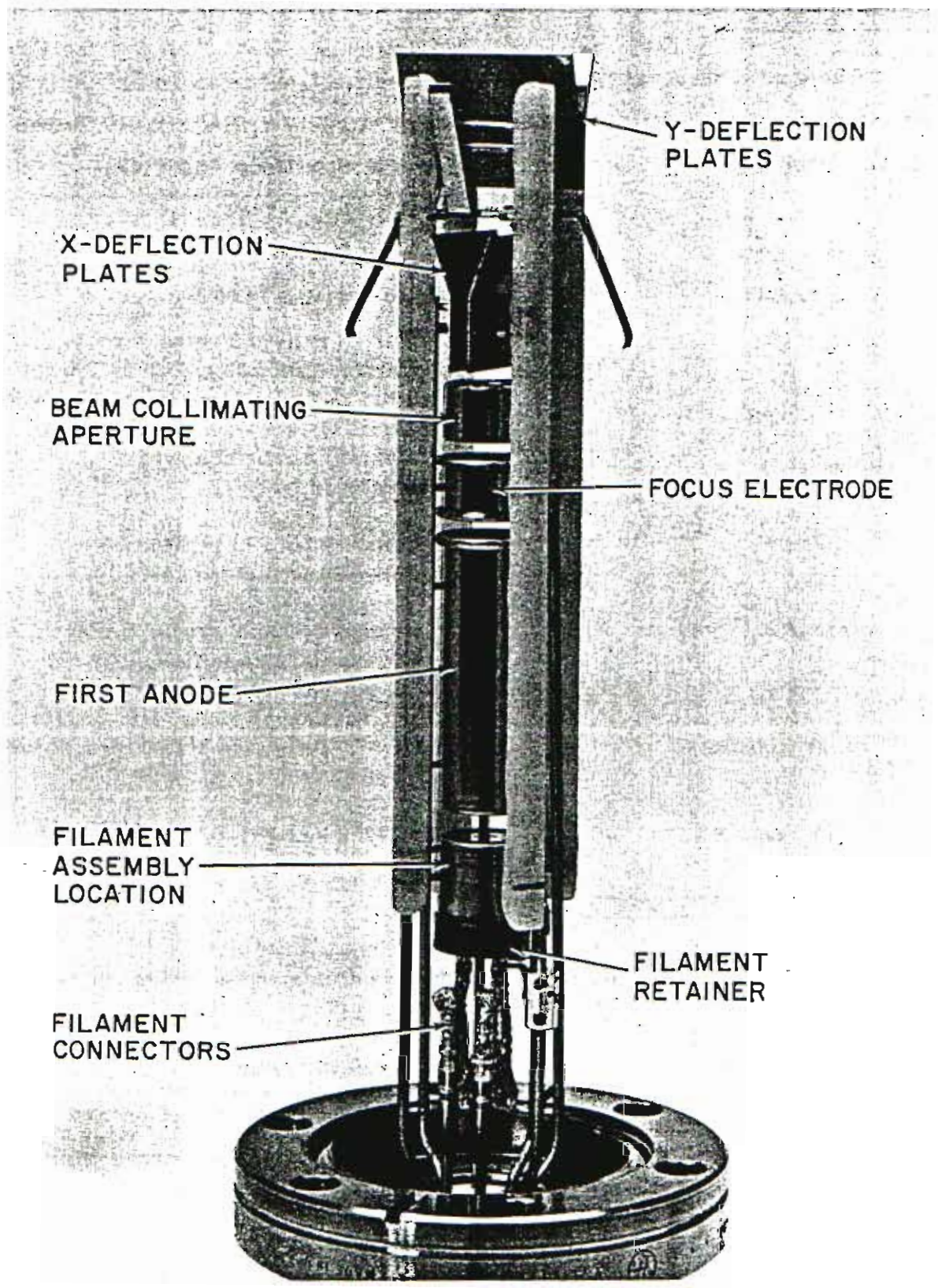

Figure 2. Auger Electron Gun, Shield Removed

SPECIFICATIONS

These specifications apply to the Auger Electron Gun when used as recommended with the Auger Power Supply which consists of Electron Gun Power Module, Model 981-2145, and Auger Gun Control Module Model 981-2147.

Beam Energy	20 to 3000 eV / 5000 eV
Beam Current	Up to 200 μA at 3000 V
Beam Size*	0.040" (1 mm) or less at zero extractor bias, 100 μA, 3000 V beam, and 3.5 inch maximum gun-to-sample distance. Beam sizes down to 0.015" (0.38 mm) can be achieved by using extractor bias.
Filament	Tungsten ribbon in replaceable, prealigned extractor assembly.
Magnetic Shielding	Mu-metal cylinder around gun assembly minimizes ac and dc fields and their resultant effects on system noise.
Beam Deflection	X- and Y-deflection plates direct beam to desired location on sample.
Flange Mounting	ConFlat Flange, 2-3/4" OD

GENERAL CHARACTERISTICS

Figure 3 is a typical plot of beam current and filament current as a function of beam voltage for two particular settings of the Beam Current Adjust potentiometer and zero Extractor voltage. At higher beam voltages, the beam current is approximately temperature limited. At lower beam voltages, the beam current becomes space charge limited. Note that the filament current approaches and is limited by the control to 3.35 amperes in the space charge limited region.

* Beam size as defined here is equivalent to the distance between positions of a knife edge alternately intercepting 10% and 90% of the beam current when moved perpendicular to the beam. Refer to Appendix A.

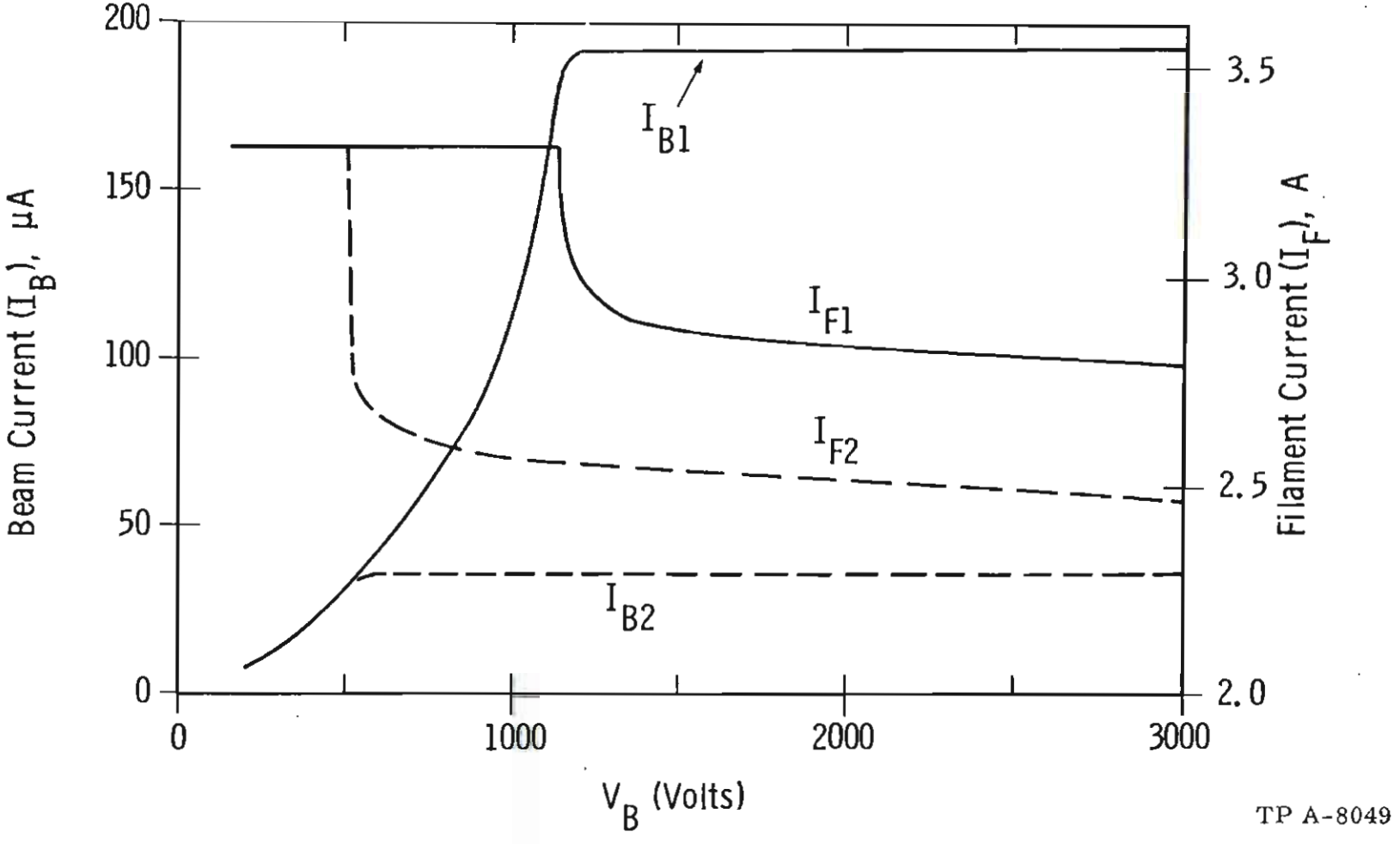

Figure 3. Beam Current and Filament Current vs Beam Voltage for Two Settings of Beam Current Adjust and Zero Extractor Bias

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The gun should not be operated unnecessarily in this mode because the resulting filament life will be reduced. Maximum filament life is achieved by operating at higher beam voltages and lower beam currents.

Figure 4 is a typical plot of beam size as a function of extractor voltage at a beam energy of 3000 volts, beam current of 100 μA, and a sample distance of 3.5 inches from the gun. Note that the beam size can be varied from 0.040 inch (1 mm) to 0.015 inch (0.38 mm) through the use of extractor bias voltage. See Appendix A for details of beam size measurement.

Figure 5 is a typical plot of beam current and filament current versus beam voltage at three different extractor bias voltages. Beam current and the corresponding filament current are strongly affected by the bias voltage. The use of bias voltage shifts the space charge limited region to higher beam voltages. When it is necessary to use bias voltage, maximum filament life is obtained by operating at beam currents which are as low as possible commensurate with other requirements.

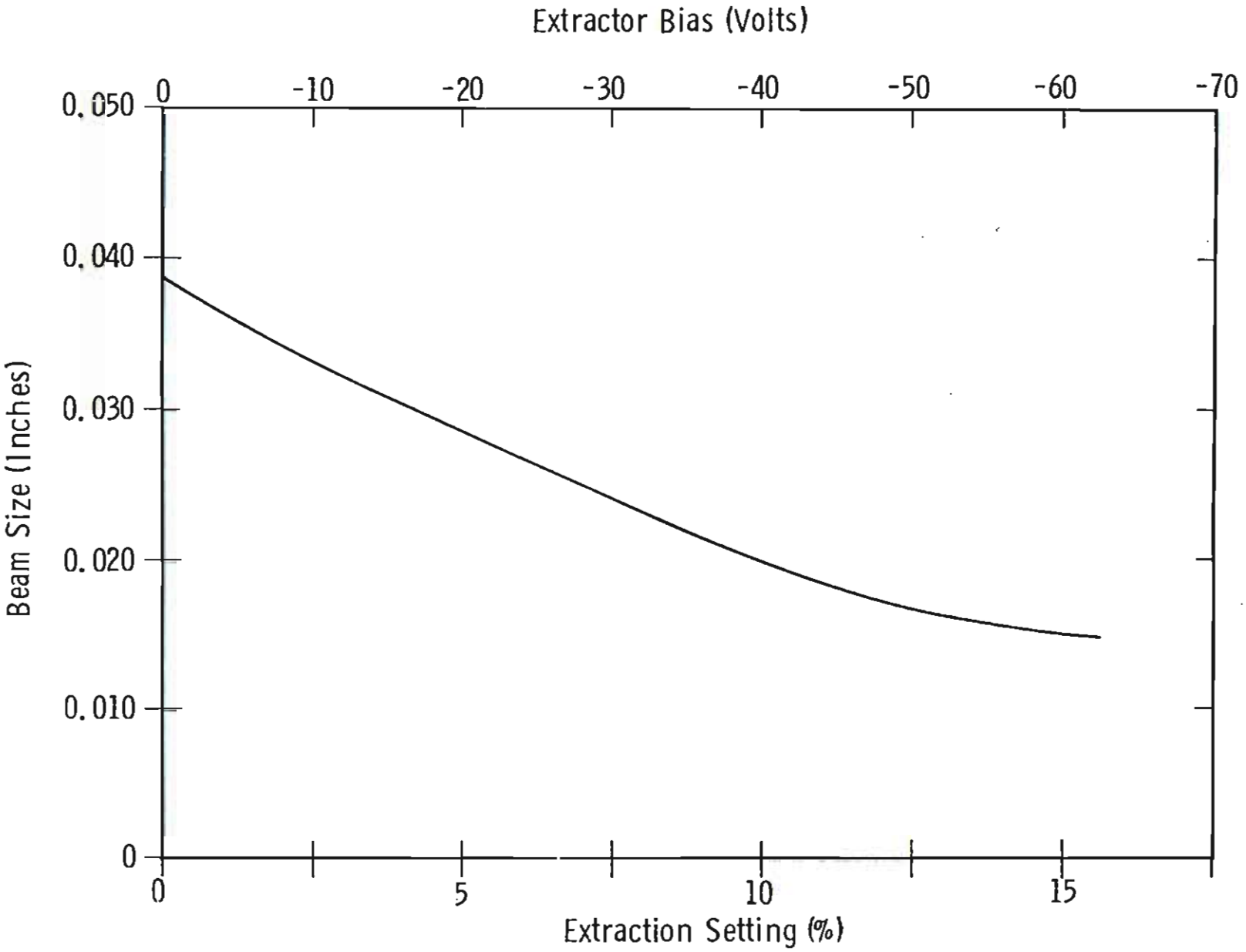


Figure 4. Beam Size vs Extractor Bias at Beam Energy of 3000 V, Beam Current of 100 μ A, at a Distance of 3.5 Inches From Cup

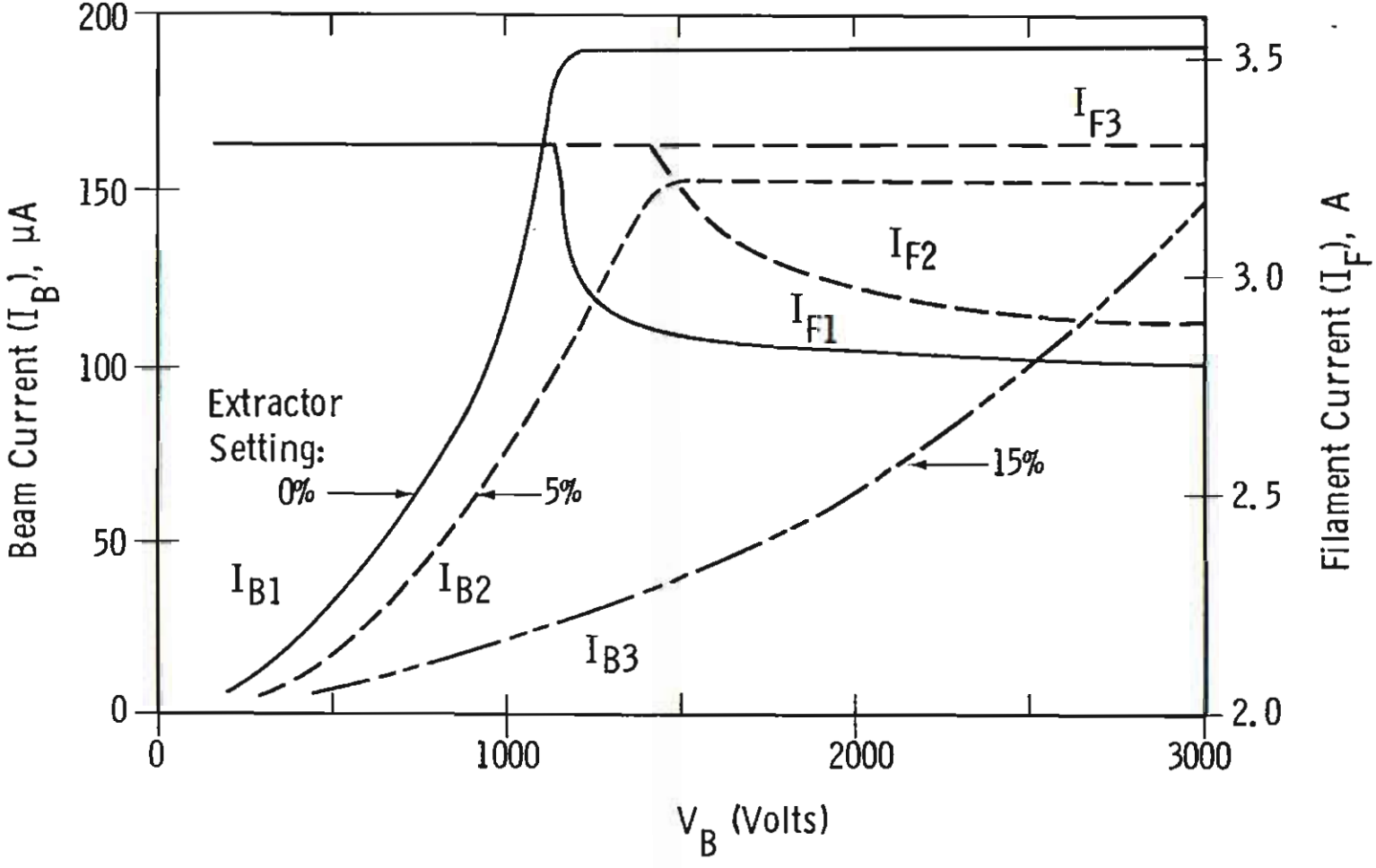


Figure 5. Beam Current and Filament Current vs Beam Voltage — Extractor Setting as a Variable

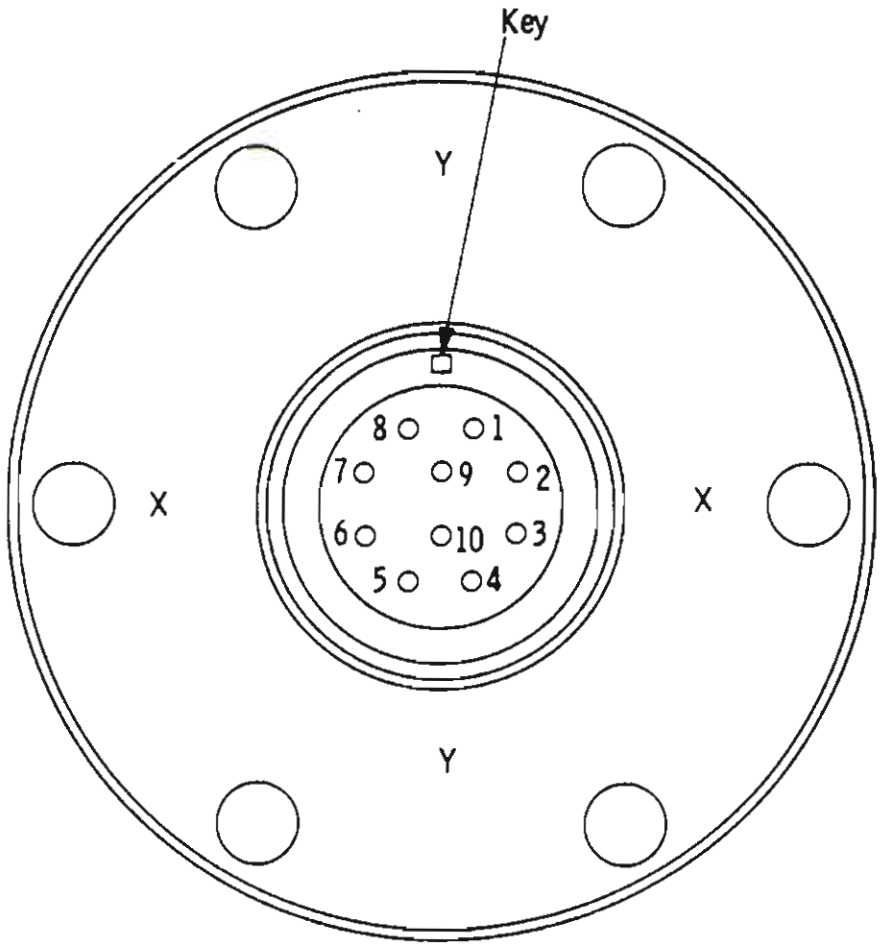
GENERAL

The gun assembly is mounted on a standard 2-3/4 inch ConFlat® Flange and the following mounting requirements should be observed.

1. Ensure that the gun mounting flange will interface with the vacuum chamber. It may be necessary to use an adapter flange to properly locate the gun with respect to the sample. When installed on the vacuum chamber, the end of the gun should be approximately 3.5" from the test sample to permit proper electron beam focus.
2. When mounting the gun horizontally, it is preferable to locate the Y Deflection pin on the connector in the uppermost position so that the Y-axis corresponds to the vertical plane (see Figure 6).

> NOTE
>
> Flange gaskets are required at all mating surfaces.

3. Allow approximately 3" clearance behind the mounting flange for the cable bend radius.



Header Pin No.	Gun Electrode	Connector Receptacle (P/N MS3103A36-407P)
1.	First Anode	M
2.	Y Deflector Plate	L
3.	Mu-Metal Shield, Grounded Deflection Plates, Beam Collimating Aperture	E
4.	Filament (+)	B
5.	Filament (-)	C
6.	Extractor Cup	A
7.	Focus	D
8.	X Deflection Plate	K
9.	No Connection	H
10.	No Connection	J

Figure 6. Auger Gun Connector Pin Identification

GENERAL

This section covers the recommended procedures for turn on, turn off, standby operation, and general gun checkout. Refer to the Auger Gun Power Supply Instruction Manual No. 87-400 281.

OPERATING MODES

The power supply operates in two modes. In the constant current mode, the actual beam current is controlled by a feedback circuit which adjusts the filament voltage to try to keep the beam current constant over the entire operating range of the gun. At low voltages where the electron gun becomes space charge limited, the power supply, of course, no longer maintains a constant beam current as the beam voltage is varied.

In the constant filament voltage mode, the filament voltage can be set to a particular value and held constant at that value. In this mode, beam current can vary as the beam voltage is varied (beam current is monitored continuously). This mode offers more convenience in some applications. For example, beam currents below that necessary for feedback control (<0.5 μA) can be obtained. Under these conditions the stability depends on the equilibrium of the filament environment.

OPERATING PROCEDURE

Gun operation will vary with the type of experiment. Refer to General Characteristics in Section I.

Before turning on the gun, pump the vacuum system to below 10^{-4} Torr.

1. Unless a proper setting of the BEAM CURRENT controls has been determined, turn these controls to their extreme counterclockwise position and place the CONSTANT BEAM CURRENT/CONSTANT FILAMENT VOLTAGE switch in the CONSTANT BEAM CURRENT position.

2. Set beam DEFLECTION controls at the center position (0).
3. Center FOCUS control.
4. Set BEAM VOLTAGE control fully counterclockwise.
5. Set EXTRACTOR potentiometer fully counterclockwise.
6. Place meter function switch in the BEAM CURRENT position. Turn on FILAMENT toggle switch. No beam current should be indicated at this point.
7. Turn on ELECTRON BEAM VOLTAGE switch.
8. Adjust BEAM VOLTAGE to 2 kV (meter function switch in the BEAM VOLTAGE position). Setting beam voltage at 2 kV ensures that the gun is in the temperature limited operating region in Step 9, below.
9. Set meter function switch in the BEAM CURRENT position and adjust BEAM CURRENT controls to produce desired level of beam current. The recommended maxumum beam current is 200 μA. For longest filament life it is advisable to operate at reduced beam currents whenever possible.

CAUTION

DO NOT OPERATE SYSTEM WITH BEAM VOLTAGE SET VERY LOW FOR PROLONGED PERIODS WITH THE FILAMENT ENERGIZED. THIS MODE OF OPERATION REQUIRES MAXIMUM FILAMENT CURRENT AND WILL REDUCE FILAMENT LIFE.

10. Adjust FOCUS potentiometer by visually observing the "spot" produced by the electron beam on the sample, or sample holder. Typical "spot" appearances vary considerably depending on beam voltage, focus, extractor bias, beam current, and display method, and can be uniform, gaussian, hollow, or split in appearance.
11. The EXTRACTOR potentiometer permits the attainment of smaller beam size through a trade-off of beam current and filament life. Extractor bias should be used only when it is needed for specific operations requiring very small spot size. The effects of extractor bias on the gun characteristics are described in Section I.

The constant filament voltage mode operating procedure is similar to the above constant beam current mode procedure. In Step 1, the mode toggle switch is placed in the CONSTANT FILAMENT VOLTAGE position, and in Step 9, the control knob below the toggle switch is adjusted for the desired value of beam current.

TURN-OFF

Turn off BEAM VOLTAGE, FILAMENT and MAIN POWER switches to turn power supply off completely.

STANDBY OPERATION

One ampere of current is supplied during standby operation to keep the filament outgassed without affecting filament life. Standby current is automatically provided when the filament is on and beam voltage is switched off.

It is advisable to turn the power supply completely off overnight.

FILAMENT REPLACEMENT

NOTE

Noise currents resulting from dirt or other contaminants on the glass insulators of the gun can develop. Therefore, the procedure listed below should be followed in a clean environment, using clean, lint-free gloves or finger cots to avoid contamination of the gun parts.

1. Remove the gun from the vacuum system.
2. Remove the magnetic shield by removing the three mounting screws and insulating ceramics from the mounting flange.
3. Disconnect the filament leads from pins 4 and 5.
4. Loosen the set screw and lower the filament retainer.
5. Slide the filament assembly down toward the gun flange until it is clear of the mounting sleeve.
6. Check the new filament assembly for continuity (resistance should be 0.2 ohm or less).
7. Installation of the new filament assembly is accomplished by reversing the above procedure.
8. Some movement of the filament assembly is possible within its mounting sleeve when the filament retainer is in place. The exact location of the filament assembly is not critical within this limited range of movement.

CAUTION

VISUALLY INSPECT FLEXIBLE BRAID LEADS TO ENSURE ADEQUATE CLEARANCE FROM ALL OTHER LEADS.

9. When re-installing the magnetic shield, the shoulders of the six ceramic insulators must be properly seated in their clearance holes before the screws are tightened.

10. Recheck filament for continuity after installation.

GLASS INSULATOR CLEANING

After long periods of operation, particularly at high beam currents, deposits may develop on the glass insulators near the focus electrode and between the extractor and first anode. The resulting leakage may give rise to a somewhat erratic beam behavior.

This can be remedied by carefully cleaning the rods with an abrasive such as a slurry of alumina powder. The slurry should be rubbed onto the insulators with a nylon cloth and wiped away when dry.

REPLACEMENT PARTS

Filament	981-0248
Screw, 0-80 UNF X 1/4" Pan Head	12-162050-04
Ceramic Bushing	A613825
Copper Gasket for 2-3/4" ConFlat Flange	953-5014