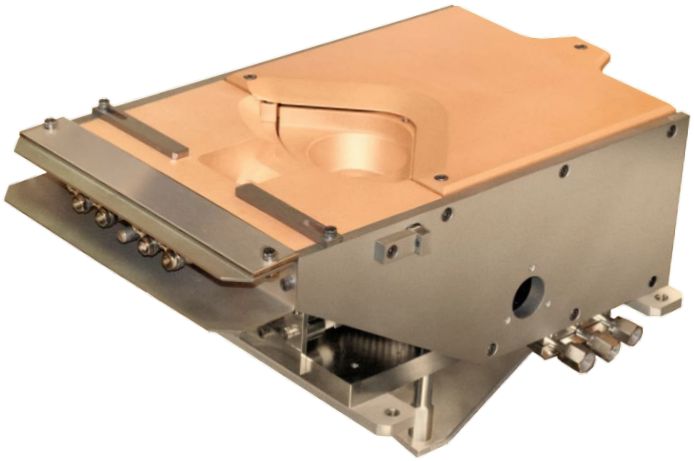
0101-9008-0

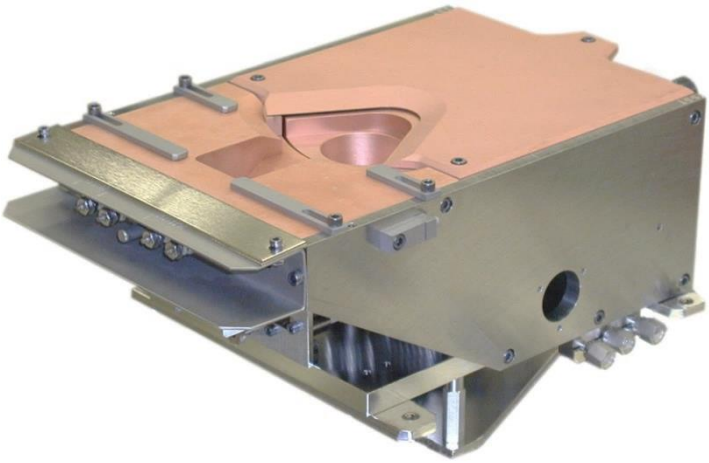
Temescal

User Manual for 2PT and 3PT PopTop Electron Beam Turret Sources

Temescal 2PT Source



Temescal 3PT Source



FerroTec

Revision B, March 2021

Temescal, a division of Ferrotec (USA) Corporation
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Revision History
0101-9008

Rev.	Change Description	Application/Reason for Change	Date	App'v'd.
A	First published version of manual	Applies to all 2PT and 3PT sources produced after April 2009.	April, 2019	IA
B	Created new Section 3 and increment the section numbers of former Sections 3, 4, and 5 Updated the information in Tables 1-1, 1-2, and 1-3 Revised section 2.4 Updated Section 6	Section 3 provides instructions for installing a 2PT or a 3PT gun in a non-Temescal system Per current info in Temescal Price Book To conform to section 3 of TBEU manual Pursuant to Field Service review	March 2021	IA

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Terms and Conditions

1. **Delivery**. Unless otherwise stated, shipments of Ferrotec Temescal Electron Beam Gun and Systems products quoted and/or produced at the Livermore, CA factory site will be made Ex-Works, Livermore, CA Incoterms. Shipping date as are approximate and are based on conditions at the time of acceptance and prompt receipt of all necessary information from the Buyer. Pro- Rata payments shall become due as shipments are made. Items held of Buyer shall be at the risk and expense of the Buyer.

2. **Title**.
   A. This subsection applies in jurisdictions where the laws provides a purchase-money security interest, or similar rights, in favor of the seller, including but not limited to the U.S., Canada, and Mexico: Title and risk of loss or damage passes to Buyer when the goods are put into possession of the freight carrier for delivery to Buyer. Seller retains a security interest in the goods to ensure payment in full. Buyer agrees not to take any action with respect to the goods that would interfere with Seller's security interest until the goods are fully paid for.

   B. This sub-section applies in all other jurisdictions: Risk of loss or damage passes to Buyer when the goods are put into possession of the freight carrier for delivery to Buyer. Seller retains sufficient title in the goods to ensure the goods are fully paid for. Buyer agrees not to take any action with respect to the goods that would interfere with Seller's title until the goods are fully paid for.

3. Delays in Deliveries. Seller shall not be liable for failure to fill any order when due to: fires; riots; strikes; freight embargoes or transportation delays; shortage of labor; inability to secure fuel, material, supplies or power at current price or on account of shortages thereof; acts of God or of the public enemy; any existing or future laws or acts of the federal or of any state or local government (including specifically but not exclusively any orders, rules or regulations issued by an official or agency of any such government) affecting the conduct of Seller's business with which Seller in its judgment and discretion deems it advisable to comply as a legal or patriotic duty; or to any cause beyond Seller's reasonable control. Seller is not liable for damages attributed to delays in delivery.

4. Taxes. Prices quoted herein shall be subject to an additional charge to cover any existing or future Manufacturers, Sales, Use, Value Added or similar tax which may be applicable and any administrative costs for required governmental permits, inspections and the life.

5. Special Order Equipment. Where buyer shall furnish special order equipment, Buyer shall bear the cost of alterations made thereon, except such as Seller may make for its own convenience. Buyer shall furnish drawings and specific information as to variations permissible between equipment and drawings. Shipping and crating charges on said equipment to and from Seller's facilities shall be borne by buyer. Seller shall have no responsibility for loss or damage to said equipment, except when due to careless handling or negligence on the part of Seller. Cost of insurance on special orders will be borne by buyer, and same are held at Buyer's risk.

6. Seller's Warranty. Seller's standard published warranty in effect at the time of shipment for the particular product shall apply. THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, INCLUDING THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Seller's liability shall not in any case exceed the cost of repair or replacement of any defective product as stated in the warranty and upon expiration of the warranty period all such liability shall terminate. Seller shall in no event be liable for consequential damages of any kind.

7. Changes and Acceptance. Any changes in drawings specifications or in their Terms and Conditions will require Seller's written approval before they become binding.

8. Cancellations. The following schedule of cancellation charges shall apply:

A. Cancellations:

i. For custom/modified products:

When cancellation notice received:	**Charge is:**
1-30 days prior to shipment	100% of product sales price
31-60 days prior to shipment	75% of product sales price
61-90 days prior to shipment	50% of product sales price
91 days or more prior to shipment	10% of product sales price

ii. For standard products: To be negotiated

B. Reschedules:

i. For completed custom/modified product rescheduled	1.5% per month x sales price of product
ii. Incomplete custom/modified product, parts rescheduled	1.5% per month x sales price of products which are stocked or ordered.

iii. Restocking: Only standard products may be restocked. 25% of dollar value returned to Seller's stock, plus all freight charges. All restocking is subject to Seller's approval and inspection.

9. Payment. The terms of payment of items quoted herein shall be: cash in advance or net 30 upon credit approval unless otherwise agreed in writing. If at any time, in the judgment of the Seller, Buyer's credit shall be impaired, Seller shall have the right to demand immediate cash payment and to refuse to make delivery except against payment therefore in cash.

10. No implied License. The sale of any product or material quoted herein does not give or imply any right or license to buyer to analyze or manufacture such product or material or to claim Buyer is an authorized re-seller of such material.

11. Export Licenses. Items quoted herein may constitute a controlled commodity requiring export licenses from the U.S. Department of Commerce prior to transshipment. Buyer shall be responsible for obtaining any such licenses required.

12. Exclusive Statement. The terms and conditions contained in Seller's Order Acknowledgement will be the complete and exclusive statement of the terms of agreement between the parties. If the terms of said Acknowledgement differ in any way from the terms of Buyer's order, the provisions of said Acknowledgement shall prevail and be controlling.

13. State Laws. This contract shall be governed in all respects by the laws of the State of New Hampshire and the State of California.

1**4. This contract is governed by Incoterms 2010.**

FERROTEC (USA) CORPORATION'S ACCEPTANCE OF THE REFERENCED PURCHASE ORDER IS EXPRESSLY MADE CONDITIONAL ON THE PARTY'S ASSENT (WHO SUBMITTED THE REFERENCED PURCHASE ORDER) TO FERROTEC'S ADDITIONAL OR DIFFERENT TERMS IN THIS ORDER ACKNOWLEDGEMENT. IF NO ANSWER IS RECEIVED FROM THE PARTY SUBMITTING THE REFERENCED PURCHASE ORDER WITHIN A REASONABLE TIME AFTER RECEIPT OF THIS ORDER ACKNOWLEDGEMENT, IT WILL BE ASSUMED THAT THEIR INCLUSION HAS BEEN ASSENTED TO.

Limited Warranty

1. **Parties Covered**. This limited warranty is given by Ferrotec (USA) Corporation hereinafter called the “Warrantor” to the buyer of the above described item(s) and extends to Buyer only and is not transferable to nor enforceable by any transferee, subsequent purchaser or successor of buyer.

2. **Term of Limited Warranty**. The term of this limited warranty shall be one year from the date of shipment of the above items(s). Warrantor shall not have liability or responsibility under this limited warranty or under any warranties implied by law or otherwise, for defects ensuring or claims asserted after the expiration of the term of this Limited Warranty.

2. **Limitations of warranties**. The only express or implied warranties of Warrantor are those expressed in this instrument.

   A. WITHOUT LIMITATION, WARRANTOR HEREBY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE EXPRESS WARRANTIES SET FORTH HERIN. THE TERM OF ANY WARRANTY OR WARRANTOR IMPLIED BY LAW SHALL END ON THE TERMINATION DATE OF THIS LIMITED WARRANTY SPECIFIED IN SECTION 2.

   B. Warranty duration for out of warranty items repaired by Ferrotec shall be ninety (90) days from date of shipment post repair “Ex-works”.

4. **Warranty Coverage**. Subject to the exclusions set forth in Section 5, the item(s) described above is/(are) warranted against defects in material or workmanship. Warrantor shall, at its option, repair or replace at its cost any defective item during the warranty period. Warrantor may repair the item at any of its worldwide service locations.

5. **Exclusions from coverage**. Warrantor expressly disclaims responsibility for any of the following, each of which is expressly EXCLUDED from this limited warranty.

   A. Ordinary wear and tear, damage or defects due to abuse, misuse, failure to use according to instruction, or exposure to temperatures and conditions in excess of those referred to in the Notes and instructions delivered herewith. If different operating temperatures or conditions are specified in documentation specific to your product, these supersede those on the enclosed Notes and instructions.

   B. Damage or defects caused by Acts of God, the elements, natural disasters, or by the wrongful or negligent act or omission of anyone other than the Warrantor.

   C. Damage or defects to any product disassembled, modified, repaired or replaced by any party other than the warrantor or its expressed authorized representative, whether or not damage was caused by said disassembly or modification.

   D. Incidental, consequential or special damages of any kind.

6. **Claims Procedure**. Buyer shall promptly notify warrantor in writing of a claim under this Limited Warranty or any warranty implied by law. Buyer is responsible for freight charges for shipment of product to Warrantor. Warrantor will pay for the freight charges for shipment of product back to Buyer where the product is found to be defective.

7. **Severability: No Waiver**. In the event any of the provisions hereof shall be invalid, the remainder of the provisions of this Limited Warranty shall remain in full force and effect. No waiver by Warrantor of the provisions hereof at any time shall constitute a waiver of any such provisions at any subsequent time or of any other provisions at any time.

SAFETY INSTRUCTIONS FOR OPERATING AND SERVICE PERSONNEL

Operators and service personnel should always wear safety glasses. Operators shall not enter areas intended for service access only. Only experienced service personnel should enter such areas, and only after taking the preliminary precautions described in paragraphs 1 through 6 below.

DANGER

Potentially lethal voltages may exist within this unit, even with the line power switched off. Service should only be attempted by qualified personnel. Failure to observe all safety precautions may result in personal injury.

This component is designed to operate as part of a system containing high-voltage equipment. Observe the precautions described below when servicing this system, especially when servicing components where high voltages may be present.

1. Before servicing or operating this equipment, read all the component manuals supplied with the system, paying special attention to safety instructions.
2. Post HIGH VOLTAGE WARNING signs in conspicuous locations within the service area.
3. Remove rings, watches, bracelets, and any other metal jewelry before working around high voltage.
4. DO NOT WORK ALONE!
5. Be sure that all equipment is connected to a power receptacle having the correct polarity and grounding, as prescribed by the local electrical codes. Refer to the power supply portion of the documentation to determine the proper electrical ground for high-voltage components.
6. Before servicing any high-voltage component, switch off the electrical power at the component's main power switch. This switch should have a lockout feature. Lock the power off and keep the key with you while you are working on the equipment.
7. Certain electrical parts (e.g., electrolytic capacitors) hold a lethal voltage even after the power is switched off. Before entering any service area, use a grounding hook to discharge such parts. Be sure that these parts are discharged before starting any repairs.
8. DO NOT touch high-voltage leads unless power is off and a grounding hook is connected to the parts to be serviced.
9. The high-voltage components of the system should be equipped with electrical interlocks to protect personnel from injury. DO NOT ATTEMPT TO DEFEAT, OVERRIDE, OR BYPASS THESE PROTECTIVE DEVICES!
10. Never leave loose ends on high-voltage connections.
11. Observe the following warning if the system employs Radio Frequency (RF) power.

DANGER

RF radiation—even at modest power levels—can cause serious injury. If any of the RF components (e.g., the RF power supply, the RF matching network, or the RF electrodes or shielding inside the product chamber) are moved or changed in any way, the RF energy may be radiated outside the equipment. Monitor the equipment to assure that external RF radiation is below the levels prescribed by any and all applicable safety codes.

SPECIAL AMENDMENT FOR UNITED KINGDOM USERS

ALL ELECTRICAL POWER SOURCES: SAFETY PRECAUTIONS

This component is designed to be used in an extra-high-voltage system. Only authorized personnel should be permitted to carry out work on this system.

Prior to any servicing, grounding hooks should be used to short out all high-voltage parts and conductors in both the vacuum system and the high-voltage power supply. Screens protecting extra-high-voltage conductors should be removed only if appropriate action has been taken to ensure that extra-high-voltage conductors are dead and cannot be reenergized inadvertently.

In addition, all personnel should be aware of:

1. The Electricity (Factories Act) Special Regulations (1908 and 1944), in particular, Regulations 18(d) and 28 of the 1980 Regulations, as amended; and

2. The employer's responsibility to set up suitable systems to safeguard the health and safety of employees, according to the Health & Safety at Work etc. Act (1974).

HEALTH HAZARD

The condensates deposited on the tank walls of a vacuum system are generally in the form of extremely fine particles. The nature, as well as the form, of the materials poses the following potential health hazards:

a) Inhaling fine particles (powder) may cause damage to the lungs. To help prevent this, wear a protective respirator mask with fine filter that has been approved by the National Institute for Occupational Safety and Health (NIOSH) and the federal Mine Safety and Health Administration (MSHA).

b) Some substances are toxic and inhaling them should be avoided. Take steps to ascertain whether or not the material being deposited is a known toxic substance. Refer to the Material Safety Data Sheet(s) covering the evaporant(s) in question.

c) Certain powders (titanium, for instance) can cause flash fires when exposed to oxygen or other oxidizers. Therefore, when opening the chamber door after a deposition cycle, exercise extreme caution and allow time for the coating surface to oxidize. Breakage of some of the more reactive condensates may be hazardous, even when the above precautions are observed. In this situation, fire-protective clothing should be worn.

d) Certain powders (platinum, for instance) are known to catalyze methyl alcohol vapors upon contact, generating heat in the process and possibly causing a fire to erupt. Therefore, never use methyl alcohol to wipe down or clean any internal tank surfaces of a vacuum system. Use isopropyl alcohol (IPA), instead. Dispose of all IPA-exposed lint-free paper/cloth into a fireproof container, while ensuring all proper safety procedures and precautions are being followed.

USER RESPONSIBILITY

This equipment will perform in accordance with the instructions and information contained in the user's manual and its referenced documents when such equipment is installed, operated, and maintained in compliance with such instructions. The equipment must be checked periodically. Defective equipment shall not be used. Parts that are broken, missing, plainly worn, distorted, or contaminated, shall be replaced immediately. Should such repair or replacement become necessary, a telephone or written request for service should be made to Temescal, Livermore, CA, a division of Ferrotec (USA) Corp.

The equipment, or any of its parts, shall not be altered without the prior written approval of Temescal. The user and/or purchaser of this equipment shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, damage, improper repair, or alteration by any party other than Temescal.

GUIDELINES AND GOOD PRACTICES

1. Follow applicable clean room procedures (smocks, masks, gloves, etc.).
2. Do not expose the vent and purge valves to excessive pressures. The nitrogen line regulator is factory set at 15 psi and must not be adjusted above 20 psi.
3. Prevent oil, grease, water, sweat, etc. from getting into the vacuum chamber.
4. Replace the source tray shield correctly to ensure that the ceramic parts of the high voltage feedthroughs are protected from being coated.
5. Clean all mechanical parts and seals with lint-free paper/cloth soaked with isopropyl alcohol (IPA). Dispose of all IPA-exposed cleaning paper/cloth in a fireproof container, while ensuring proper safety precautions are being followed.
6. Polish scratched surfaces with Scotch-Brite, taking care not to produce any cross scratches.
7. Shaft seals are all ferromagnetic. No lubrication is required.
8. Check the chamber door's seal and sealing surfaces each time before closing it.
9. Check and clean the source tray seals and sealing surfaces with IPA each time before raising the source tray into place.
10. Staff must be trained by competent personnel. DO NOT allow staff to operate the system or do maintenance and recovery work on it until they are trained by competent personnel.
11. Document all alarms, deviations, breakdowns, and servicings done on either a hardcopy or an electronic equipment-log system.
12. When operating the source at emission current levels above the bias level, do not observe it through the viewport unless you are wearing polarizing lenses or some other appropriate form of eye protection. Depending on the type of material being evaporated and the observed effective lumens, which may range as high as 45,000 lx, multiple polarizers or types of eye protection equipment may be required. Failure to observe this precaution may result in serious damage to the operator's vision.

1 Product Description and Specifications

1.1 Overview

This section provides a general description of Temescal's 2PT and 3PT 'PopTop' turret sources, specifications for these sources, and information about source accessories available from Temescal. Specific topics covered included are:

1.2 Product Description
1.3 Specifications
1.4 Installation Requirements
1.5 Source Accessories

1.2 Product Description

1.2.1 General Characteristics

Temescal's PopTop turret sources offer enhanced versatility, convenience, and dependability in applications ranging from optical and microelectronic production to specialized R&D coating. The key to these enhancements is the pneumatically actuated crucible cover, which is raised automatically before the turret is rotated. When lowered, the cover isolates the pockets from one another, virtually eliminating cross-contamination. The design of the cover also minimizes evaporant buildup where it abuts the active pocket, greatly reducing the risk of turret jamming during rotation. The net benefits include minimization of cross-contamination, more reliable turret operation, and vastly reduced downtime for source cleaning and maintenance. Maintenance downtime can be further reduced if users keep a clean cover handy and simply replace the used cover with the clean one. The used cover can then be sent to a maintenance area for a thorough cleaning and glass-bead honing.

Removing the crucible cover requires simply raising the cover and removing the cover's three mounting screws. It is not necessary to blow the cooling water out of the source before removing the cover. Once the cover is off, crucible removal is relatively easy, though this operation does necessitate blowing out the source's water channels. The removable crucible cover also enhances the versatility of the source, making it easy to replace one crucible with another whose pockets differ in number and capacity.

1.2.2 Principal Features of PopTop Sources

Figures 1-1 through 1-3 point out the major functional features of the 2PT and 3PT sources. Figures 1-1 and 1-2 show top views of the two sources. From this perspective, the features of the two sources are nearly identical. Figure 1-3 shows a front view of the 2PT source. That illustration also accurately reflects the features of the 3PT source, though the dimensions of the two sources differ. For dimensioned drawings of the two sources, see Figures 1-4 and 1-5. Note that all illustrations in this manual show bottom-drive versions of both sources. However, a side-drive version of the 2PT source is also available.

Figure 1-1 Top View of 2PT Source

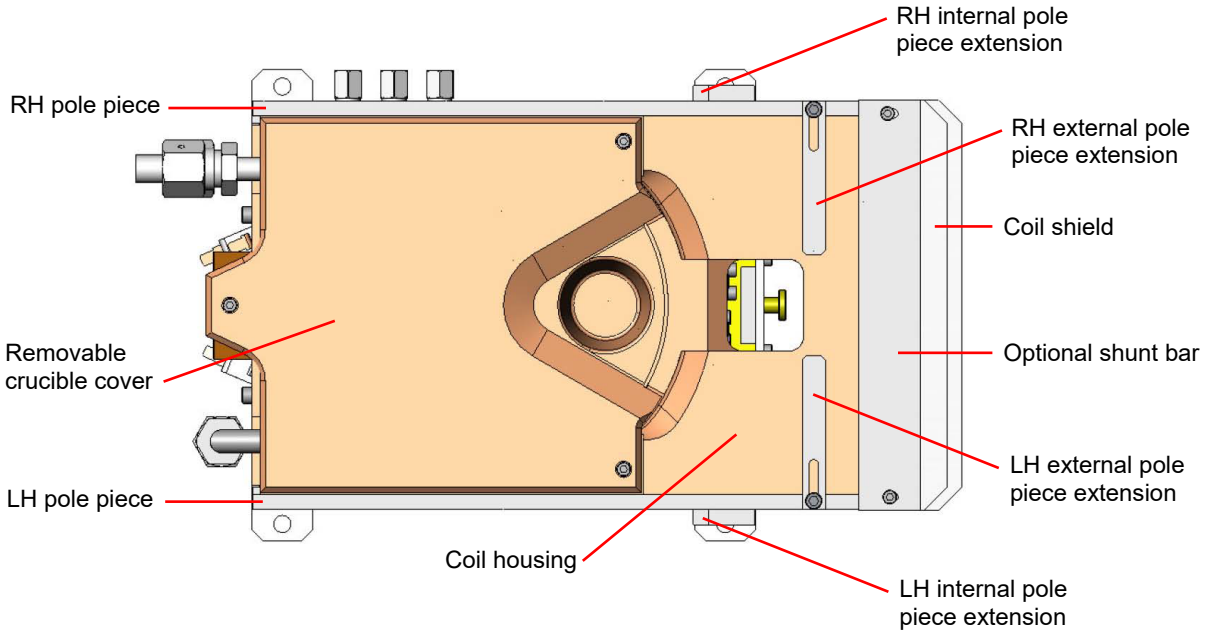


Figure 1-2 Top View of 3PT Source

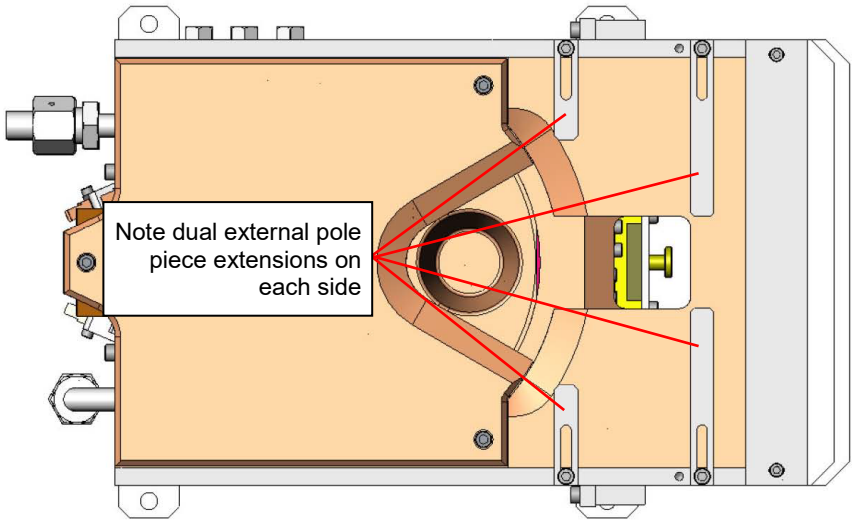
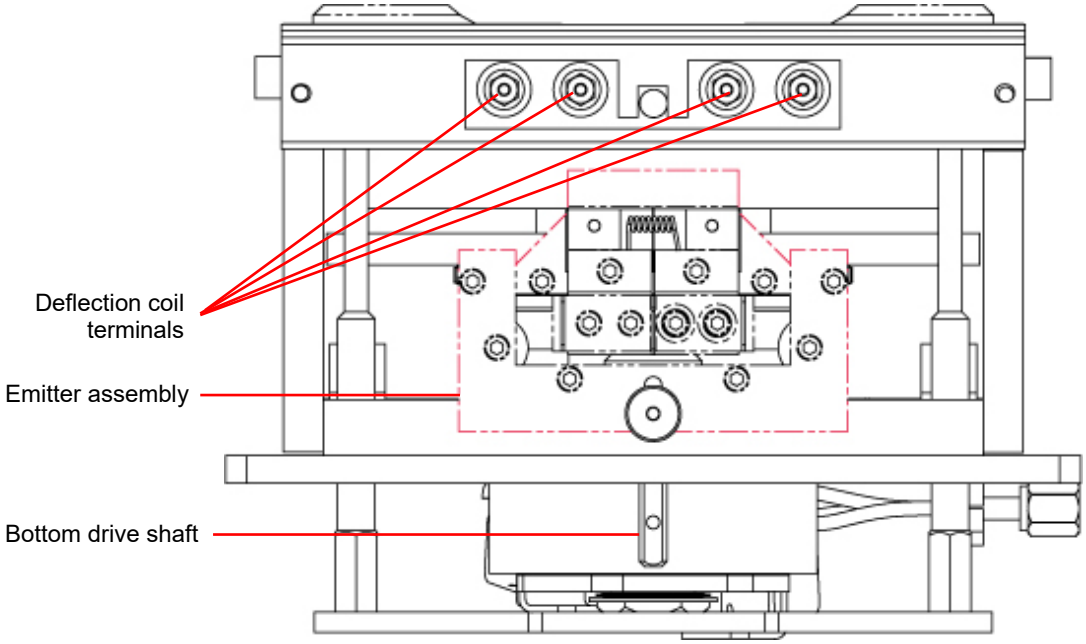


Figure 1-3 Front View of 2PT Source (Shown Here with High Performance Emitter)



Emitter Assembly

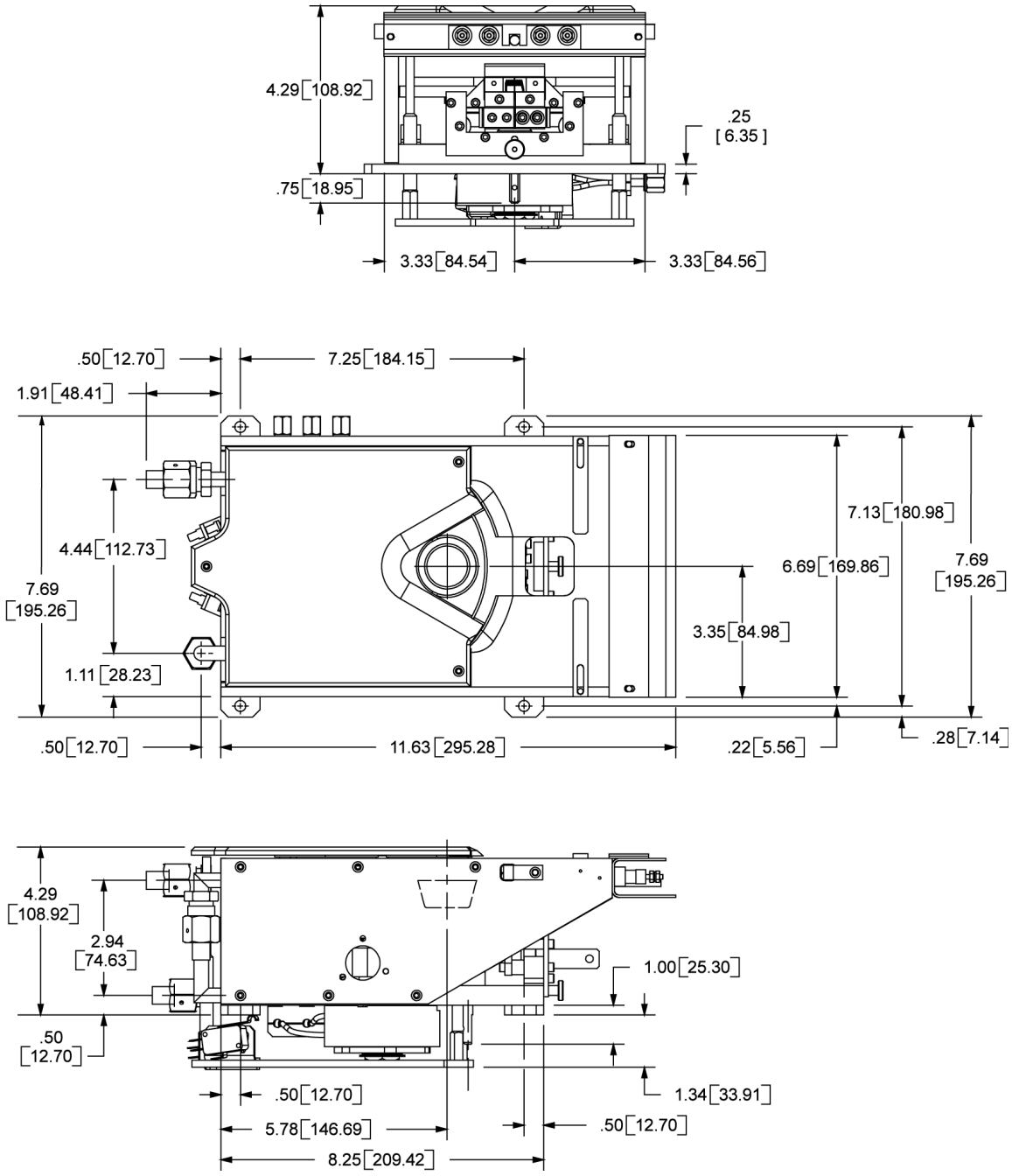
The electron beam is generated by the emitter assembly mounted at the front of the source. The primary parts of the emitter are an electron-emitting filament and a beam former. The filament is easily replaced, and the entire emitter can be quickly disassembled for cleaning.

Three emitters are available for 2PT and 3PT sources, that standard emitter (PN 0204-0284-0), the high-performance emitter, (PN 0916-8294-0), and the simple emitter (PN 0629-0514-0). For information on rebuilding any one of these emitters, see the videos available from Temescal Customer Service.

Regardless of which emitter is used in your source, its filament should last for 100-plus hours of operating time when the source is used for evaporating metals. Shorter filament lifetimes can be expected when the unit is used for evaporating dielectric materials, as these processes create an area of localized high pressure near the filament. For all other applications, short filament life is attributable to the following causes.

1. Improper installation of the filament.
2. Incorrect use of a deposition controller, which must never drive the source beyond its maximum rated output (10 kW for the 2PT source, 12 kW for the 3PT source). If the power request from the deposition controller remains too high for too long, the source's filament can burn out as a result of excessive applied power.

Figure 1-4 Dimensioned Views of 2PT Gun (Shown with High Performance Emitter)

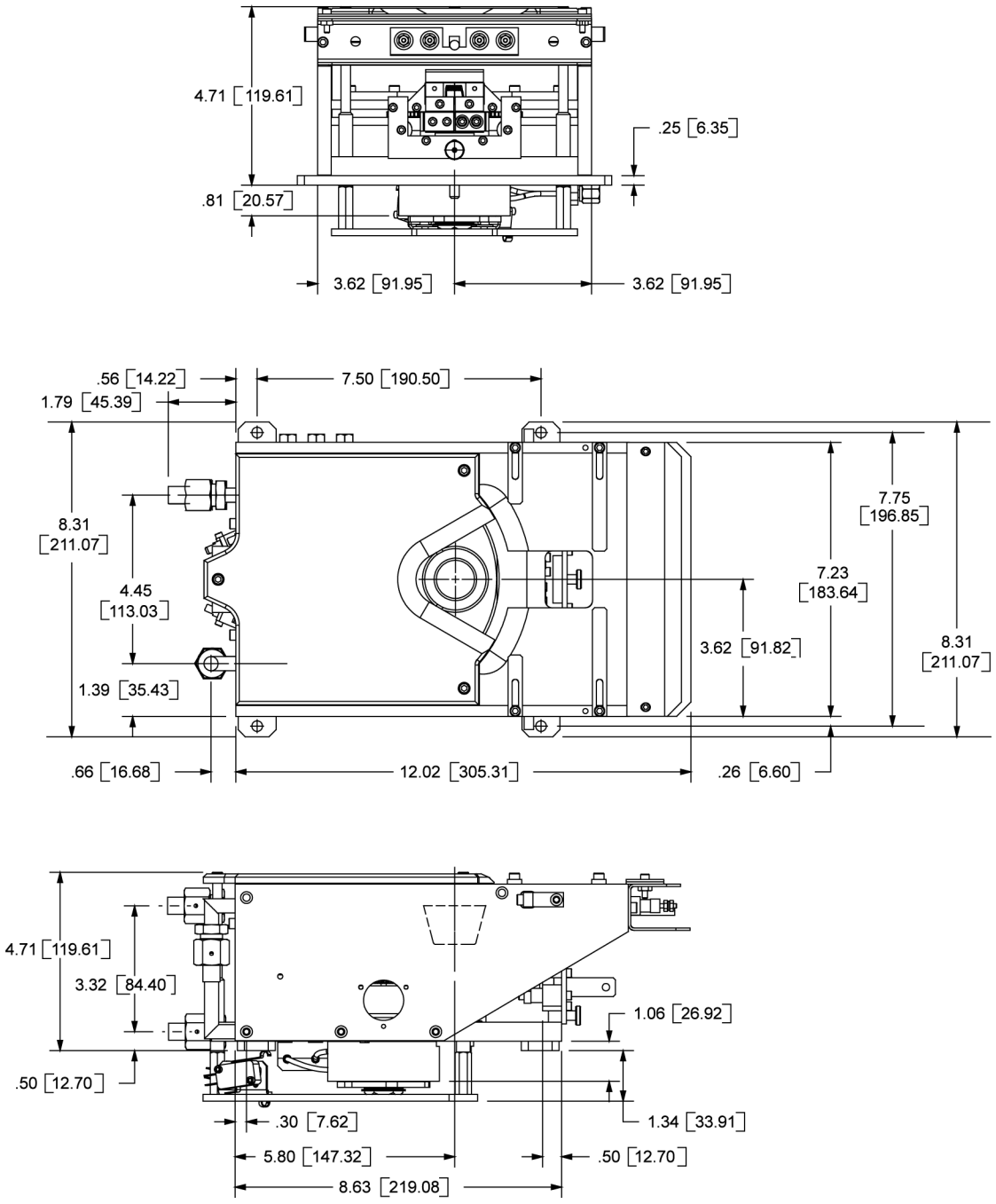


Drive Assembly

The source is designed so that when one pocket is in the `home' position, the others are shielded by the crucible cover. A ring gear fixed to the bottom of the crucible mounting flange mates with the gear on the end of the drive shaft, whose other end accepts a mechanical coupling. On the side-drive 2PT source, this end of the drive shaft extends horizontally from the housing. On bottom-drive models, the drive shaft extends beneath the source's baseplate. On both side-

drive and bottom-drive models, one turn of the drive shaft produces ¼ turn of the crucible.

Figure 1-5 Dimensioned Views of 3PT Gun (Shown with High Performance Emitter)



Cooling System

Water circulates through channels in the baseplate and the coil housing to ensure adequate cooling during operation. The water inlet and outlet are located on the rear of the source, as shown in Figure 2-7.

Magnetic Beam Deflection

The source's main magnetic field is produced by a permanent magnet mounted at the rear. Modified by the two pole pieces that form the sides of the source, this magnetic field bends the electron beam through its 270° arc and directs it into the exposed pocket. The beam's position within the pocket can be more precisely controlled by fields generated by a set of electromagnetic deflection coils mounted in the front end of the source. These fields also affect the beam's shape and concentration, which are further influenced by two sets of adjustable pole piece extensions. One set of these extensions is mounted on top of the source, while the other extends inside its coil housing. The 2PT source has a single pair of external pole piece extensions, while that 3PT source has two, as shown in Figure 1-2.

1.3 Specifications

Dimensions	See Figures 1-4 and 1-5
Weight	Model 2PT: 44.2 lbs. (20 kg) Model 3PT:50.3 lbs. (22.8 kg)
Rotation torque	10 in. lbs. (11.5 kg cm)
Maximum bakeout temperature	302° F (150° C)
Maximum power	Model 2PT: 10 kW Model 3PT: 12 kW
Acceleration voltage	4-10 kV
Evaporation rate	25,000 Å/min. of Aluminum at a source-to-substrate distance of 10 inches (254 mm)
Operating pressure range	
Maximum	5×10^{-4} Torr (6.7×10^{-4} mbar)
Minimum	1×10^{-8} Torr (1.33×10^{-8} mbar)
Beam characteristics	
Deflection	270°
Range of spot size/shape	From tight oval beam to diffuse oblong beam
Sweep capability	Longitudinal and lateral when operated with a sweep controller

1.4 Installation Requirements

1.4.1 Required Components

Feedthroughs

The feedthroughs listed below are required for installation of the source.

- One octal feedthrough rated for a minimum of 5 A at 600 V. Available from Temescal is PN 6047-5808-0, a 1"-dia., O-ring-sealed, high-current octal feedthrough that meets these requirements.
- Two HV feedthroughs rated for 1.5 A at 12k VDC and 70 A at 12 VAC. Available from Temescal is PN 0715-9033-0, a 1"-dia., O-ring-sealed HV feedthrough that meets these specifications.
- One rotary-motion feedthrough. Available from Temescal is PN 9999-0013-1, a 1"-dia. Ferrofluidic rotary feedthrough with ¼" input and output shafts. The rotary drive connected to this feedthrough can be either manually operated or motor driven.

> NOTE
> Whether the turret is manually rotated or motor driven, an external index controller is required to ensure that each rotation ends with the requested pocket correctly exposed in the 'Home' position.

- One air/water feedthrough. For 18-inch source trays, Temescal offers an air/water feedthrough (PN 0628-8264-2PTT20) for use with the 2PT source and another (PN 0628-8264-3PTT20) for 3PT sources. Also available are two air/water feedthroughs for 25-inch source trays, PN 0628-8264-2PTT44 for 2PT sources and PN 0628-8264-3PTT44 for 3PT sources. All four are pre-welded, O-ring-sealed feedthroughs precisely sized for use with the source in question. Maximum pressure rating for all four is 100 psig (7.0 kg/cm^2).

All required feedthroughs are included in Temescal's Feedthrough Kits. Kit 0503-0201-7 contains the octal, HV, and rotary feedthroughs listed above plus the pre-welded air/water feedthrough for the 2PT source (PN 0628-8264-2PTT20). Kit 0503-0201-8 contains the same octal, HV, and rotary feedthroughs plus the pre-welded air/water feedthrough for the 3PT source (PN 0628-8264-3PTT20).

Additional Required Components

In addition to the feedthroughs listed above, the following components are required to support the operation of a 2PT or 3PT source:

1. A system for rotating the crucible to the desired pocket. For best results, use Temescal's TemEbeam Controller EBC (PN 0620-7492-1), which also provides beam on/off control and sweep control. For a more detailed description, see section 1.5.3.
2. A water-flow switch that can be connected to the gun water interlock on the e-beam power supply. This switch should be set up so that the interlock is

made when the water pressure is above 3.0 gallons per minute (GPM). A suitable water-flow switch (PN 9102-0151-2) is available from Temescal.

3. A pressure interlock that will prevent the filament current from being on when vacuum chamber pressure is higher than 5.3×10^{-4} Torr.
4. Any additional interlock switches deemed necessary or desirable by the user.
5. A source shutter and shutter drive system, consisting of a shutter arm, a shutter, a rotary-motion feedthrough for the shutter drive, a shutter actuator mechanism, and a shutter control system. Temescal offers a shutter drive kit (PN 0413-4313-0) that includes a rotary feedthrough, a shutter drive assembly, a solenoid valve, an adjustable flow-control valve, plus all required interconnecting and mounting hardware. For a more detailed description of this kit, see section 1.5.5. Temescal also offers a manual Shutter Control Kit (PN 0611-4810-0) for use on systems without automated shutter control. For more detailed information about this kit, see section 1.5.6. Shutters and shutter arms must be ordered separately. For ordering numbers, contact Temescal Sales.
6. A flexible coupling for connecting the output shaft of the rotary-motion feedthrough to the source's drive shaft, As Figure 2-6, a second flexible coupling is required to connect the output shaft of the Index Drive assembly to the input shaft of the rotary feedthrough. However, that coupling is included with the Index Drive assembly. Also available from Temescal is a flexible coupling (PN 9015-0101-0) which accommodates a 1/4" shaft on one end and a 3/8" shaft on the other.
7. A stainless steel shield, similar to that shown in Figure 2-18, which is required to prevent the fields surrounding the high-voltage feedthroughs from affecting the gun's coil-current terminals. Temescal offers a ready-made HV shield like that shown in Figure 2-19. For 2PT source installations, order PN 0626-9024-0; for 3PT source installations, order PN 0626-9024-1. Note that these shields can be used only if the HV feedthroughs are located precisely as shown in Figure 2-2 with respect to the source.
8. Some means of actuating the pneumatic components that raise and lower the PopTop crucible cover on 2PT and 3PT sources.
9. Kapton-insulated wire and lugs for making connections between the octal feedthrough and the gun's PopTop Up and PopTop Down limit switches and its defection coils. For installations in Temescal systems, order PN 6342-1916-1 to obtain 16 feet of Kapton-insulated wire, PN 6044-0359-0 to order high-temperature 16-14 AWG ring lugs to connect the Kapton-insulated wire to the deflection coils, and PN 6044-2230-0 to obtain female quick-disconnect spade connectors to connect the same wire to the PopTop limit switches. For customers installing 2PT or 3PT sources in non-Temescal systems, the Kapton-insulated wire and connecting hardware are included in the PopTop Electrical Installation kit (PN 0620-9720-0).
10. Appropriate hardware for mounting the source on the system's source tray. For this purpose, Temescal offers Mechanical Installation Kit PN 0629-4540-0 for use with the 2PT source and Mechanical Installation Kit PN 0629-4550-0 for use with the 3PT source.

CAUTION

It is critical to isolate the coil-current leads from the effects of the high voltage. Failure to provide adequate isolation for these leads will result in erratic beam position control and may result in damage to other system components. Beam sweep controllers are particularly vulnerable to the effects of high-voltage interference and arcing.

Minimum Required Installation Set

Systems in which a 2PT or 3PT source is to replace an existing turret source may already be equipped with Items 1-7 in the list above. In that case, the minimal installation set for a PopTop source would be:

- A 2PT or 3PT source base unit plus desired crucible(s) and crucible cover(s). See section 1.5.1 for ordering numbers for crucibles and covers.
- One PopTop Gun Mechanical Installation Kit (PN 0629-4540-0 for the 2PT source, PN 0629-4550-0 for the 3PT source)

Customer's installing a 2PT or 3PT source in a non-Temescal system will also need to purchase a PopTop Electrical Installation kit. Use of Temescal's TemEbeam Controller (PN 0620-7492-2 or -3) is strongly recommended for all users.

1.4.2 Utility Requirements

Electrical Power

To produce an electron beam, the source must be powered by an electron-beam power supply capable of providing up to 35 A of filament current at 12 VAC and up to 1.5 A of emission current at 4-10k VDC (10 kW max. for 2PT sources, 12 kW max. for 3PT sources). A separate circuit must supply a beam position control current of up to 4 A at 13 VDC to the gun's deflection coils. If beam-sweep control is desired, it must be supplied by a beam sweep controller. On systems without a beam sweep controller, this current is supplied by the e-beam power supply.

Source Cooling Water

Max. Temperature	68° F (20° C)
Flow rate	3.0 gpm (0.19 liter/sec)
Max. inlet pressure	100 psi (6890 mbar)
Min. pressure differential	50 psi (3445 mbar)

CAUTION

Inadequate water flow may result in severe damage to the source. Damage resulting from an inadequate supply of cooling water is not covered by its warranty.

Compressed Air

Compressed air must be supplied to raise the gun's PopTop cover. If the optional PopTop Air Installation Kit (PN 0733-0524-0) is used, the facility regulator supply this compressed air must be set to a maximum pressure of 85 psi.

1.5 Source Accessories

1.5.1 Additional Crucibles

Tables 1-1 and 1-2 list the part numbers of the crucibles and crucible covers currently available for the 2PT and 3PT sources.

Table 1-1 Crucibles and Crucible Covers Available for 2PT Sources

FOUR-POCKET CRUCIBLES	
Description	**Part Number**
4 × 15-cc pockets	0715-8444-0
4 × 25-cc pockets	0715-8454-0
2 × 7-cc pockets + 2 ×15-cc pockets	0715-8464-0
2 × 15-cc pockets + 2 × 25-cc pockets	0715-8494-0
1 × 7-cc pocket + 1 × 15-cc pocket + 2 × 25-cc pockets	0715-8474-0
SIX-POCKET CRUCIBLES	
Description	**Part Number**
Six 7-cc pockets	0715-8514-0
Six 15-cc pockets	0715-8504-0
EIGHT-POCKET CRUCIBLE	
8 x 15-cc pockets	0626-7464-0
CRUCIBLE COVERS	
Description	**Part Number**
Cover for use with 4-pocket crucibles	0627-8144-1
Cover for use with 6-pocket crucibles	0627-4854-1
Cover for use with 8-pocket crucibles	0715-8163-0

Table 1-2 Crucibles and Crucible Covers Available for 3PT Sources

FOUR-POCKET CRUCIBLES	
Description	**Part Number**
4 × 40-cc pockets	0626-1204-0
4 × 60-cc pockets	0626-1214-0
SIX-POCKET CRUCIBLES	
Description	**Part Number**
6 × 25-cc pockets	0626-1224-0
6 × 30-cc pockets	0626-1234-0
4 × 25-cc pockets + 2 × 15-cc pockets	0627-5644-0
5 × 25-cc pockets + 1 × 15-cc pockets	0627-4764-0
EIGHT-POCKET CRUCIBLE	
8 x 15-cc pockets	0626-7464-0
CRUCIBLE COVERS	
Description	**Part Number**
Cover for use with 4-pocket crucibles	0627-2764-1
Cover for use with 6-pocket crucibles	0627-2964-1
Cover for use with 8-pocket crucibles	0629-7494-0

1.5.2 Crucible Liners

Optional crucible liners available from Temescal increase evaporation rates by reducing heat transfer between the evaporant and the water-cooled crucible. They also allow particulate-free pocket replenishment and reduce the risk of cross-contamination when one material replaces another in a given pocket. Liners are available in the following materials:

- Molybdenum. These are high-strength inserts machined from solid-rod molybdenum. When considering the use of these liners, users should be aware that some metals alloy with molybdenum.
- Tungsten. In most respects, tungsten liners are suitable for the same range of applications as molybdenum liners. The one significant difference is that tungsten has a higher melting point than molybdenum.
- Graphite. These liners are machined from ATJ-grade solid-rod graphite. Materials such as pure gold, silver, and copper do not alloy with graphite and are easily removed from the insert.
- POCO graphite. Liners made of this material are effective in aluminum evaporation processes. Their use impedes the formation of aluminum carbide.

Table 1-3 lists the part numbers for the crucible liners available for the 2PT and 3PT sources.

Table 1-3 Part Numbers for Crucible Liners Available for 2PT and 3PT Sources

Size	7 cc	15 cc	25 cc	Tall 25 cc (for use in 6 × 25-cc crucibles)	40 cc
Tungsten (Lanthanated)	0627-6152-1L	0627-6152-3L	0627-6152-5L	0627-6152-6L	0627-6152-7L
Molybdenum	0627-6162-1	0627-6162-3	0627-6162-5	0627-6162-6	0627-6162-7
AJT Graphite	0627-6172-1	0627-6172-3	0627-6172-5	0627-6172-6	0627-6172-7
Poco Graphite	9998-9004-0	9998-9013-0	0515-2212-1	0627-6172-6P	9998-9008-1

1.5.3 TemEbeam Controller (EBC)

The TemEbeam Controller (EBC) is a rack-mountable unit designed to control three or more components in an e-beam deposition system. In its current configuration, the TemEbeam Controller enables control in any of four operating modes over the following components/functions:

- **E-beam power supply:** The EBC monitors and provides on/off control over the HV, the gun (i.e., the filament current). The EBC's Ebeam Control module also enables control over the HV and emission power requests.
- **Beam position and sweep control:** The EBC enables position/sweep control over any e-beam source with +4 A to –4 A coil current output. Users can program and store up to 10 sweep programs per pocket on board the EBC. Sweep waveforms available from the EBC include sine, clipped, sawtooth, and ramped. In addition, sweep programs based on arbitrary waveforms can be downloaded from external sources. When the EBC is operating in its Remote mode, up to eight sweep programs per pocket can be selected by a higher-level controller.
- **Turret rotation:** The EBC enables rotation control over any compatible e-beam source with up to 10 pockets. The EBC provides uni- or bidirectional rotation in either the clockwise or the counterclockwise direction.

The PopTop Electrical Kit (PN 0620-9720-0) includes all the parts and wiring required to connect the EBC's Indexer Drive unit to a 2PT or 3PT source.

1.5.4 Shutter Drive Kits

Two Shutter Drive Kits (PNs 0413-4313-0 and 0413-4313-1) are available from Temescal. Each kit includes:

- a shutter drive assembly plus 3" extension rod and rod holder
- an adjustable rotary actuator
- a solenoid valve plus tubing and elbows for connecting the solenoid's output ports to the rotary actuator
- an adjustable flow-control valve

- a rotary-motion feedthrough
- hardware for mounting these components.

The two kits are identical, except that 0413-4313-0 has a 120 VAC, 60 Hz solenoid and 0413-4313-1 has a 24 VDC solenoid. Note that source shutters and shutter mounting arms are not included in these kits. Numerous combinations of shutters and shutter arms are available from Temescal. Contact Temescal Sales for assistance in ordering these items.

1.5.5 Manual Shutter Control Kits

For systems without automated source shutter control, Temescal offers two different manual shutter control kits. The Single Shutter Control Kit (PN 0611-4810-0) consists of:

- a rack mountable box containing one toggle switch and a 120 VAC relay
- a cable for connecting the control box to the shutter-drive solenoid

The Dual Shutter Control Kit (PN 0611-4810-1) provides a control box with two toggle switches plus cables for connecting the control box to two shutter-drive solenoids. Users implementing either of these shutter control kits should also order Temescal's 120 VAC shutter drive kit (PN 0413-4313-0).

1.5.6 Ancillary Shielding

The following items may be required for operation of the source, depending on the application and whether the source is to be installed on a source tray alongside another e-beam source.

- A shield for secondary electrons. When the source is used to evaporate materials with high atomic weights, such as tungsten or gold, numerous electrons may bounce off the evaporant pool and be deflected over the rear of the gun. These electrons, which are known as *secondary electrons,* may strike the water lines or the nearby chamber wall, damaging either or both over time. If your application entails this hazard, a stainless-steel shield should be mounted so that it extends above the rear of the source.
- If two sources are being installed on one source tray, shielding against mutual interference between their magnetic fields is required. Such shielding should be made of thin sheets of mumetal and stainless steel loosely bolted together. Figures 2-20 and 2-21 illustrate two methods of installing such a shield.

2 Installation in a Temescal System

2.1 Section Overview

This section provides the information required for the installation of a 2PT or a 3PT source in a Temescal system. Specific topics, by subsection, are:

NOTE

Read the following specifications and instructions carefully before installing the source. The installation procedures and safety precautions described below are very specific and must be adhered to closely. Taking a casual attitude toward any of these measures may result in inefficient or unsafe source operation. Bear in mind that the source is powered by a high-voltage power supply with its own installation and safety requirements. Consult the power supply's manual for additional information relating to source installation and interconnection, paying particular attention to instructions concerning interlocks.

2.2 Unpacking the Contents of Base Unit Kits

Remove the source from its shipping container. While unpacking, check the contents of the container against the packing list. Any discrepancy between the parts list and the actual parts received should be reported to Temescal representatives. Before disposing of the packaging, inspect all parts for any damage that may have occurred during shipment and verify that the gun is in good working order. If you discover that the source has been damaged in shipment, report that damage immediately to the carrier and to Temescal Customer Service.

NOTE

To minimize vacuum system contamination, always wear rubber or lint-free linen gloves when handling the source, any of its parts, or any other component that will be used inside the vacuum chamber.

Each order for a 2PT or 3PT gun should include:

- one base unit kit
- one crucible
- one crucible cover
- one emitter assembly
- one spare parts kit for the emitter assembly

Purchase of either the Simple Emitter (PN 0629-0514-0) and its spare parts kit (PN 0629-0260-0) or the High-Performance Emitter (PN 0916-8294-0) and its spare parts kit (PN 0916-8300) is strongly recommended.

2.2.1 Contents of a 2PT Base Unit Kit

A base unit kit for a 2PT source (PN 0626-4365-0) includes the following items:

- an assembled 2PT base unit (i.e., a bottom-drive 2PT source minus crucible, crucible cover, and emitter)
- four shunt bars
- Cross-contamination inserts for both four-pocket and six-pocket crucibles
- one spare parts kit (PN 0627-3050-0) for the source
- One pair of in-vacuum HV leads plus attachment hardware
- one 7/64" ball-end Allen driver with specially molded sleeve for retaining a 76-32" socket-head screw
- one 10-24 × 1-3/4" stainless steel thumbscrew for use in crucible installation and removal
- a CD containing a copy of this manual

Temescal also offers a side-drive 2PT base unit kit (PN 0626-4345-0), whose contents are identical with the above, except that a side-drive shaft is provided instead of a bottom-drive shaft.

2.2.2 Contents of 3PT Base Unit Kit

A base unit kit for a 3PT source (PN 0627-2805-0) includes the following items:

- an assembled 3PT base unit (i.e., a bottom-drive 3PT source minus crucible, crucible cover, and emitter)
- Cross-contamination inserts for both four-pocket and six-pocket crucibles
- four shunt bars
- one spare parts kit (PN 0627-3050-0) for the source
- one 7/64" ball-end Allen driver with specially molded sleeve for retaining a 7/64" socket-head screw
- one 9/64" ball-end Allen driver with specially molded sleeve for retaining an 8-32" socket-head screw
- one 10-24 × 1-3/4" stainless steel thumbscrew for use in crucible installation and removal
- a CD containing a copy of this manual

NOTE

2PT and 3PT base units ship with anti-cross-contamination inserts for both four- and six-pocket crucibles, regardless of which type of crucible is supplied as part of a particular order. The smaller, nearly cube-shaped copper inserts (PN 0715-8173-1) are for use with four-pocket crucibles, crucibles with one banana-shaped pocket, and continuous-trough evaporant carousels. The longer, arc-shaped inserts (PN 0715-8173-2) are for use with six-pocket crucibles. Take care not to lose or damage the set of inserts that will not be used initially. You will need these inserts should you later switch to a crucible that requires their use.

2.3 Installation Preliminaries

2.3.1 Source Tray Layout Requirements

This section describes the source tray layout requirements for installation of a 2PT or a 3PT gun and its required feedthroughs. If you do not have a source tray that can be readily modified, consider contacting Temescal Sales regarding the purchase of a source tray ready-made for that purpose.

NOTE

The source should be mounted only on a source tray made of type-304 stainless steel or some other nonmagnetic material. Mounting the source on a surface made of magnetic material will severely distort the source's magnetic field.

Source Mounting Location

First determine the gun's precise orientation and mounting position on the source tray. The optimal mounting location should be determined by the following factors:

- The source must be mounted so that the exposed pocket is positioned correctly with respect to the system's substrate fixturing. The source's precise mounting position is determined by the location of the rotary feedthrough for the turret drive. The center of that feedthrough should be exactly 0.5 inches from the source tray's center point along the gun's longitudinal axis, as shown in Figure 2-1. If you are installing a Temescal air/water feedthrough designed for use with a PopTop source, that feedthrough must also be installed in the exact location shown in Figure 2-2.
- The operator must have a clear view of the exposed pocket through the viewport. On systems with deposition shutters, the viewport must be low enough to allow a clear line of sight beneath the shutter to the exposed pocket. On such systems, providing a clear line of sight over the raised crucible cover will require positioning the source with its front end pointing from 30° to 60° away from the viewport. On systems without deposition shutters, the viewport can be at any height, and the source can be positioned at almost any angle with respect to the viewport. However, for safety reasons, the source should never be mounted so that either its front or rear end faces a viewport.

CAUTION

Do *not* mount the source so that the viewport is either directly in front of the source or directly behind it. Under certain conditions, the full-strength electron beam can be directed toward those areas. The result could be severe injury to anyone looking through the viewport.

Figure 2-1 Locations of Rotary and Air/Water Feedthroughs

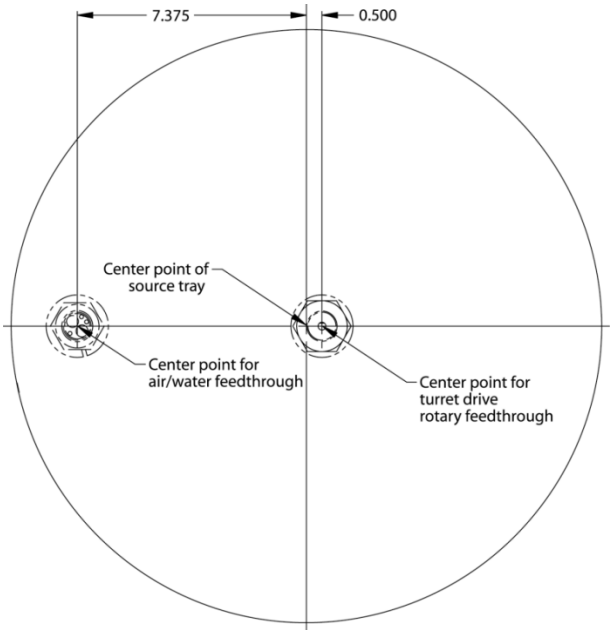


Figure 2-2 shows the precise distances between the center of the rotary feedthrough and the centers of the holes in the gun's four mounting tabs. Figure 2-2 also shows the recommended mounting positions for the octal feedthrough, the HV feedthroughs, and the rotary feedthrough for the source shutter for PT source installations on 18-inch source trays.

Figure 2-2 18-Inch Source Tray Layout

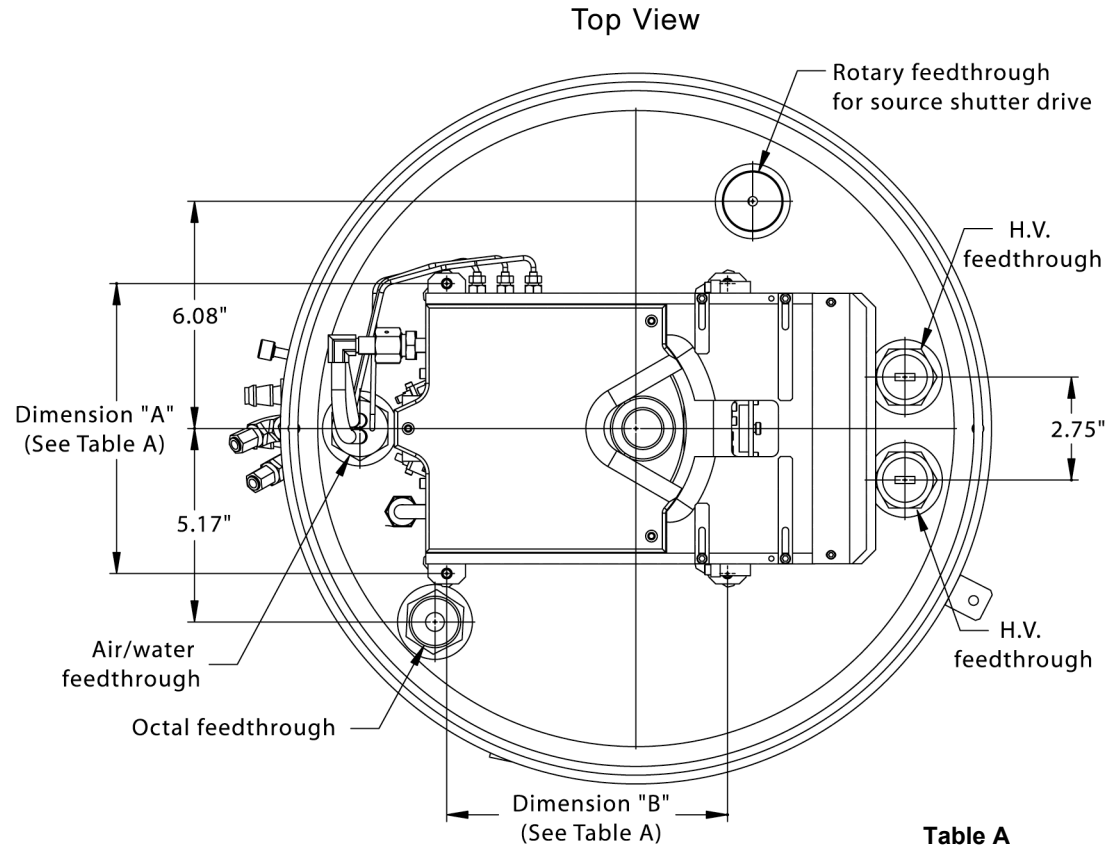
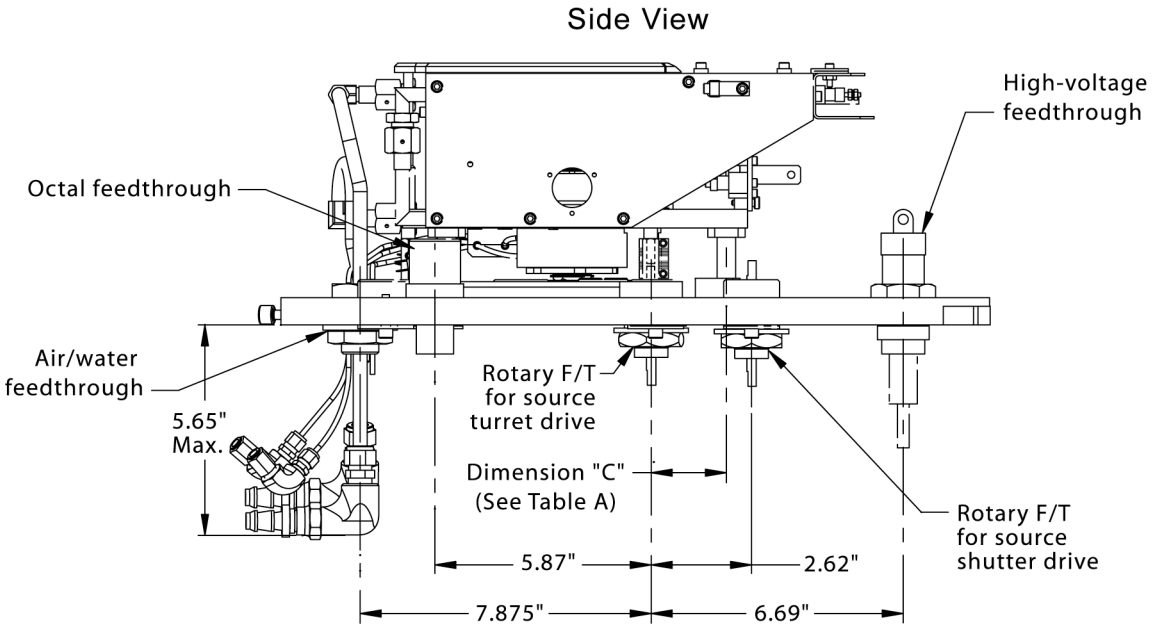


Table A

Source	2PT	3PT
Dimension “A”	7.120	7.750
Dimension “B”	7.250	7.500
Dimension “C”	1.430	1.945



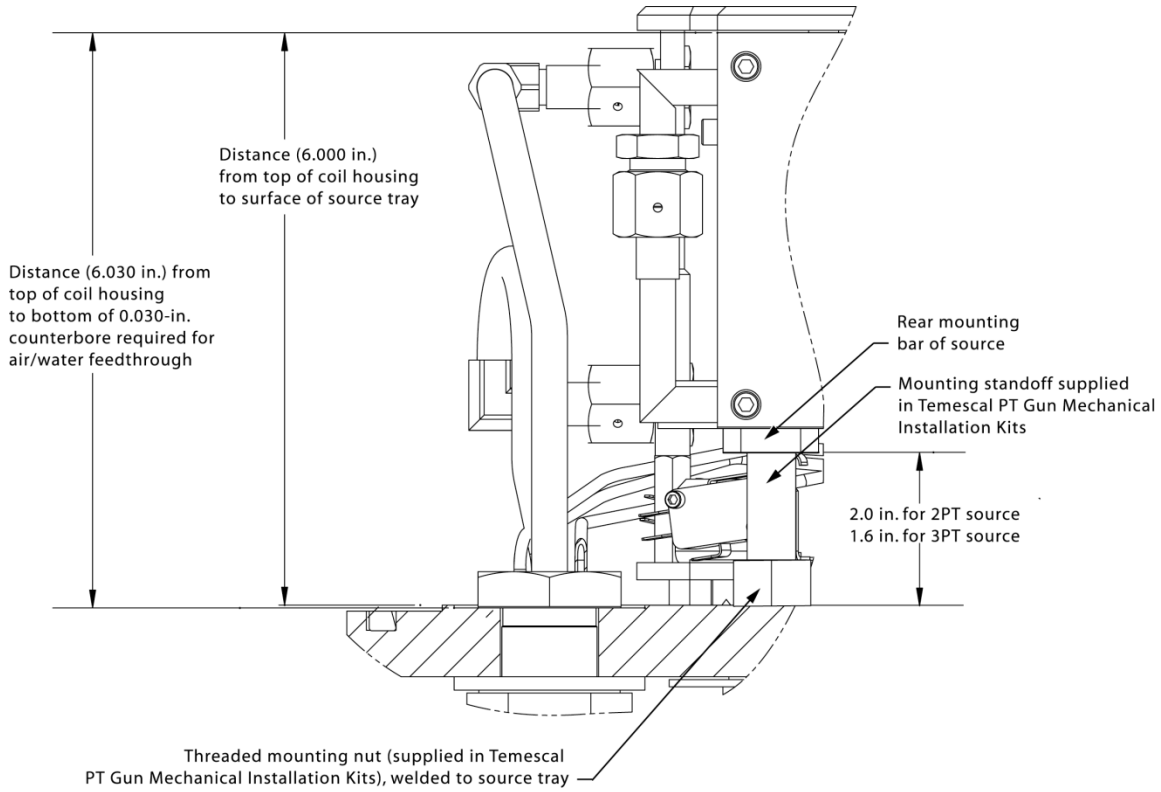
In side-drive installations, the rotary feedthrough must be aligned as precisely as possible with the gun's drive shaft. In practice, this is difficult to achieve with complete precision, so the coupling and shaft extension used must provide enough flexibility to compensate for any misalignment between the rotary feedthrough and the gun's drive shaft. For this reason, the use of a flexible drive shaft extension and a flexible coupling (PN 9015-0121-3) is recommended.

If two sources are to be installed on one source tray, there are additional requirements, as described in section 2.7.

Required Mounting Heights for PopTop Guns

The source must be mounted so that the top of its coil housing (i.e., the topmost surface of the base unit without the crucible cover) is exactly 6.0 inches above the source tray. This height requirement ensures that the water lines on a pre-welded Temescal PopTop air/water feedthrough can be without stress to the gun's water inlet and outlet. For 2PT sources, the 6.0-in. mounting height requires a clearance of 2 in. between the source tray and the mounting bars attached to the source baseplate. For the taller 3PT source, this clearance must be 1.6 in. These clearances provide sufficient space beneath the source for its cover actuation components to function without obstruction. Figure 2-3 shows the correct mounting heights for PT sources.

Figure 2-3 Required Mounting Height for PT Sources



Mounting standoffs of the correct height plus threaded mounting nuts are supplied in Temescal's PopTop Gun Mechanical Installation Kits (PN 0629-4540-0 for the 2PT gun, PN 0629-4550-0 for the 3PT gun). Also included in these kits are lock washers and ¼-20 mounting bolts of appropriate lengths.

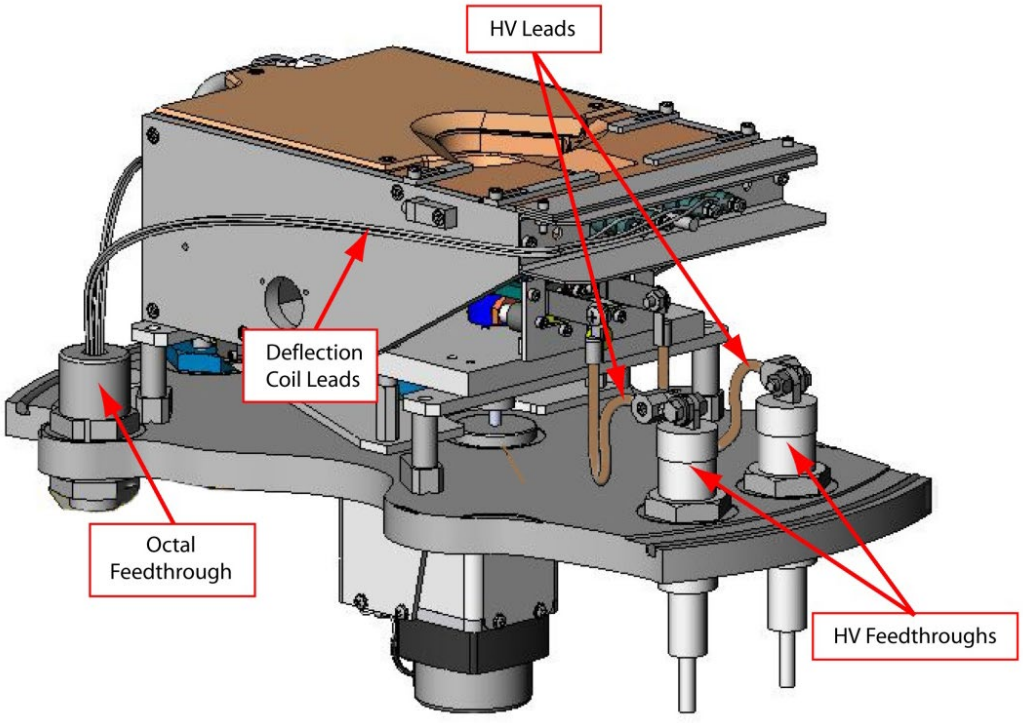
NOTE

Customer-supplied standoffs and threaded mounting tabs (if used) must be made of type-304 stainless steel or some other nonmagnetic material. Their top and bottom surfaces must be square and flat to ensure optimal contact with surfaces above and below them. The gun's mounting straps, the standoffs, and the threaded mounting tabs must provide a secure path to ground for the high-voltage current that will pass through the gun.

Locations of HV and Octal Feedthroughs

The high-voltage feedthroughs should be mounted beside each other somewhere in front of the source, perhaps slightly off to one side. The octal feedthrough should be mounted to one side of the source, ideally as far from the high-voltage feedthroughs as possible. Mounting the octal feedthrough in the location specified in 2-2 makes it possible to route the deflection coil leads along the inside of the coil shield (see Figure 2-4), so that its lower lip shields them optimally from the HV feedthroughs. If the high-voltage feedthroughs are not mounted squarely in front of the source, the deflection coil leads should ideally run along the side of the source opposite the side toward which the HV feedthroughs are offset.

Figure 2-4 Correct Feedthrough Placements and Routing of Deflection Coil Leads



NOTE

Do <u>not</u> mount the octal feedthrough in front of the source, between the two high-voltage feedthroughs. That arrangement makes it impossible to isolate the coil-current leads from the effects of the high voltage.

2.3.2 Preliminary Procedures

Step	Action
1	Make sure that the facility circuit breaker supplying power to the e-beam power supply is switched off and locked/tagged out, in accordance with local safety codes.
2	Power down the sweep controller (or EBC, if your system is already equipped with one).
3	Lower the source tray and swing it out into its service position.
4	Shut off the supply of 24VDC power to the vacuum cubicle. If required to do so by local regulations, lock out and tag out this supply.
5	Shut down the supplies of facility water and compressed air to the system. If local regulations require it, lock out and tag out these supplies per those regulations.
6	Next, blow down the water circuit that will supply cooling water to the source.
7	Touch all HV components already installed within the vacuum cubicle with a properly connected grounding hook.
8	If you are replacing an existing e-gun with a PopTop gun, remove the source shutter, the debris and HV shields, and the gun.
9	Remove any of the existing components that are to be replaced during the PT gun installation procedure.
10	If your system is already equipped with an EBC, skip this step and proceed to Step 11. Otherwise, perform substeps a) through d) below. a) Install the EBC, following the instructions described in Section 3 of the EBC manual. When connecting the EBC's Sweep Coil Drive Cable (PN 0620-9120), follow the procedure described below in section 2.4.5. b) If the EBC is to be under the control of a higher-level controller, perform the additional installation procedures described in either section 6.2, 7.3, 8.2, 9.2, or 10.2, depending on which type of higher-level controller the EBC will be operating under and, if the higher-level controller is a PLC-based system controller, on how it communicates with the EBC. c) Perform the basic configuration procedures described in Section 4 of the EBC manual.

d) If the EBC is to be under the control of a higher-level controller, perform the additional configuration procedures described in either section 6.3, 7.3, 8.3, 9.3, or 10.3, depending on which type of higher-level controller the EBC will be operating under and, if the higher-level controller is a PLC-based system controller, on how it communicates with the EBC.

11 Configure The EBC's Turret Control module for the number of pockets in the new source. For instructions on doing so, see section 4.5.3 in the EBC manual.

2.4 Installation Procedures

The following procedures assume that you are using the following Temescal components:

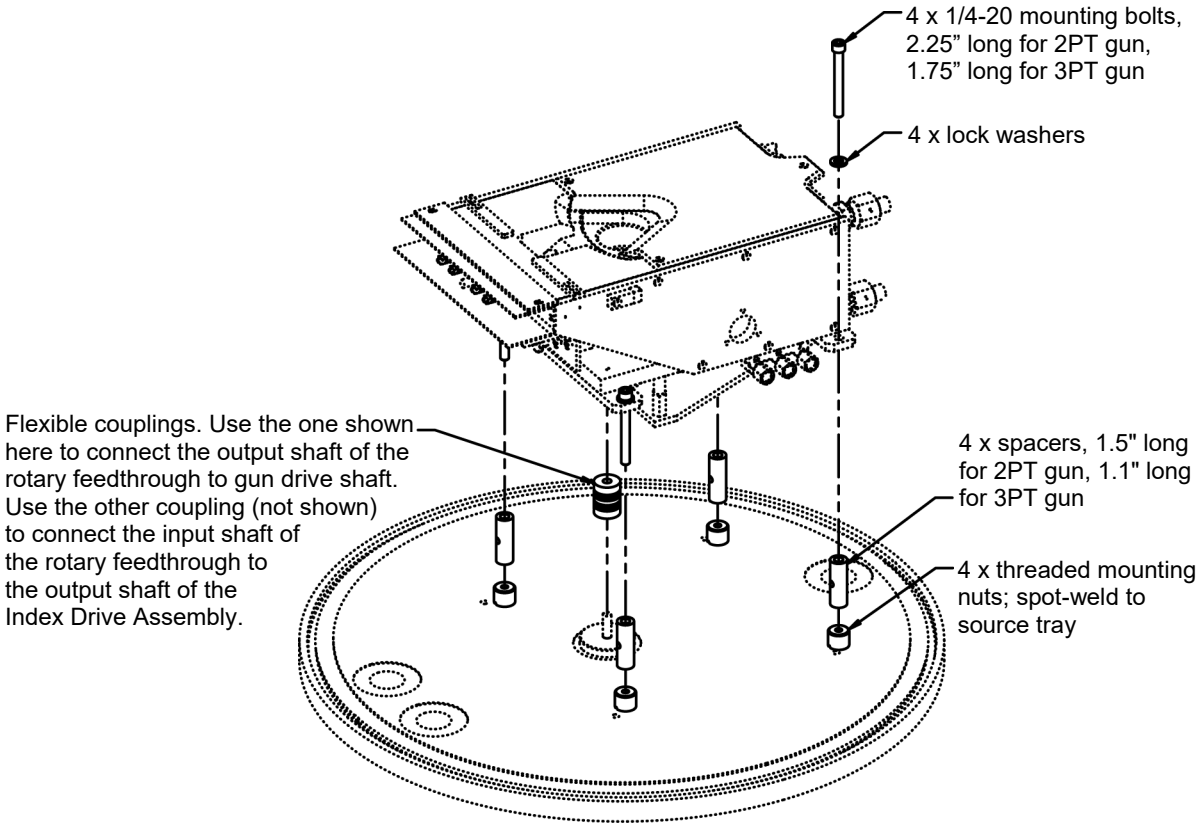
- PopTop Feedthrough Kit (PN 0503-0201-7 for 2PT source, PN 0503-0201-8 for 3PT Source)
- PopTop Gun Mechanical Installation Kit (PN 0629-4540-0 for the 2PT gun, PN 0629-4550-0 for the 3PT gun)
- either Air Kit PN 0627-3010-2 or 0627-3010-4, depending on whether your system has an Allen-Bradley PLC or a Beckoff SLC
- TemEbeam Controller (PN 0620-7492-1)
- Temescal HV shield (PN 0626-9024-0 for 2PT gun, PN 0626-9024-1 for 3PT gun). **NOTE:** These shields can be used only if the HV feedthroughs are located precisely as shown in 2-2 with respect to the source.

2.4.1 Mount the Source on the Source Tray

This section describes how to mount the source using one of Temescal's PopTop Gun Mechanical Installation Kits (PN 0629-4540-0 for the 2PT source, PN 0629-4550-0 for the 2PT source). Figure 2-5 shows the contents of those kits. For information about the correct source mounting location, see section 2.3.1, with particular reference to Figures 2-1 and 2-2

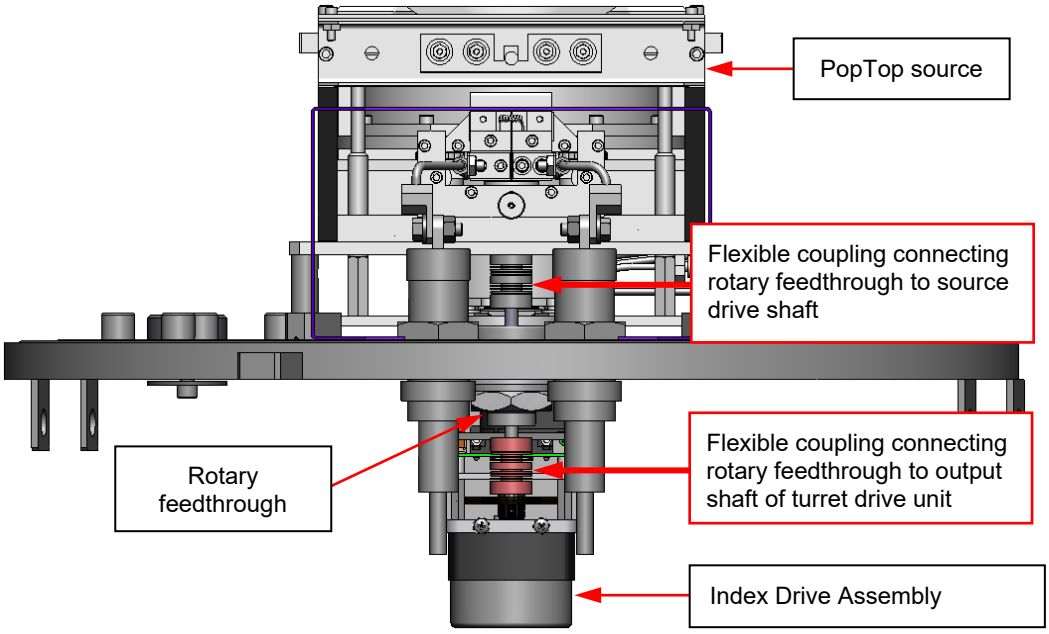
The following procedure assumes that all feedthroughs, except for the Temescal PopTop Air/Water Feedthrough, have been installed and that the threaded mounting bolts for the source have been correctly spot-welded in the correct positions on the source tray.

Figure 2-5 Parts Included in PT Gun Mechanical Installation Kits



Step	Action
1	Place the four mounting standoffs in place atop the mounting nuts spot-welded to the source tray.
2	Set a flexible coupling in place on the rotary feedthrough's output (i.e., vacuum-side) shaft and tighten the setscrew that secures the coupling to the shaft (see Figure 2-6).
3	Lower the source into its mounting position, taking care to ensure that its drive shaft extends into the flexible coupling that you installed in Step 2.
4	Put the mounting bolts and lock washers in place and thread the bolts a few turns into the mounting nuts. Do not tighten the bolts at this point.
5	Adjust the position of the flexible couple so that it is equidistant from the top of the rotary feedthrough and the bottom of the source's spider plate. If necessary, loosen the coupling's lower set-screw in order to adjust its position. Then tighten both of its set-screws.

Figure 2-6 Flexible Couplings Required in PopTop Gun Installations



6 Make sure that this flexible coupling is not distorted or under obvious lateral stress and that the shafts it connects are aligned with each other. If necessary, adjust the position of the gun slightly. Then tighten the gun's mounting bolts.

2.4.2 Connect the In-Vacuum HV Leads

Perform the procedure described below to connect the HV leads between the emitter bus bars and the in-vacuum side of the HV feedthroughs.

Step Action

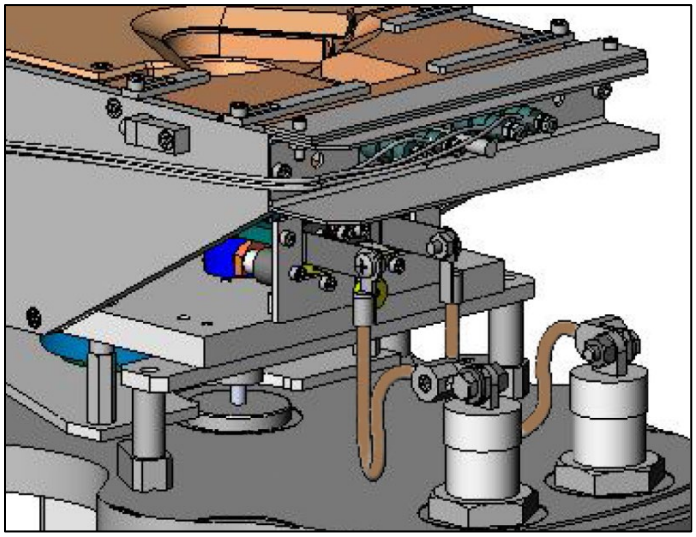
1 Each of the high-voltage leads supplied with the source has a lug crimped onto one end. Using the nuts and bolts provided with the HV leads, secure these lugs to the emitter assembly's bus bars.

2 Route the other end of each lead to the nearest feedthrough without crossing them and with a bend like that shown in Figure 2-7. Then cut the leads to length.

DANGER: HIGH VOLTAGE

The HV leads must NOT touch the source tray or any other grounded component or structure.

Figure 2-7 Required Bends in Installed HV Leads



3 Attach the supplied mounting hardware to the unterminated ends of the HV leads and connect that mounting hardware to the terminals on the HV feedthroughs.

2.4.3 Install the Temescal Air/Water Feedthrough and Connect It to System Water Supply and Return Lines

The following procedure describes how to install the air/water feedthrough. If the source is to be mounted on an 18 ″ source tray, this will be either PN 0628-8264-2PTT20 (for the 2PT source) or PN 0628-8264-3PTT20 (for the 3PT source). If the source is to be mounted on a 27.5″ source tray, you will use either PN 0628-8264-2PTT44 (for the 2PT source) or PN 0628-8264-3PTT44 (for the 3PT source). The installation procedure is the same regardless of which of these feedthroughs is used.

NOTE

The following procedure assumes that the 1" hole for the air/water feedthrough is located precisely as indicated in 2-1 and that the required 2" × 0.030" counter bore is in place around this hole.

Step	Action
1	Remove the O-ring from the feedthrough and coat the O-ring with Krytox lubricant. Then put it back in place in the feedthrough's groove.
2	Insert the feedthrough into the hole previously drilled in the source tray so that the feedthrough's vacuum-side water and air fittings are adjacent to the source inlets and outlets that mate with them (Figure 2-8).
3	Put the feedthrough's washer in place below the source tray and screw on its attachment nut until it is finger-tight.
4	Screw the feedthrough's water line fittings onto the source's water inlet and outlet ports and tighten the fittings.

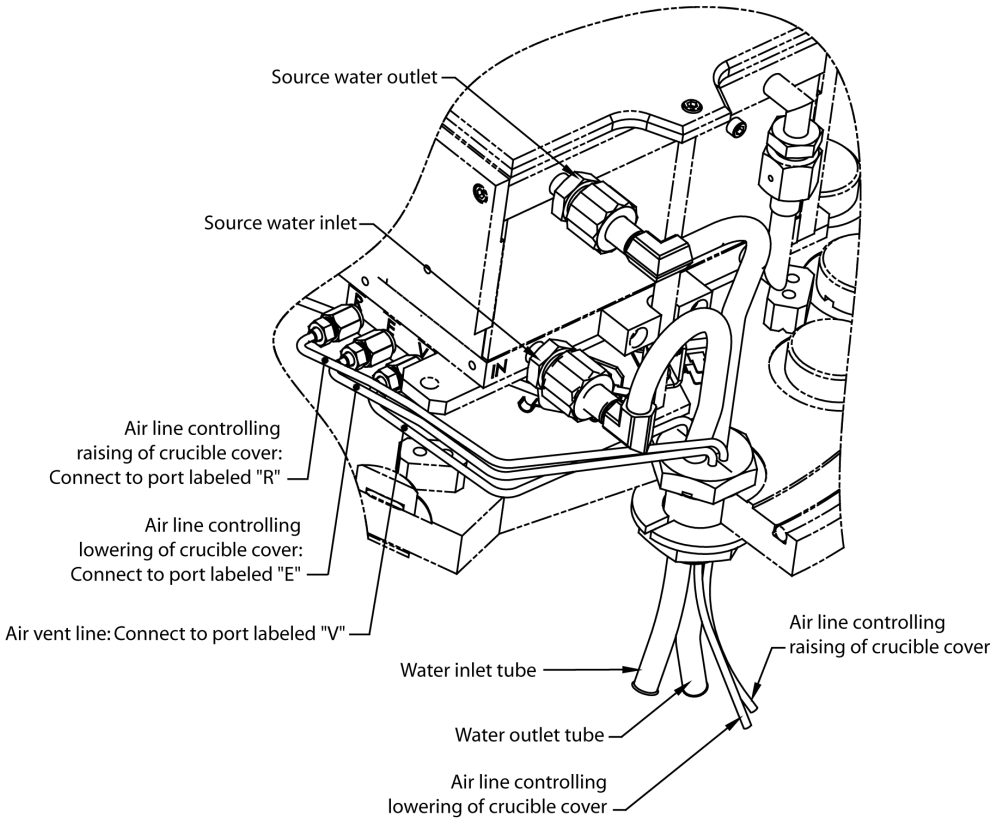
CAUTION

The water lines must be connected as shown in Figure 2-8, with the supply line connected to the gun's lower external water junction and the return line connected to the gun's upper external water fitting.

5 Place a 1/8-in. VCR gasket into the air ports marked R, E, and V on the side of the source (see Figure 2-8).

6 Screw the feedthrough's air fittings into the appropriate ports on the source, as shown in Figure 2-8. Tighten the fittings enough to prevent air leakage.

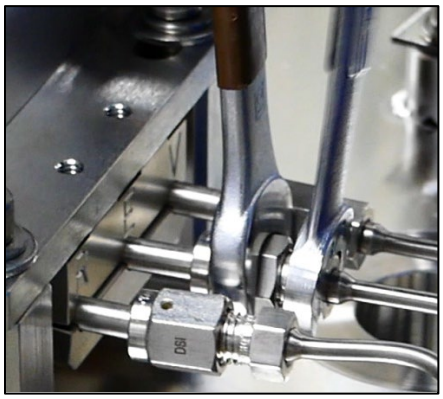
Figure 2-8 Connecting Temescal PopTop Air/Water Feedthrough Lines to Source



CAUTION

Take care when connecting the fittings on the air/water feedthrough's pneumatic tubes those connected to the source's E, R, and V pneumatic ports. When doing so, it's essential to use a 7/16" end wrench to hold the fittings on the source side in place while using another 7/16" end wrench to tighten the fittings on the ends of the tubes running to the feedthrough, as shown in Figure 2-9. Failure to observe these precautions risks damaging the source's external pneumatic lines.

Figure 2-9 Correct Method of Tightening Fittings Attached to Source's External Pneumatic Lines

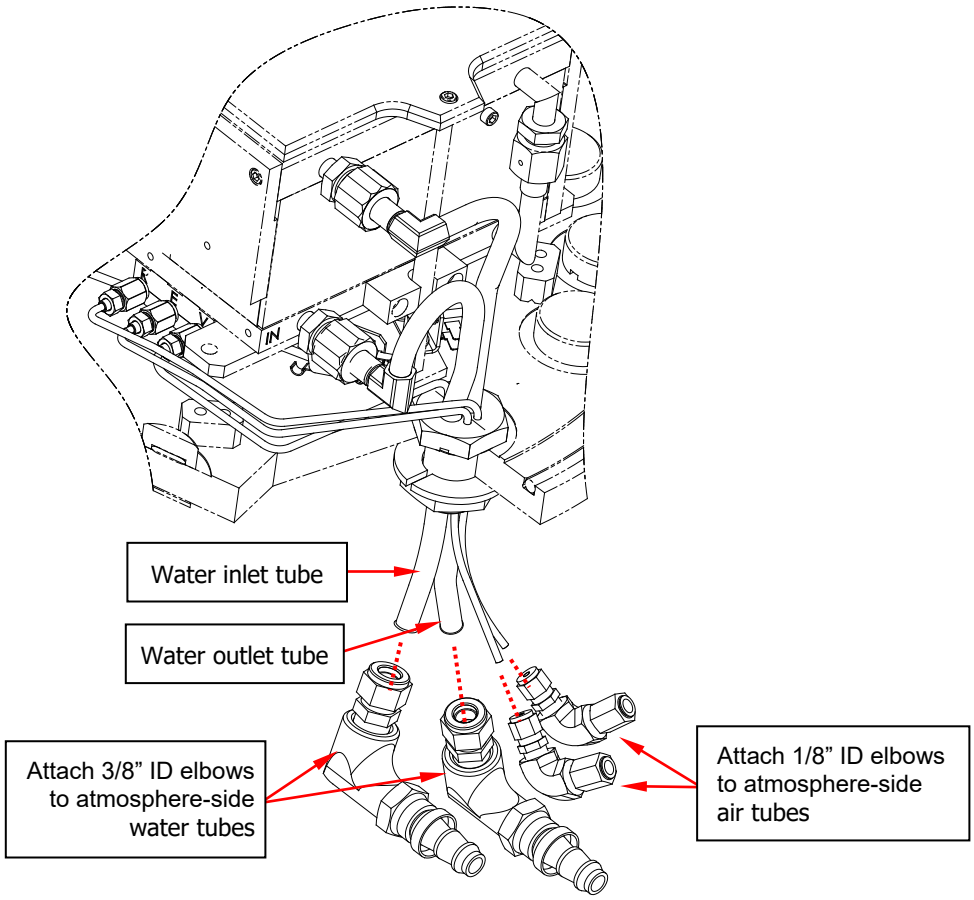


CAUTION

Connecting the vent line to a source of pressurized air will result in damage to or failure of the air cylinder's bellows.

7 Attach the 3/8" elbows supplied with the feedthrough to its water inlet and outlet tubes (see Figure 2-10).

Figure 2-10 Attaching Fittings to Air/Water Feedthrough's Atmosphere-Side Tubes



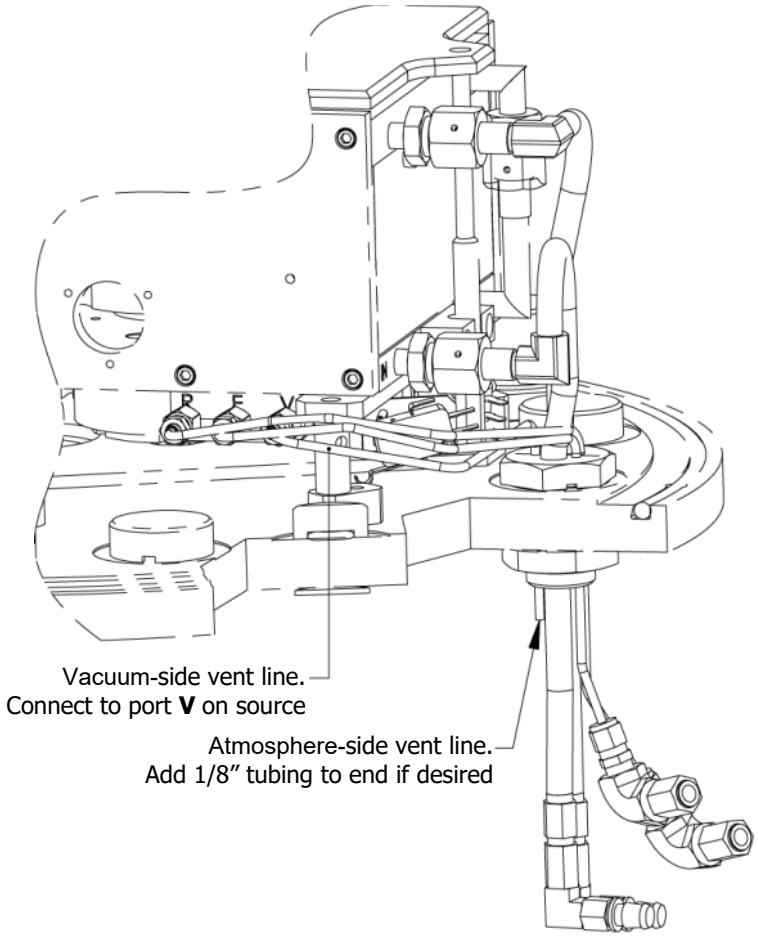
8 Attach the system's water supply line to the elbow you attached to the feedthrough's water inlet tube (see Figure 2-10).

9 Attach the system's water return line to the elbow you attached to the feedthrough's water return tube (see Figure 2-10).

10 Attach the 1/8" ID elbows supplied with the feedthrough to the atmosphere-side air tubes, as shown in Figure 2-10.

11 Figure 2-11 shows the short atmosphere-side end of the feedthrough's vent line, which is connected to the source port marked **V** for vent line. If desired, attached a length of 1/8" tubing this tube.

Figure 2-11 The Air/Water Feedthrough's Vent Tube



2.4.4 Connect the System's Pneumatic Supply and Return Lines to the Air/Water Feedthrough

The following procedure describes how to install either Air Kit PN 0627-3010-2 or 0627-3010-4, depending on whether your system has an Allen-Bradley PLC or a Beckoff SLC. Note that the procedure is identical regardless of which Air Kit

you are installing, as the only difference between the two Air Kits is their solenoids.

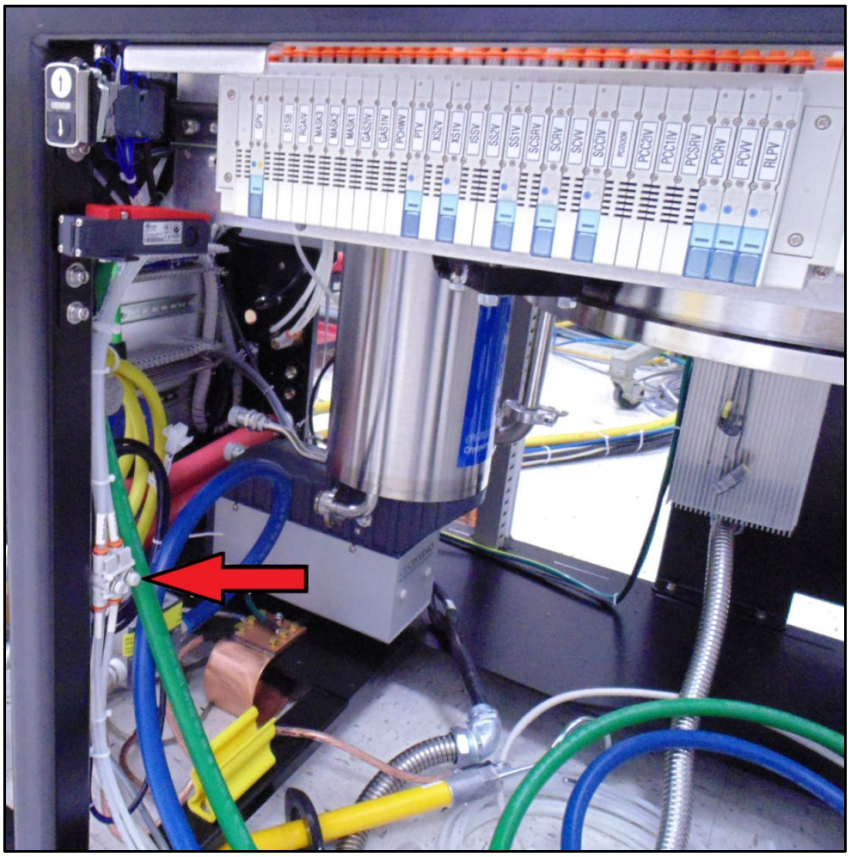
If you're installing a PopTop gun in a non-Temescal system or in a Temescal system without a pneumatic manifold, perform the procedure described in section 3.4.7 instead of the following.

Step	Action
1	Figure 2-12 shows the elbows and fittings that are to be attached to the ends of the longer air tubes of the air/water feedthrough. Assemble the fittings to the elbows and press the elbows onto the ends of these tubes, if similar elbow-fitting assemblies are not already attached.

Figure 2-12 Fittings To Be Attached to Air Tubes of Air/Water Feedthrough

2	Insert the Air Kit's solenoid valve into an empty slot in the system's pneumatic manifold. In modern Temescal systems, this will be a pre-assigned slot labeled **PTV**.
3	Tie-wrap the two speed controllers supplied in the Air Kit it to the vacuum cubicle's frame, at a location somewhere near the pneumatic manifold (see Figure 2-13).

Figure 2-13 Appropriate Location for Mounting of Speed Controllers



4 Cut two lengths of the 1/8”-ID tubing supplied with the kit, making them long enough to reach from speed controllers to the ports labeled **2** and **4** in the pneumatic manifold adjacent to the solenoid valve you installed in Step 2. Leave enough slack so that the tubing can be tie-wrapped to the vacuum cubicle’s frame.

5 Connect these two lengths of tubing to the pneumatic manifold ports specified above and to the upper ports of the two speed controllers and tie-wrap the tubing in place.

6 Cut two more lengths of tubing so that they reach from the speed controllers to the air tubes on the atmosphere side of the air/water feedthrough, leaving enough slack so that the tubing can be tie-wrapped in place.

7 Connect the tubing from pneumatic port **2** adjacent to the PTV solenoid valve to the fitting on the end of the air tube in the air/water feedthrough that connects to pneumatic port **E** on the source (see Figure 2-8).

8 Connect the tubing from pneumatic port **4** adjacent to the PTV solenoid valve to the fitting on the end of the other air tube in the

air/water feedthrough (i.e., the air tube that is connected to pneumatic port **R** on the source).

9 Tie-wrap these lengths of tubing to the vacuum cubicle frame and to other appropriate structures within the cubicle.

2.4.5 Make Atmosphere Side Connections to the Deflection Coil Circuit

Making Atmosphere-Side Deflection Circuit Connections when Replacing an SS64 with an EBC

Perform the following procedure if you are replacing a Temescal SS64 beam sweep controller with an EBC.

Step	Action
1	Switch off the input power to the SS64, unplug its power cable, and disconnect the ground wire connected to its rear panel.
2	Disconnect the Sweep Coil Drive cable from the SS64 rear panel.
3	Remove the SS64 from the operator station.
4	Connect the Sweep Coil Drive cable to the EBC's rear panel SWEEPER COILS connector.

Making Atmosphere-Side Deflection Circuit Connections if not Replacing an SS64

Perform the following procedure if you are installing an EBC with a sweep control board in a system not previously equipped with an SS64.

Step	Action
1	Connect the amphenol connector on one end of the Sweep Coil Drive cable (PN 0620-9102-0) to the **SWEEPER COILS** connector on the EBC rear panel.
2	Modern Temescal systems have deflection circuit connections pre-wired to the atmosphere side of octal feedthrough, with a male Molex connector labeled SWEEPPG on the other end of those wires. Connect the female Molex connector (also labeled SWEEPPG) on the other end of the Sweep Coil Drive cable to that male Molex connector. If you are installing the EBC in an older Temescal system or in a non-Temescal system, perform the procedure described in section 3.4.3.

2.4.6 Make Atmosphere-Side Connections for the PopTop Limit Switches

Next make the atmosphere-side electrical connections required for the PopTop limit switches. If your system's vacuum cubicle is pre-wired with a cable terminating in a female Molex connector labeled PTLSPG, perform the procedure described immediately below. If your system's wiring harness does not include a female Molex connector labeled PTLSPG, perform the procedure describe below under the heading "Using the PopTop Electrical Installation Kit to Make Atmosphere-Side Connections for the PopTop Limit Switches."

Step	Action
1	Remove the black connector that is attached to the underside (i.e., the atmosphere side) of the body of the octal feedthrough.
2	Remove the metal cap from this connector. To do so, insert a flat-bladed screwdriver into one of the rectangular slots at the top of the cap and gently pry against the flange that forms the top of the connector. Pry the cap loose as far as you can using this slot, then insert your screwdriver in the other slot in the cap and repeat the process. If necessary, once a gap is visible between the cap's top edge and the connector's top flange, you can insert the screwdriver into this gap and pry the cap the rest of the way loose. When prying, take care not to damage either the thin metal of the cap or the connector body.
3	Remove the Molex pin connector from the Pin 1 slot in Molex connector PTLSPG.
4	Clip the wire that's connected to this pin connector just short of it.
5	Strip about 1/8-inch of insulation off the end of this wire and solder the bare wire end to Pin 5 on the atmosphere side of the octal feedthrough.
6	Remove the Molex pin connector from the Pin 2 slot in Molex connector PTLSPG.
7	Clip the wire that's connected to this pin connector just short of it.
8	Strip about 1/8-inch of insulation off the end of this wire and solder the bare wire end to Pin 6 on the atmosphere side of the octal feedthrough.
9	Remove the Molex pin connector from the Pin 3 slot in Molex connector PTLSPG.
10	Clip the wire that's connected to this pin connector just short of it.
11	Strip about 1/8-inch of insulation off the end of this wire and solder the bare wire end to Pin 7 on the atmosphere side of the octal feedthrough.
12	Remove the Molex pin connector from the Pin 4 slot in Molex connector PTLSPG.

13 Clip the wire that's connected to this pin connector just short of it.

14 Strip about 1/8-inch of insulation off the end of this wire and solder the bare wire end to Pin 8 on the atmosphere side of the octal feedthrough.

15 Snap the metal cap back into place on the black connector shown above and push this assembly back onto the bottom of the feedthrough. Note that the shaft in the center of the feedthrough is keyed, so the black connector can be installed only in one orientation.

16 If necessary, tighten the clamp screws on the bottom of the metal cap.

Using the PopTop Electrical Installation Kit to Make Atmosphere-Side Connections for the PopTop Limit Switches

This section describes how to use Temescal's PopTop electrical kit (PN 0620-9720-0) to make atmosphere-side connections for the PopTop limit switch circuit. The Electrical Kit (PN 0620-9720-0) is designed for use with Temescal's EBC and Air Installation Kit (PN 0733-0524-0), and it provides the circuitry required to support the operation of the PopTop cover, including:

- connections between the PopTop limit switches and the EBC's rear-panel **Indexer Control** and **Aux I/O** connectors
- on systems that lack a pneumatic manifold and must employ the PopTop Air Installation Kit, circuitry that controls the solenoid that actuates up-down motion of the PopTop cover.

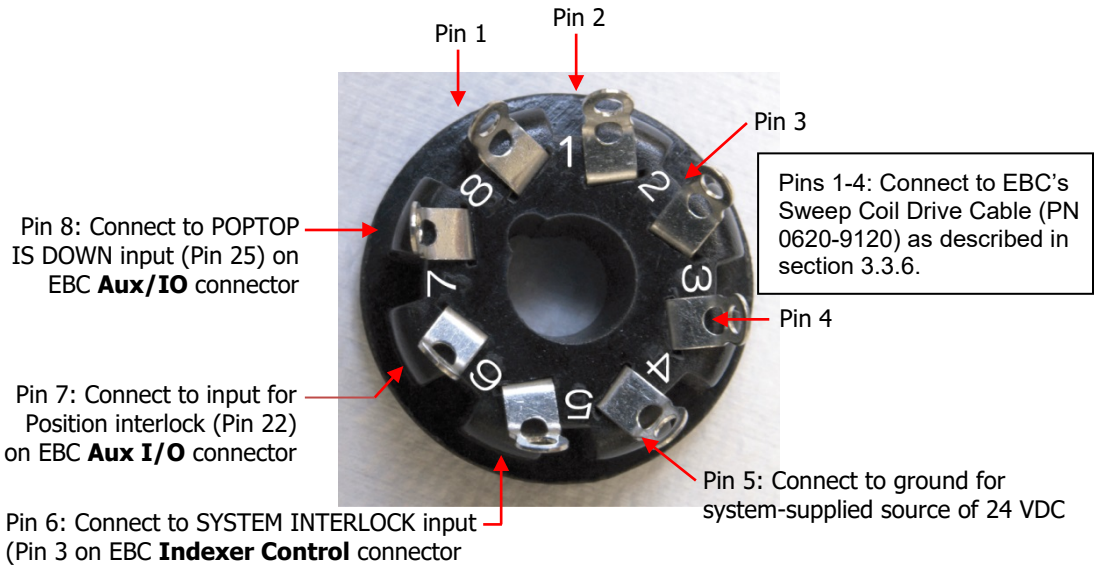
Referring to 620-9722, the schematic for the PopTop Electrical Installation Kit, make only the required connections to the PopTop limit switches, disregarding the portion of the schematic the pertains to the PopTop solenoid.

Step Action

1 Remove the black connector and metal cap from the atmosphere side of the octal feedthrough. To do so, perform Steps 1 and 2 of the procedure described immediately above.

2 Make the connections shown in Figure 3-14 to Pins 5-8 on the connector that you just removed.

Figure 3-14 Connections to Atmosphere Side of Octal Feedthrough



3 Snap the metal cap back into place on the black connector shown above and push this assembly back onto the bottom of the feedthrough. Note that the shaft in the center of the feedthrough is keyed, so the black connector can be installed only in one orientation.

4 If necessary, tighten the clamp screws on the bottom of the metal cap.

2.4.7 Make Connections to the In-Vacuum Terminals of the Octal Feedthrough

Making Connections Between the Octal Feedthrough and the Deflection Coils

Step	Action
1	Using a 1/16" Allen wrench, loosen the three set-screws that secure the metal cap to the ceramic connector on top of the octal feedthrough. Then remove the cap.
2	Remove the ceramic connector from the top end of the feedthrough. Note the numbers molded into the raised ceramic ring that surrounds this connector's terminals (see Figure 2-16).
3	Sixteen feet of Kapton-insulated wire is supplied in the PopTop Electrical Installation Kit. Cut four lengths of that wire that will extend easily from the octal feedthrough to the deflection coil terminals.
4	Strip about 1/8-inch of insulation from both ends of these leads.

5 Solder one end of each of these leads to Terminals 1-4 on the feedthrough connector you removed in Step 3 of this procedure.

6 Feed the other ends of these leads through the feedthrough cap you removed in Step 2 of this procedure.

7 Crimp ring-type lugs provided in the Electrical Installation Kit onto the other end of each deflection coil lead.

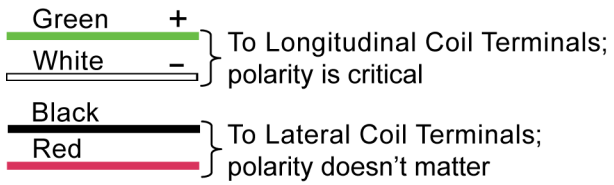
8 Route these leads neatly to the deflection coil terminals, approximately as shown in Figure 2-4.

CAUTION

It is critical route the deflection coil leads between the lips of the coil shield, as shown in Figure 2-4. Doing so helps to isolate the deflection coil leads from the effects of high voltage. Failure to achieve this isolation will result in erratic beam position control and may damage various system components. Beam sweep controllers are especially vulnerable to the effects of high-voltage interference and arcing.

9 Attach the lugs on the ends of these leads to the deflection coil terminals so that the continuity between the terminals and the leads of the Sweep Coil Drive cable attached to the atmosphere side of the octal feedthrough is as shown in Figure 3-15.

Figure 3-15 Correct Continuity Between Sweep Coil Drive Cable Leads and Coil Terminals



If you installed the Sweep Coil Drive cable as described above under the heading ” Making Deflection Coil Connections if not Replacing an SS64,” then the in-vacuum coil leads should be connected as follows:

- Pin 1: To + Longitudinal terminal
- Pin 2: To − Longitudinal terminal
- Pin 3: To either Lateral terminal
- Pin 4: To either Lateral terminal

If you left in place a Sweep Coil Drive cable whose conductors were previously soldered to terminals on the atmosphere side of the octal feedthrough, check to see which pins those colored leads are actually connected to. Connect the in-vacuum coil leads so that continuity is as shown in Figure 3-15. The legends stamped into the coil shield’s top surface indicate which terminals are connected to the lateral coils and which are connected to the longitudinal coil. The polarity of the longitudinal coil’s terminals is indicated on the same surface.

Making Connections between the Octal Feedthrough and the PopTop Limit Switches

Step	Action
1	Cut four 10-inch lengths of Kapton-insulated wire and strip the insulation from both ends of each piece of wire.
2	Crimp and solder 3/16-inch female spade connectors onto one end of each of these wires. Appropriate spade connectors are available in the PopTop Electrical Installation Kit or under Temescal PN 6044-2230-0.
3	Feed the other ends of wires through the octal feedthrough cap you removed in Step 2 of the preceding procedure.
4	Solder these wire ends to terminals 5 through 8 of the octal feedthrough connector you removed in Step 3 of the preceding procedure.
5	Connect these wires as shown in Figure 2-16 to terminals on the PopTop Up and PopTop Down limit switches. Specifically: • Connect Pin 8 or the octal feedthrough to the **NC** terminal on the PopTop Up switch to Pin 8 • Connect Pin 7 to the common terminal on the PopTop Up switch • Connect Pin 6 to the **NO** terminal on the PopTop Down switch • Connect Pin 5 to the common terminal on the PopTop Down switch common terminal. Figure 2-17 identifies the two PopTop limit switches. Figures 2-18 and 2-19 indicate which the terminals on each limit switch must be connected to which terminals on the octal feedthrough.

Figure 2-16 Connections to Vacuum Side of Octal Feedthrough

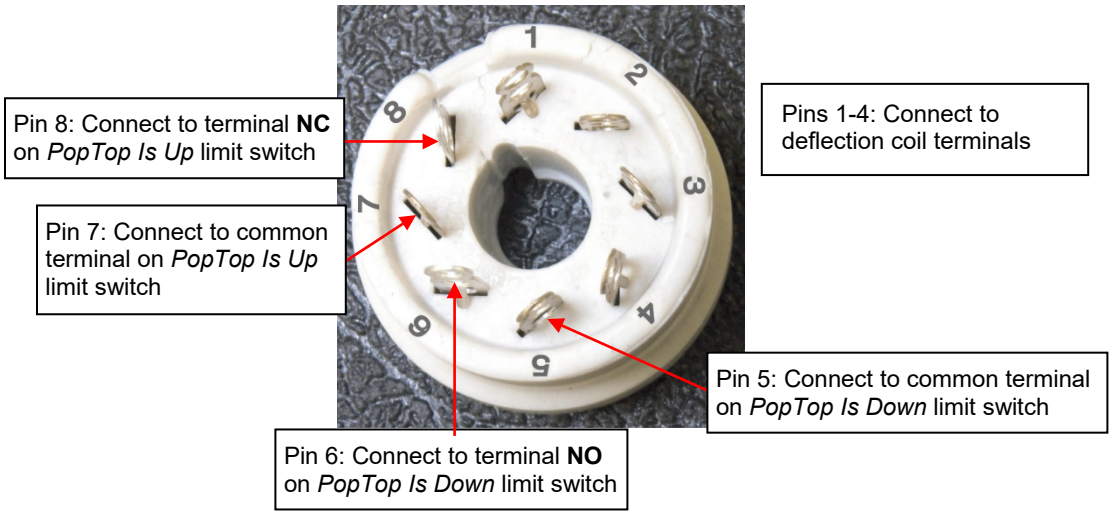


Figure 2-17 PopTop Limit Switches

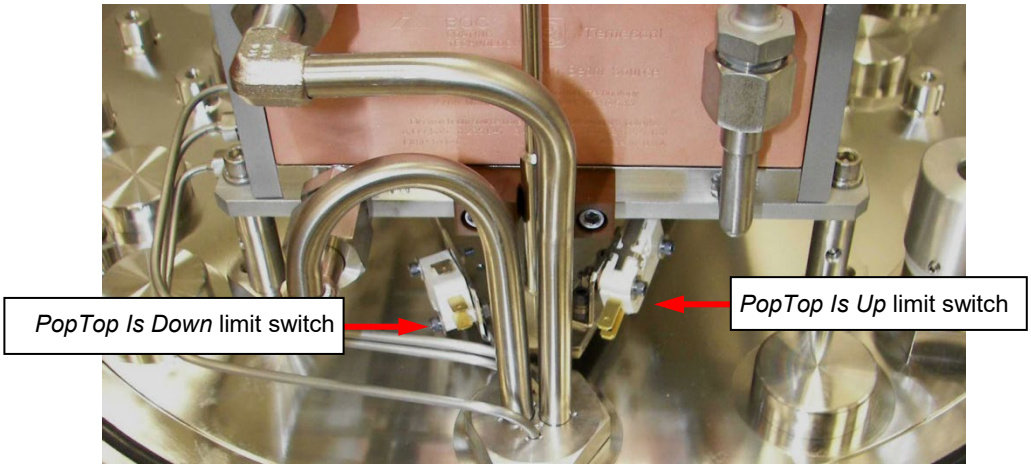


Figure 2-18 Terminals on *PopTop Is Up* Limit Switch

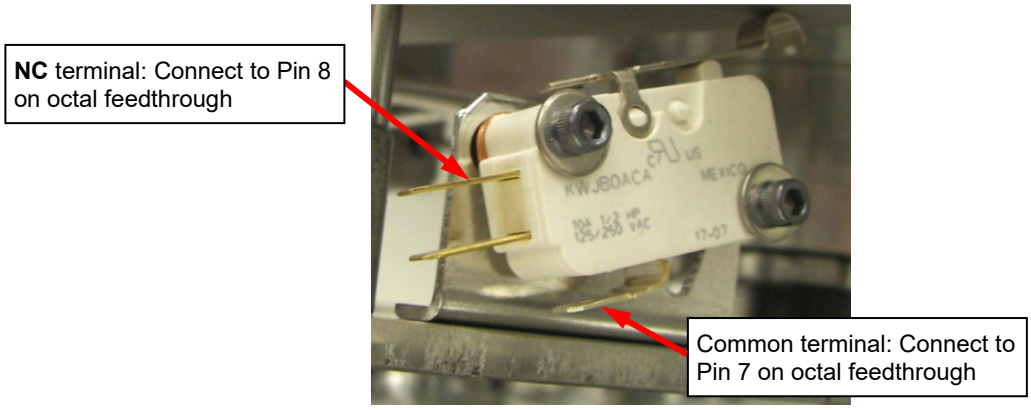
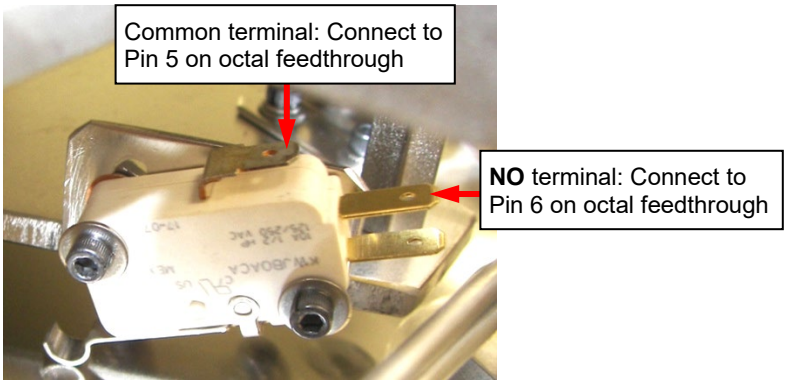


Figure 2-19 Terminals on *PopTop Is Down* Limit Switch



6 Insert the ceramic connector back into the top of the octal feedthrough.

7 Replace the metal feedthrough cap on top of the ceramic connector and retighten the two set-screws that secure the former to the latter.

2.4.8 Adjust the PopTop Limit Switches

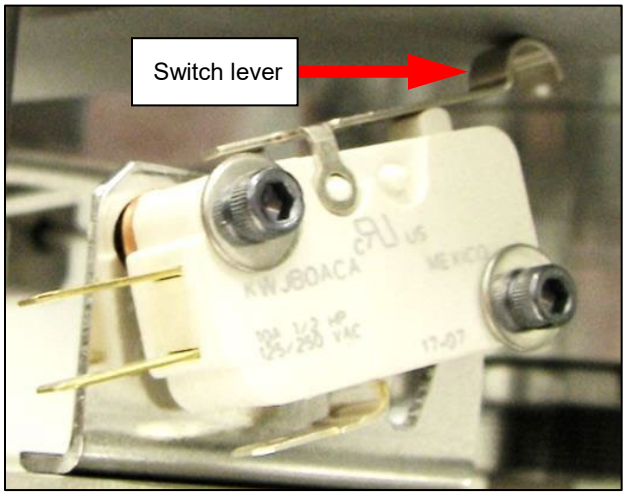
The PopTop Up and PopTop Down limit switches are located in the back of the source, as shown in Figure 2-17. Both switches must be adjusted so that they are open when the PopTop cover is all the way up and closed when the cover is all the way down.

CAUTION

When adjusting the limit switch positions, take care not to overtighten the screws that secure the switches in place, as doing so can break the plastic switch body. However, it is essential to tighten these screws enough to prevent the switches from rotating as the PopTop moves up and down.

Step	Action
1	Restore power to the circuit supplying 24VDC electricity to the system.
2	Use the system's automated control system to command the PopTop cover to go up. To do so on a Temescal system, touch the **Source Poptop Go Up** button on the Service Source 1 screen when the cover is closed. When the cover is in the fully raised position, check the position of the switch lever atop the PopTop Up limit switch. That lever should be fully depressed but not bent downward at the end. Figure 2-20 shows the correct lever position. If the lever's position is incorrect, loosen the two socket-head screws that secure the limit switch in place and adjust it as necessary. Then retighten the screws. When the lever of this switch is in this position, **Source Poptop Go Up** on the Service Source 1 screen should be highlighted green.

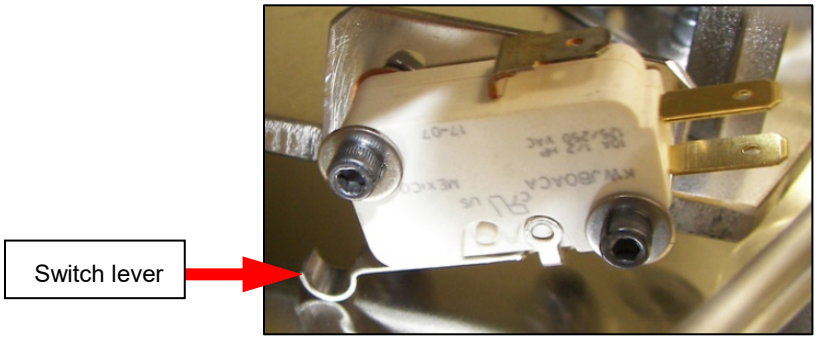
Figure 2-20 Correct Position of Switch Lever on *PopTop Is Up* Limit Switch when PopTop Cover Is Fully Raised



3	Using the system's automated control system, command the PopTop cover to go down. To do so on a Temescal system, touch the **Source Poptop Go Up** button when the cover is in the fully-raised position. When the cover is all the way down, check the position of the switch

lever atop the PopTop Down limit switch. That lever should be pressed against the bottom of the ceramic switch body but not bent upward at the end. Figure 2-19 shows the correct lever position. If the lever's position is incorrect, loosen the two socket-head screws that secure the limit switch in place and adjust it as necessary. Then retighten the screws. When the lever of this switch is in this position, the **Source Poptop Go Up** row on the Service Source 1 screen should be gray (i.e., green highlighting extinguished).

Figure 2-21 Switch Lever on *PopTop Is Down* Limit Switch when Depressed



4 Repeat Steps 2 and 3 to verify the correct operation of both limit switches.

2.5 Installing Required Ancillary Hardware

This section describes the installation of ancillary hardware required to support source operation, including and in-vacuum HV leads (see section 2.4.2, high-voltage shielding (see section 2.5.3), high-voltage and gun interlocks (see section 2.5.1), and the system's low-impedance ground (see section 2.5.2).

2.5.1 Install Interlocks

Connect all protective interlocks. The minimum interlock requirement includes the following:

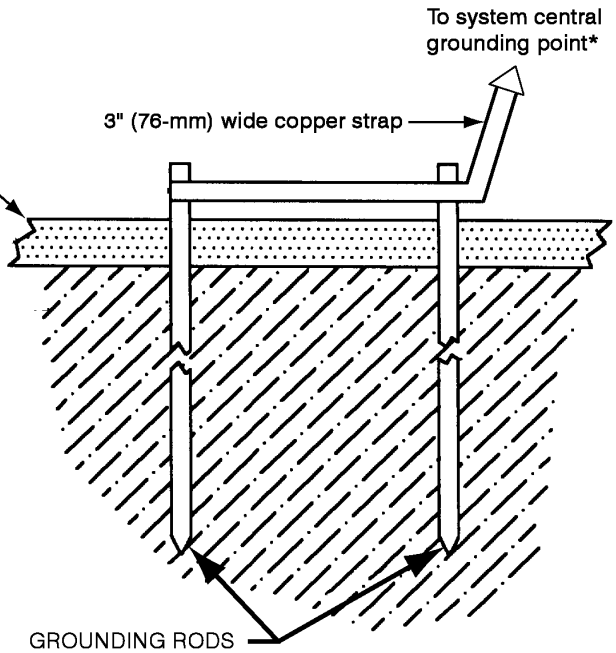
- a chamber pressure interlock that prevents the filament current and the high-voltage from being on when the pressure is higher than 5 x 10^{-4} Torr
- a water pressure interlock that prevents the filament current from being on if the water pressure is lower than 3.0 GPM
- a rotation interlock that prevents rotation when the PopTop cover is up
- an interlock that prevents the filament current and the high-voltage from being on if the vacuum chamber door or the door(s) on the vacuum cubicle are open.

2.5.2 Connect the Source Tray to a Low-Impedance Ground

The source operates at extremely high voltage with respect to earth ground. It can therefore place ungrounded elements at dangerous potential. This potential varies depending on the impedance to ground and the coupling between the source and the ungrounded components. Make sure the earth ground to the building (and hence to the system) is at zero resistance. The building's water pipes will generally not provide proper earth ground. Figure 2-22 shows the two approved methods for setting up a facility low-impedance ground.

Figure 2-22 Two Methods of Installing a Low-Impedance Ground

PREFERRED METHOD



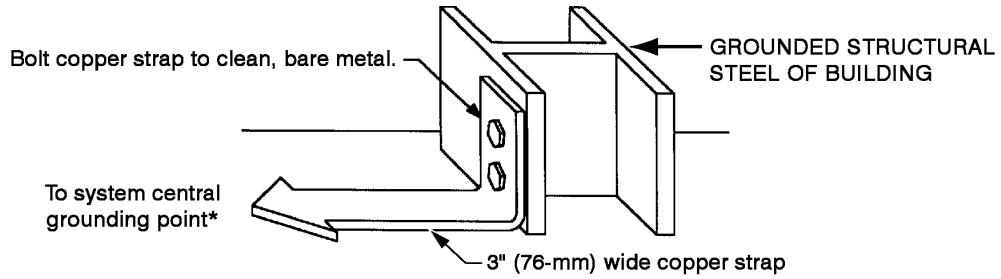
1. As shown at right, sink two grounding rods through the floor of the building and into the earth, approximately six feet apart. The location chosen for these rods should be as close as possible to the vacuum cubicle. The rods must be copper-clad steel, 8 feet in length, and their top ends should extend approximately 6 inches above the surface of the floor.
2. Measure the resistance between the rods. If the resistance is greater than 3 ohms, try lowering it by pouring salt water or copper sulfate down the sides of the rods. If the resistance is still greater than 3 ohms, consult Temescal.
3. When you have verified that the resistance between the two grounding rods is 3 ohms or less, silver solder the copper stap connected to the system central grounding point to each of the rods.

NOTE

Do NOT rely on mechanical connections between the copper strap and the grounding rods.

*Distance from system central grounding point to facility low-Z grounding point	Required size of connecting copper strap
0-60 ft. (0 –18.3 m)	3 in. (76 mm) wide x .035 –.050 (0.9 –1.3 mm) thick
>60 ft.	Consult Temescal

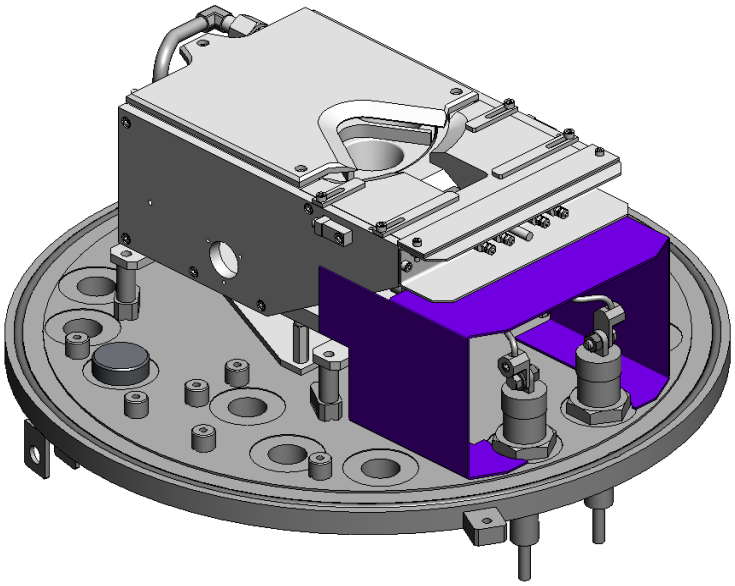
ALTERNATIVE METHOD



2.5.3 Install a High-Voltage Shield over the HV Feedthroughs and Leads

Install an HV shield similar to the one shown below to provide additional isolation of the deflection coil terminals from the effects of high voltage. If the HV feedthroughs are mounted precisely in the locations shown in 2-2, a ready-made Temescal HV shield (PN 0626-9024-0 for the 2PT gun, PN 0626-9024-1 for the 3PT gun) can be used.

Figure 2-23 Correct Placement of High-Voltage Shielding



2.6 Installing Optional Equipment

Step	Action
1	If your source tray is not fitted with full debris shields, install a shield that will cover the in-vacuum feedthroughs and leads and as much of the emitter assembly's filament bus bars as possible (see Figure 2-23). This shield should be made of type-304 stainless steel, and it should be placed so that no part of it is closer than 1/4" to either of the high-voltage feedthroughs. There should be no grounded components within the shielded area.
1	Install a deposition shutter and supporting hardware, if such is required for your application. The shutter must be at least 1.5" above the top of the crucible.
2	Install shielding for secondary electrons. Such shield should be installed at the rear of the gun and should be at least 5-in. (127-mm) high.

2.7 Installing a Second Source

If two electron beam sources are to operate on one source tray, they must be installed facing opposite directions. In addition, a mumetal-and-stainless-steel shield must be installed between them to prevent magnetic interference between the two sources. The mumetal-and-stainless-steel shield must not interfere with the operation of the moving parts of the PopTop source. Figures 2-24 and 2-25 illustrate two methods of mounting such a shield assembly.

Figure 2-24 Magnetic Shield Mounted to Water Lines in a Two-Gun Installation

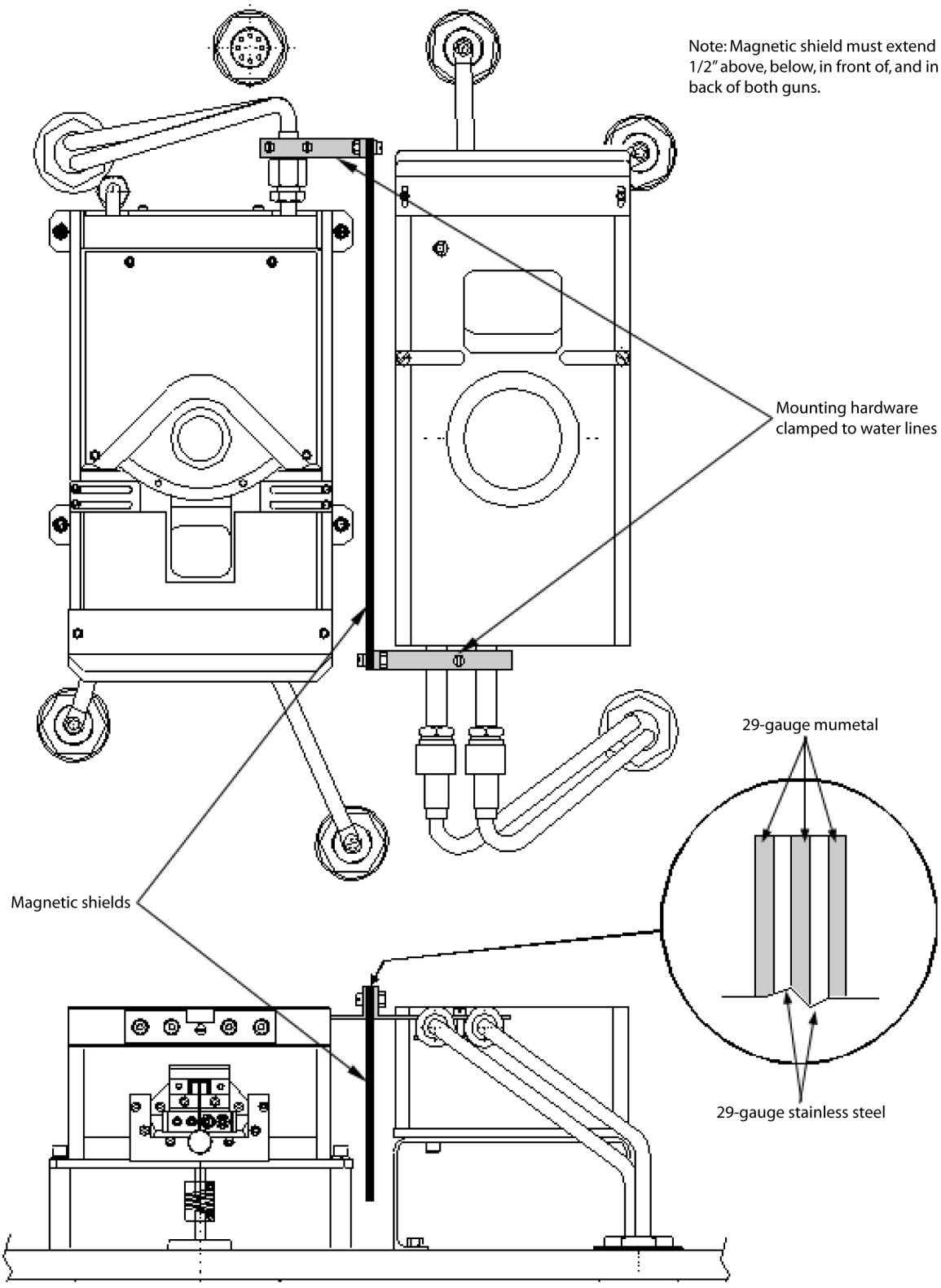
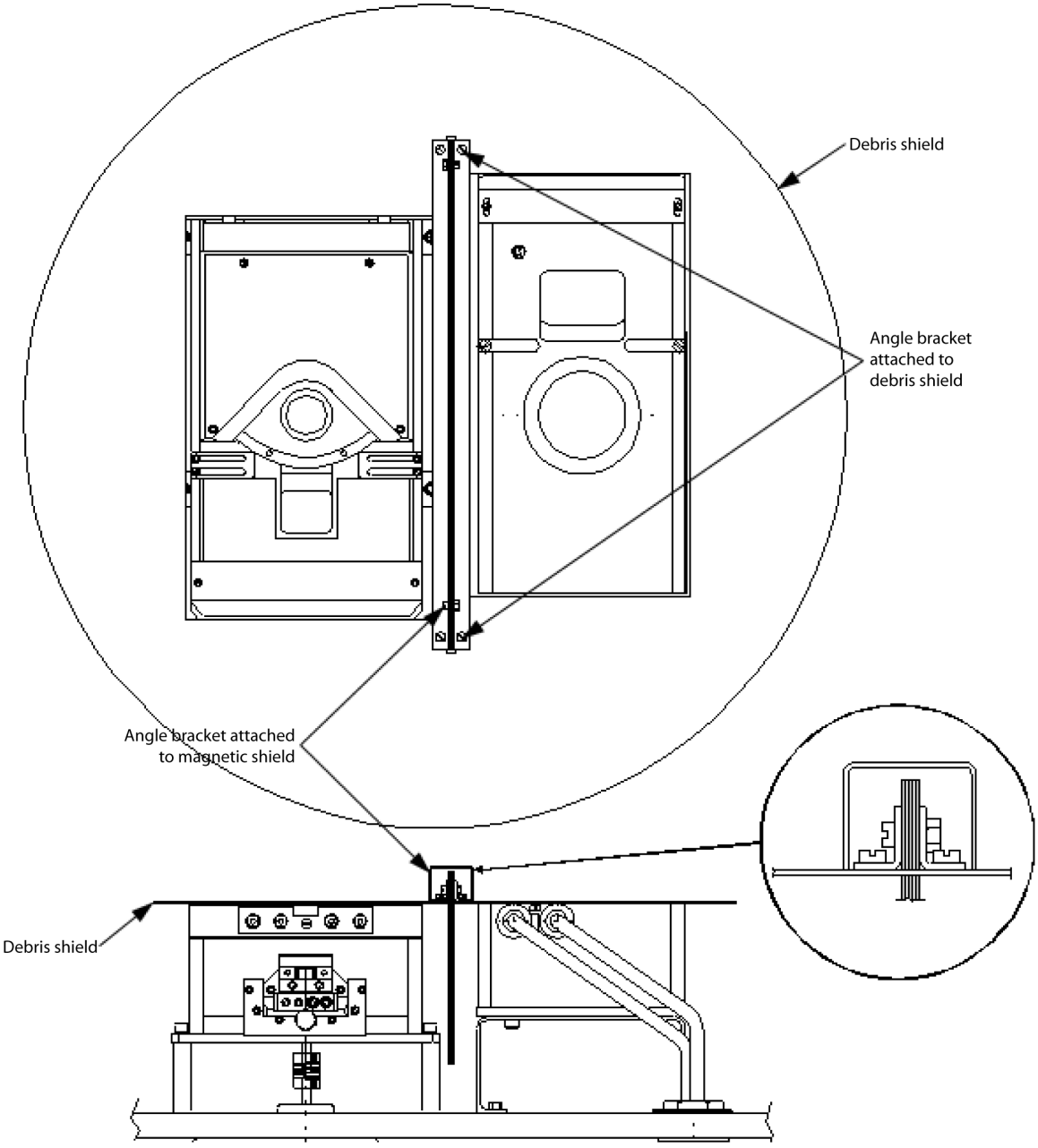


Figure 2-25 Magnetic Shield Mounted to Debris Shield in a Two-Gun Installation



3 Installation in a Non-Temescal System

3.1 Section Overview

This section describes the procedures required to install a 2PT or 3PT source in a box coater-type evaporation system. The procedures described in section 3.4.4 also apply to older Temescal systems that lack pneumatic manifolds.

Specific topics covered are:

NOTE

Read this section carefully before installing the source. The installation procedures and safety precautions described below are very specific and must be adhered to closely. Taking a casual attitude toward any of these measures may result in inefficient or unsafe source operation. Bear in mind that the source is powered by a high-voltage power supply with its own installation and safety requirements. Consult the power supply's manual for additional information relating to source installation and interconnection, paying particular attention to instructions pertaining to interlocks.

3.2 Unpacking

Remove the source from its shipping container. While unpacking, check the components in the container against the packing list. Any discrepancy between the packing list and the parts received should be reported to a Temescal representative. Inspect all parts for possible damage in shipping and verify that the gun is in good working order before disposing of its

packaging. If the source has been damaged in shipment, report the damage immediately to the carrier and to Temescal Customer Service. For a list of the required package contents, see section 2.2 of this manual.

NOTE

To minimize system contamination, always wear latex gloves when handling any part of the source or any other component that will be used inside the vacuum chamber.

3.3 Installation Preliminaries

3.3.1 Hardware and Utility Requirements

For a list of basic hardware requirements, see section 1.4.1 in this manual. However, if you are not going to employ a Temescal air/water feedthrough, you will need to install two 1" bolt-hole feedthroughs for water supply and return lines and three similar feedthroughs for connecting the source's pneumatic ports to their atmosphere-side sources. For a list of utility requirements, see section 1.4.2.

3.3.2 Source and Feedthrough Mounting Requirements

Source Location

First determine the gun's precise orientation and mounting position. The optimal mounting location depends on the following factors:

- The source must be mounted so that the exposed pocket is positioned correctly with respect to the chamber's substrate fixturing.
- The operator must have a clear view of the exposed pocket through the viewport. On systems with a source shutter, the viewport must be low enough to allow a clear line of sight to the gun's exposed pocket beneath the shutter. On such systems, providing a clear line of sight over the raised crucible cover will require positioning the source with its front end pointing from 30° to 60° away from the viewport. On systems without a source shutter, the viewport can be mounted at any desired height, and the source can be positioned at almost any angle with respect to the viewport. However, for safety reasons, the source should never be mounted so that either its front or rear end faces a viewport.

CAUTION

Do <u>not</u> mount the source so that the viewport is either directly in front of the source or directly behind it. Under certain conditions, the full-strength electron beam can be directed toward those areas. The result could be severe injury to anyone looking through the viewport.

NOTE

The source should be mounted only on a surface made of type-304 stainless steel or some other nonmagnetic material. Mounting the source on a surface made of magnetic material will severely distort the source's magnetic field.

If two sources are to be installed on one source tray, there are additional requirements, as described in section 2.7.

Required Mounting Height for 2PT and 3PT Guns

2PT and 3PT sources require a minimum of 1.5-inch clearance above the mounting surface. Appropriate mounting standoffs plus threaded mounting nuts are supplied in Temescal's PopTop Gun Mechanical Installation Kits (PN 0629-4540-0 for the 2PT gun, PN 0629-4550-0 for the 3PT gun). Also included in these kits are four ¼-20 mounting bolts of appropriate lengths and four lock washers. Figure 3-1 illustrates the hardware included in the Mechanical Installation kits.

NOTE

Customer-supplied standoffs and threaded mounting tabs (if used) must be made of type-304 stainless steel or some other nonmagnetic material. Their top and bottom surfaces must be square and flat, providing optimal contact with surfaces above and below them. The gun's mounting straps, the standoffs, and the threaded mounting tabs must provide a secure path to ground for the high-voltage current that will pass through the gun.

Locations of HV and Octal Feedthroughs

The high-voltage feedthroughs should be mounted beside each other somewhere in front of the source, perhaps slightly off to one side. The octal feedthrough should be mounted to one side of the source, ideally as far from the high-voltage feedthroughs as possible. Mounting the octal feedthrough in the approximate location shown in Figure 2-4 makes it possible to route the deflection coil leads along the inside of the coil shield, as shown in that illustration, so that its lower lip shields the leads optimally from the HV leads and feedthroughs. If the high-voltage feedthroughs are not mounted squarely in front of the source, the deflection coil leads should ideally run along the side of the source opposite that toward which the HV feedthroughs are offset. An HV shield like that shown in Figure 2-23 is also required to shield the coil leads from the fields surrounding the high voltage components on the source tray.

NOTE

Do <u>not</u> mount the octal feedthrough in front of the source, between the two high-voltage feedthroughs. This arrangement makes it impossible to isolate the coil-current leads from the effects of the high voltage.

Mounting Requrements for the Rotary Feedthrough and the Optional Air/Water Feedthrough

In a bottom-drive installation, the center of the rotary feedthrough should be exactly 0.5 inches from the source tray's center point along the gun's longitudinal axis, as shown in Figure 2-1. In side-drive installations, the rotary feedthrough must be aligned as precisely as possible with the gun's drive shaft. In practice, this is difficult to achieve with complete precision, so the coupling and shaft extension used must provide enough flexibility to compensate for any misalignment between the rotary feedthrough and the

gun's drive shaft. For this reason, the use of a flexible drive shaft extension and a flexible coupling (PN 9015-0121-3) is recommended.

Installing a Temescal Air/Water Feedthrough for 2PT/3PT Sources

If you are installing one of the air/water feedthroughs designed for use with 2PT or 3PT sources (PN 0628-8264-2PTT20 for the 2PT source, PN 0628-8264-3PTT20 for the 3PT source), that feedthrough must also be installed exactly in the location relative to the rotary feedthrough shown in Figure 2-1. Note also that the air/water feedthrough must be installed in a 0.030-inch counterbore in the mounting surface, as shown in Figure 2-3 and that the source mounting height must be exactly as shown in that illustration.

3.3.3 Preliminary Procedures

Step	Action
1	Make sure that the facility circuit breaker supplying power to the e-beam power supply is switched off and locked/tagged out, in accordance with local safety codes.
2	Power down the sweep controller (or EBC, if your system is already equipped with one).
3	Shut off the supply of 24VDC power to the vacuum cubicle. If required to do so by local regulations, lock out and tag out this supply.
4	Shut down the supplies of facility water and compressed air to the system. If local regulations require it, lock out and tag out these supplies per those regulations.
5	Next, blow down the water circuit that will supply cooling water to the source.
6	Touch all HV components already installed within and outside the vacuum chamber with a properly connected grounding hook.
7	If you are replacing an existing e-gun with a PopTop gun, remove the source shutter, the debris and HV shields, and the gun.
8	Remove any existing components that are to be replaced during the PT gun installation procedure.
9	If you are installing a TemEBeam controller (EBC), perform Steps 10 and 11 of section 2.3.2 in this manual.

3.4 Source Installation Procedures

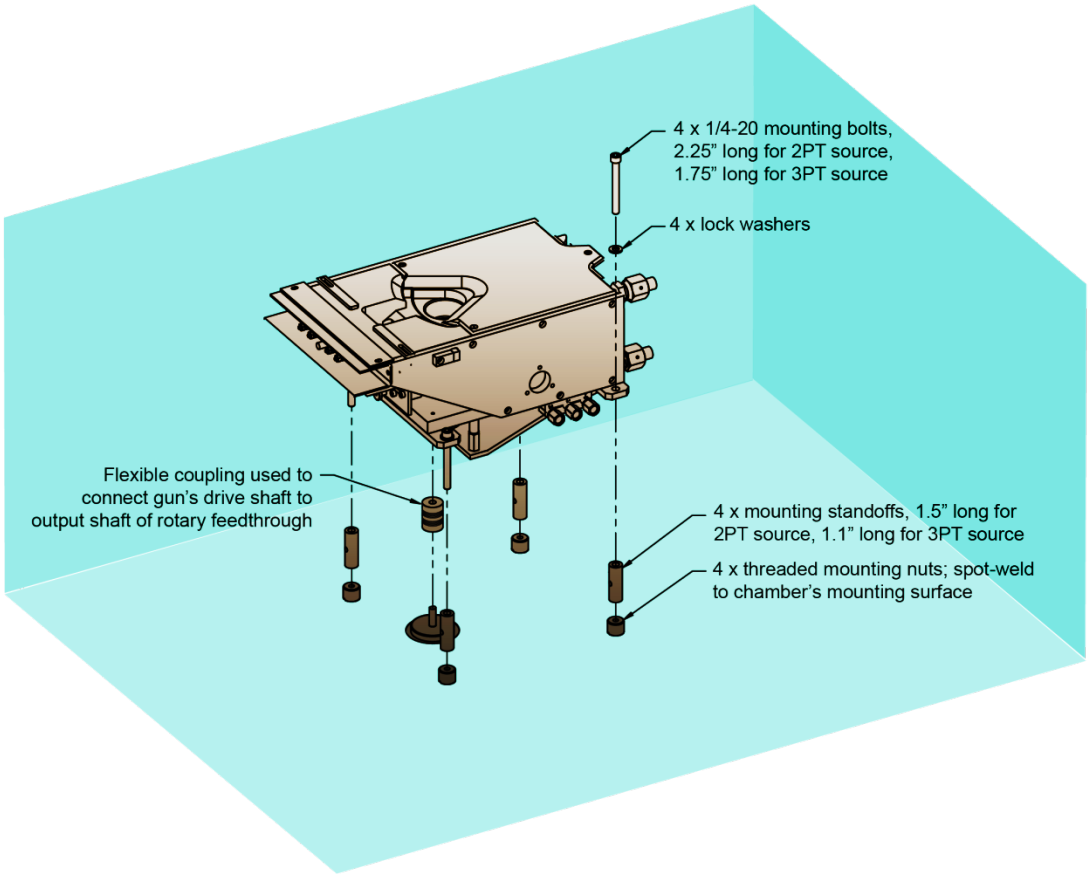
The following procedures cover only the installation of a 2PT or a 3PT source, and they assume that all required feedthroughs have been properly installed and that atmosphere-side connections to the HV and water feedthroughs have been correctly made. It is also assumed that you are using these Temescal installation kits:

- PopTop Gun Mechanical Installation kit (PN 0629-4540-0 for the 2PT gun, PN 0629-4550-0 for the 3PT). Figure 3-1 identifies the contents of those kits.

- PopTop Air Installation kit (PN 0733-0524-0)
- PopTop Electrical Installation kit (PN 0620-9720-0)

3.4.1 Mount the Source

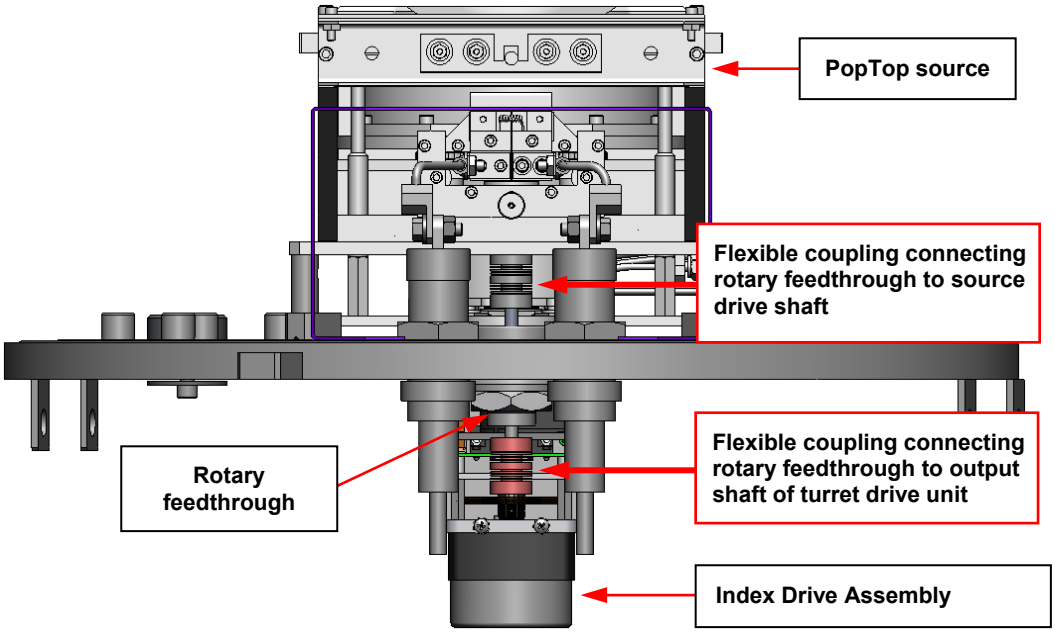
Figure 3-1 Parts Included in PT Gun Mechanical Installation Kits



Step	Action
1	Set the four mounting standoffs in place atop the mounting nuts spot-welded to the source tray.
2	Place a flexible coupling in place on the rotary feedthrough's output (i.e., vacuum-side) shaft and tighten the set-screw that secures the coupling to the shaft (see Figure 3-2).
3	Lower the source into its mounting position, taking care to make sure that its drive shaft extends into the flexible coupling that you installed in Step 2.
4	Put the mounting bolts and lock washers in place and thread the bolts a few turns into the nuts. Do not tighten the bolts at this point.

5 Adjust the position of the flexible couple so that it is equidistant from the top of the rotary feedthrough and the bottom of the source's spider plate. If necessary, loosen the coupling's lower set-screw in order to adjust its position. Then tighten both of its set-screws.

Figure 3-2 Flexible Couplings Required in PopTop Gun Installations



6 Make sure that this flexible coupling is not linearly distorted and that the shafts it connects are in line with each other. If necessary, adjust the position of the gun slightly to ensure that this is the case. Then tighten the gun's mounting bolts.

7 Install the emitter assembly

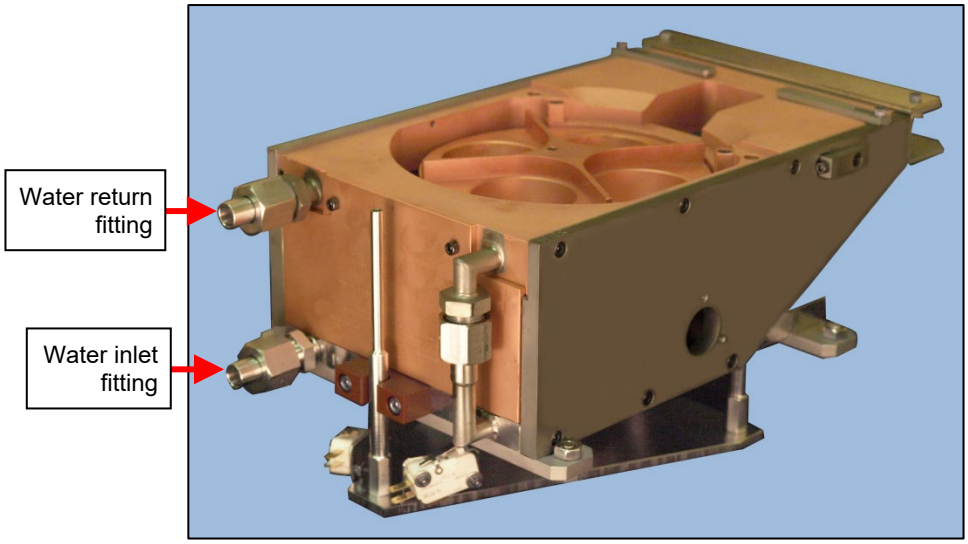
3.4.2 Install the Index Drive Assembly

Install the Index Drive Assembly (PN 0629-0634-10), following the procedure described in section 3.3.1 of the EBC manual. When installing the flexible coupling that connects the output shaft of the Index Drive assembly to the input shaft of the rotary feedthrough (see Figure 3-2), position that coupling midway between them.

3.4.3 Connect In-Vacuum Water Supply and Return Lines

Using customer-supplied tubing, connect the source's water inlet and return fittings to the feedthrough tubes connected to the atmosphere-side water supply and water return lines.

Figure 3-3 Source Water Inlet and Water Return Fittings



NOTE

If you are going to employ one of Temescal's PopTop air/water feedthroughs, refer to 2.4.6 for instructions on installing it and making connections to atmosphere-side and in-vacuum water lines.

3.4.4 Make Pneumatic Connections

NOTE

If you are going to employ one of Temescal's PopTop air/water feedthroughs, refer to 2.4.6 for instructions on installing it and making connections to atmosphere-side pneumatic lines and to the gun's Extend, Return, and Vent pneumatic ports.

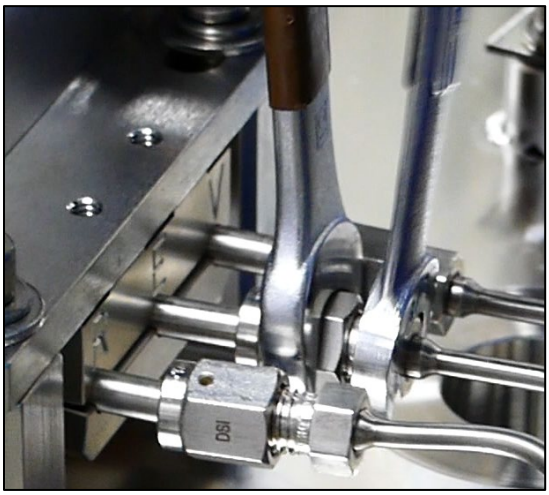
Install In-Vacuum Pneumatic Lines

Using customer-supplied hardware, install fittings and tubing to connect the three air feedthroughs to the pneumatic ports on the source that are labeled **E, R,** and **V**.

CAUTION

Take care when making connections to the fittings on the ends of the source's E, R, and V pneumatic fittings. When doing so, it's essential to use a 7/16" end wrench to hold the fittings on the source side in place while using another 7/16" end wrench to tighten the fittings on the ends of the tubes running to the feedthrough, as shown in Figure 3-4. Failure to do so risks damaging the source's external pneumatic lines.

Figure 3-4 Correct Method of Tightening Fittings Attached to Source's External Pneumatic Lines

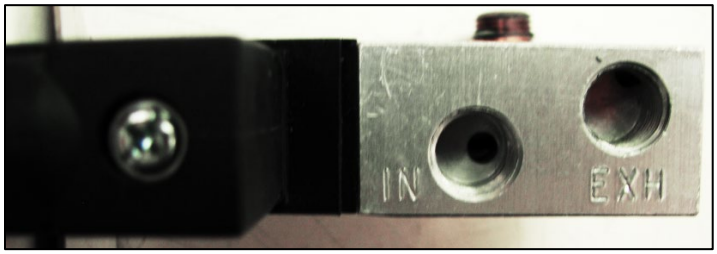


Install the PopTop Air Kit

This section describes how to install PopTop Air kit PN 0733-0524-0, which is designed for installations in systems that do not have a pneumatic manifold like those on modern Temescal systems. Refer also to the drawing 0733-0524. The Air Installation kit is expressly designed to operate in conjunction with Temescal's PopTop Electrical Installation Kit.

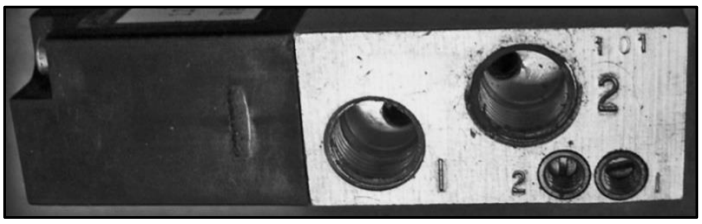
Step	Action
1	On the supply/exhaust side of the solenoid valve (see Figure 3-5), install a 1/4" elbow in the port labeled **EXH**.

Figure 3-5 Ports Labeled *IN* and *EXH* on Supply/Exhaust Side of Solenoid Valve



2	Install another elbow in the solenoid port labeled **IN** o the same side of the solenoid. If necessary, use the 1/4" to 1/8" reducer and the 1/4" Tee provided in the kit, (see drawing 0733-0524).
3	Using customer-supplied tubing or the tubing supplied in the Air Kit, connect facility compressed air supplies to each of the fittings you've installed in the solenoid.
4	Turn the solenoid valve over and install two of the kit's 1/8" elbows in the ports labeled **1** and **2** on the side of the solenoid (see Figure 3-6).

Figure 3-6 Ports Labeled *1* and *2* on Reverse Side of Solenoid Valve



5 Using the mounting hardware supplied with the kit, mount the solenoid in a convenient location on the vacuum system's frame.

6 Attach the remaining two 1/8" elbows to the atmosphere-side tubes of two of the feedthroughs installed to supply compressed air to the PopTop source.

7 Using the 1/8" tubing supplied with the kit, connect the solenoid port labeled **1** to the air feedthrough tube that is connected to the source pneumatic port labeled **E**.

8 Using another length of the same tubing, connect the solenoid port labeled **2** to feedthrough tube that is connected to the source pneumatic port labeled **R** on the TBEU.

3.4.5 Make Atmosphere Side Deflection Circuit Connections

Step	Action
1	Remove the black connector that is attached to the atmosphere side of the body of the octal feedthrough.
2	Remove the metal cap from this connector. To do so, insert a flat-bladed screwdriver into one of the rectangular slots at the top of the cap and gently pry against the flange that forms the top of the connector. Pry the cap loose as far as you can using this slot, then insert your screwdriver in the other slot in the cap and repeat the process. If necessary, once a gap is visible between the cap's top edge and the connector's top flange, you can insert the screwdriver into this gap and pry the cap the rest of the way loose. When prying, take care not to damage either the thin metal cap or the connector body.
3	Cut the Molex connector (labeled SWEEPPG) from the end of the EBC's Sweep Coil Drive Cable (PN 0620-9120), leaving the ends of the cable's four wires exposed.
4	Insert the ends of these wires through the metal cap you just removed. If necessary, loosen the clamp screws on the bottom of the cap in order to insert the wires through it.
5	Strip about 1/8" of insulation from the ends of these four wires.
6	Solder the stripped ends of these wires to Pins 1-4 on the black connector you removed from the octal feedthrough, as follows:

- Pin 1: Green wire
- Pin 2: White wire
- Pin 3: Black wire
- Pin 4: Red wire

For an illustration of the atmosphere side of the octal feedthrough, see Figure 3-7.

3.4.6 Install the PopTop Electrical Installation Kit

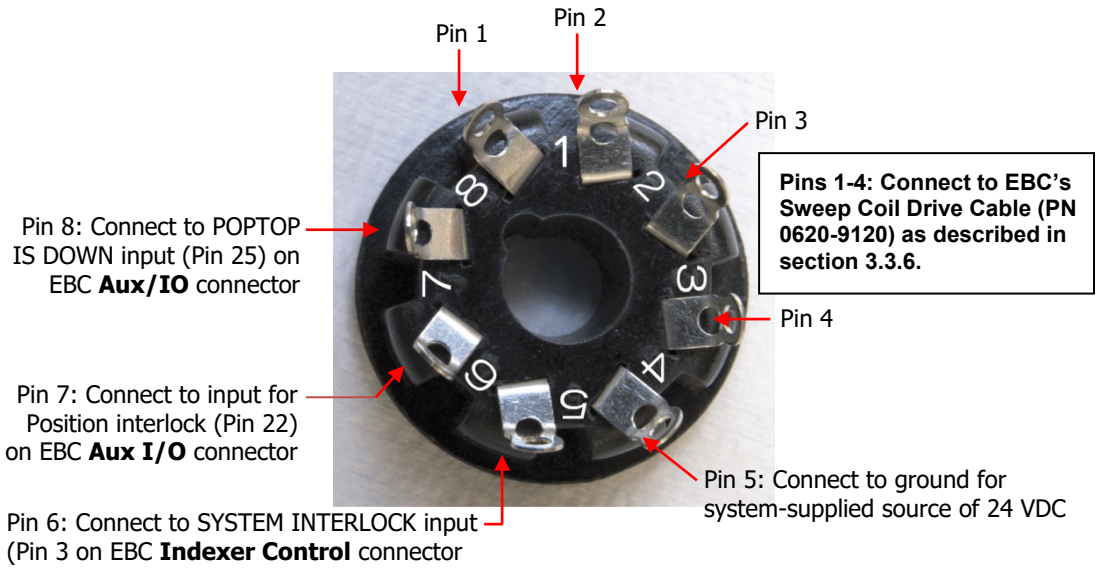
Temescal's PopTop Electrical Installation kit (PN 0620-9720-0) is designed for use with Temescal's EBC and Air Installation Kit (PN 0733-0524-0).The Electrical Kit provides the circuitry required to support the operation of the PopTop cover, including:

- connections between the PopTop limit switches and the EBC's rear-panel **Indexer Control** and **Aux I/O** connectors
- circuitry that controls solenoid that actuates up-down motion of the PopTop cover.

In making these connections, refer to 620-9722, the schematic for the PopTop Electrical Installation Kit. The following procedure details the connections to be made to the atmosphere side of the octal feedthrough.

Step	Action
1	Make the connections shown in Figure 3-7 to Pins 5-8 on the atmosphere-side feedthrough connector that you removed in Step 2 of the procedure described in section3.4.5.

Figure 3-7 Connections to Atmosphere Side of Octal Feedthrough



2 Snap the metal cap back into place on the black connector shown above and push this assembly back onto the bottom of the feedthrough. Note that the shaft in the center of the feedthrough is keyed, so the black connector can be installed only in one orientation.

3 If necessary, tighten the clamp screws on the bottom of the metal cap.

Make in-vacuum connections between the octal feedthrough and the PopTop limit switches exactly as shown in Figure 3-10.

3.4.7 Make Connections to the In-Vacuum Terminals of the Octal Feedthrough and Adjust the PopTop Limit Switches

Making Connections Between the Octal Feedthrough and the Deflection Coils

Step Action

1 Using a 1/16" Allen wrench, loosen the setscrews that secure the metal cap to the ceramic connector on top of the octal feedthrough. Then remove the cap.

2 Remove the ceramic connector from the top end of the feedthrough. Note the numbers molded into the raised ring that surrounds the circle of metal terminals molded into this connector (see Figure 3-10).

3 Sixteen feet of Kapton-insulated wire is supplied in the Temescal PopTop Electrical Installation kit (PN 0620-9720-0). Cut four lengths of this wire that will extend easily from the octal feedthrough to the deflection coil terminals.

4 Strip about 1/8-inch of insulation from both ends of these leads.

5 Five high-temperature ring-type lugs (PN 6044-0359-0) are supplied in the PopTop Electrical Installation kit. Crimp one of these lugs onto the end of each these lead.

6 Attach the lugs on the ends of these leads to the deflection coil terminals.

7 Route these leads neatly to from the coil terminals to the octal feedthrough, incorporating gentle bends as shown in Figure 2-4.

CAUTION

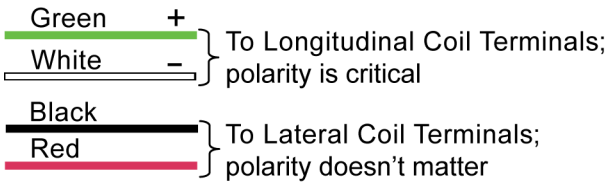
It is critical to route the deflection coil leads along the inside of the coil shield, as shown in Figure 2-4. Doing so helps to isolate the coil leads from the effects of high voltage. Failure to ensure this isolation will result in erratic beam position control and may damage various system components. Beam sweep controllers are especially vulnerable to the effects of high-voltage interference and arcing.

8 Feed the other ends of these leads through the feedthrough cap you removed in Step 1 of this procedure.

9 Solder one end of each of these leads to Terminals 1-4 on the feedthrough connector you removed in Step 3 of this procedure so that

the leads of the Sweep Coil Drive Connector connect through the feedthrough to the coil terminals as shown in Figure 3-8.

Figure 3-8 Correct Connection of Sweep Coil Drive Cable Leads through Octal Feedthrough to Coil Terminals



If the Sweep Coil Drive cable is connected to the atmosphere site of the feedthrough as prescribed in Step 6 of section 3.4.5, then the in-vacuum coil leads should be connected as follows:

- Pin 1: To + Longitudinal terminal
- Pin 2: To − Longitudinal terminal
- Pin 3: To either Lateral terminal
- Pin 4: To either Lateral terminal

However, check to see how the colored leads are connected the atmosphere side of the octal feedthrough in your system and connect the in-vacuum coil leads so that the continuity is as shown in Figure 3-8. The legends stamped into the top surface of the coil shield indicate which terminals are connected to the lateral coils and which are connected to the longitudinal coil. The polarity of the longitudinal coil's terminals is indicated on the same surface.

10 Using a torque wrench accurate within the range of 3-5 inch-lbs., tighten each of the outer screws securing to the coil leads to 4 inch-lbs.

Making Connections between the Octal Feedthrough and the PopTop Limit Switches and Adjusting Those Switches

Step	Action
1	Cut four segments of Kapton-insulated wire that will extend easily from the octal feedthrough to the PopTop limit switches.
2	Strip the insulation from both ends of each wire segment.
3	Crimp and solder 3/16-inch female spade connectors onto one end of each of these wires. Appropriate connectors are available from Temescal under PN 6044-2230-0.
4	Feed the other ends of wires through the octal feedthrough cap you removed in Step 2 of the preceding procedure.
5	Solder these wire ends to terminals 5 through 8 of the octal feedthrough connector that you removed in Step 3 of the preceding procedure.

6 Connect these wires as shown in Figure 3-10 to terminals on the PopTop Up and PopTop Down limit switches. Specifically:

- Connect Pin 8 or the octal feedthrough to the **NO** terminal on the PopTop Up switch to Pin 8
- Connect Pin 7 to the common terminal on the PopTop Up switch
- Connect Pin 6 to the **NC** terminal on the PopTop Down switch
- Connect Pin 5 to the common terminal on the PopTop Down switch common terminal.

Figure 3-9 Connections to Vacuum Side of Octal Feedthrough

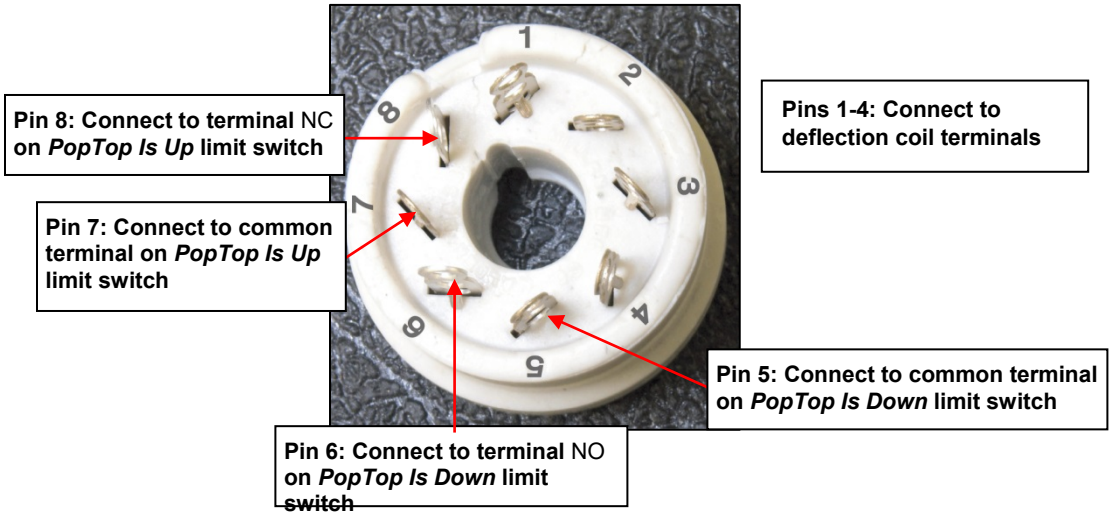


Figure 3-11 identifies the two PopTop limit switches. Figures 3-12 and 3-13 indicate which the terminals on each limit switch must be connected to which pins on the octal feedthrough.

Figure 3-10 PopTop Limit Switches

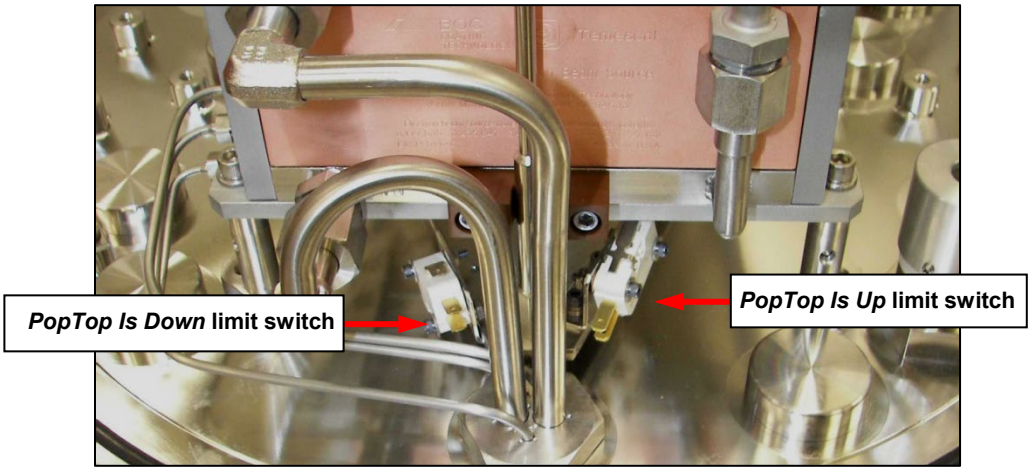


Figure 3-11 Terminals on *PopTop Is Up* Limit Switch

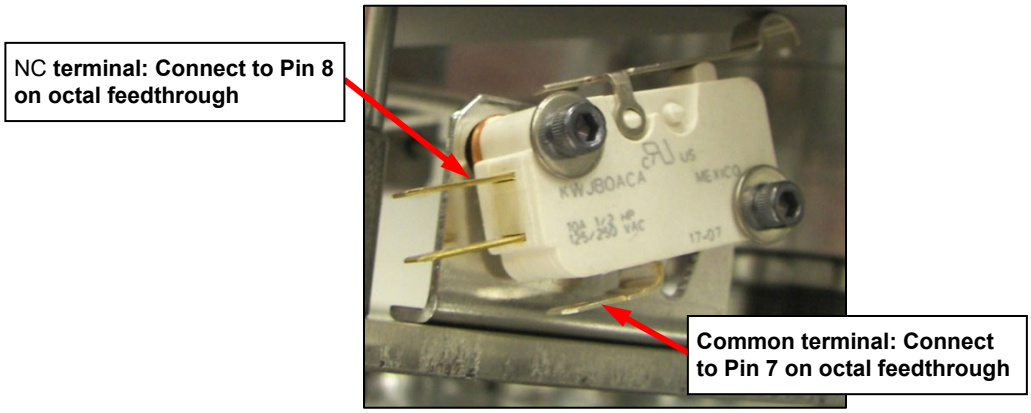
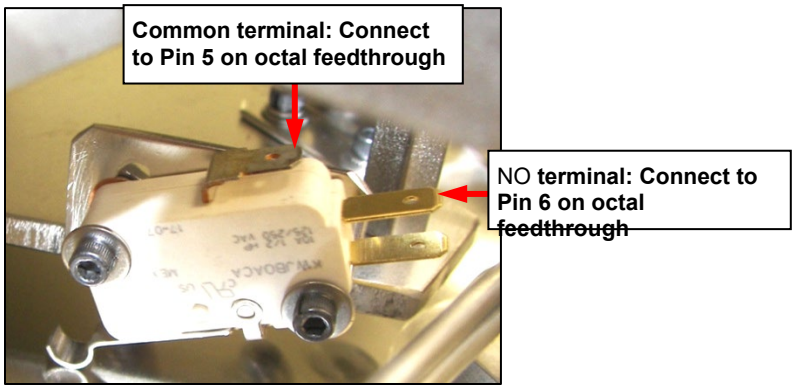


Figure 3-12 Terminals on *PopTop Is Down* Limit Switch



7 Insert the ceramic connector back into the top of the octal feedthrough.

8 Replace the metal feedthrough cap on top of the ceramic connector and retighten the two set-screws that secure the former to the latter.

9 Adjust the PopTop Limit Switches, following the procedure described in section 2.4.9.

3.4.8 Install the In-Vacuum HV Leads

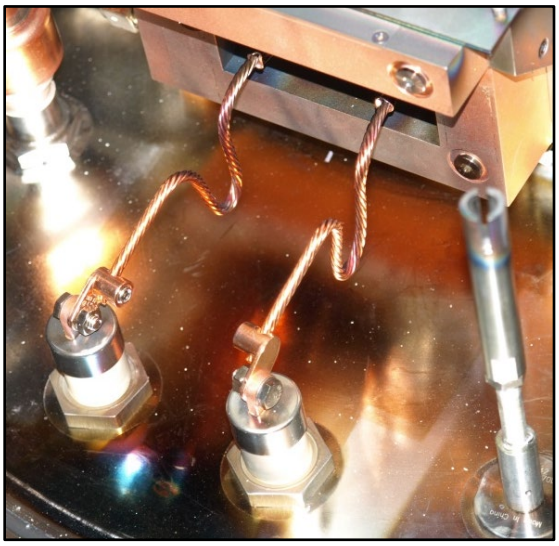
Perform the procedure described below to connect the HV leads to the emitter bus bars and to the in-vacuum terminals of the HV feedthroughs.

Step	Action
1	Each of the high-voltage leads supplied with the source has a lug crimped onto one end. Using the nuts and bolts provided with the HV leads, secure these lugs to the emitter assembly's bus bars.

2 Route the other end of each lead to the nearest feedthrough, without crossing them and with a bend like that shown in Figure 3-14. Then cut them to length.

DANGER: HIGH VOLTAGE
The HV leads must NOT touch the source tray or any other grounded component or structure.

Figure 3-13 Correct Installation of In-Vacuum HV Leads



NOTE
XL source shown above, but details of HV lead installation shown there are identical for the 2PT and 3PT sources.

3 Attach the supplied mounting hardware to the unterminated ends of the HV leads and connect that mounting hardware to the terminals on the HV feedthroughs.

3.4.9 Install the Source's Crucible and PopTop Cover

Install the crucible, following the procedure described in section 4.5.3. Then install the PopTop cover.

3.5 Install Required and Optional Ancillary Equipment

Install the required ancillary equipment as described in section 2.5 of this manual. Install optional in-vacuum equipment as described in section 2.6. If you are installing a second source next to the PopTop source, refer to the instructions described in section 2.7.

4 Source Operation

4.1 Section Overview

This section provides a guide to source operation. Section 4.2 is an overview of the electron beam controls, section 4.3 describes the initial operating procedure, and section 4.4 describes routine inspection and cleaning procedures. These three subsections are provided as general guidelines to the subjects they cover; actual operating procedures will vary, depending on the details of your installation and application(s). However, section provides detailed, 4.5 specific instructions regarding crucible removal/reinstallation. Specific technical data on other aspects of electron beam deposition are available upon request from Temescal.

4.2 Electron Beam Control

The source operates in conjunction with an electron beam power supply and an EBC. Various features of these components allow control over the following beam parameters:

- total beam power
- position of the beam spot (i.e., the area where the beam strikes the evaporant material)
- size and shape of the beam spot.
- The features that provide control over these parameters are:
- acceleration voltage control on the e-beam power supply
- emission control on the e-beam power supply
- the EBC's beam position/sweep control function
- pole piece extensions on the source itself

The effects of adjusting these control features are described below.

4.2.1 Adjusting the Acceleration Voltage

The potential at which the DC electron beam operates is termed the *acceleration voltage*. This value is set via the e-beam power supply's HV control circuit, which should provide a read-out of the acceleration voltage in kV. Together with the emission current control, the acceleration voltage determines total e-beam power. However, the acceleration voltage value must be kept constant, as it strongly affects the longitudinal position of the beam spot. Reducing the acceleration voltage moves the beam spot toward the front of the source (i.e., toward the emitter assembly), while increasing the acceleration voltage moves the beam spot toward the rear of the source. For instructions on setting the acceleration voltage, see the manual for your e-beam power supply.

Although PT guns can be operated at any acceleration voltage between 4 kV and 10 kV, the permanent magnet is gaussed for operation at a specific acceleration voltage value. On the standard model 2PT source, the permanent magnet is

gaussed so that at 8 kV or 10 kV acceleration voltage, the beam strikes the target material just in front of the rear edge of the exposed pocket.

On special versions of this source, the permanent magnet is gaussed so that at 8 kV acceleration voltage, the beam strikes the material at or near the pocket center. In either case, if the source is operated at an acceleration voltage lower than the designated value, the beam will fall in front of the correct position (i.e., farther toward the front of the source). In that event, it may be necessary to mount one or more magnetic shunt bars to make the beam strike the correct position.

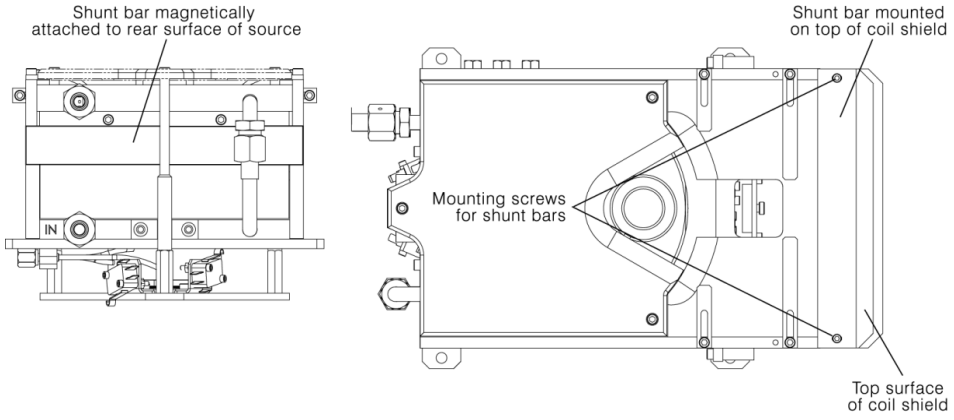
Two shunt bars are supplied with the source, although in some cases additional shunt bars may be required. The mounting positions for the shunt bars are shown in Figure 4-1. Note, however, that the effect of the shunt bars varies depending on whether they are mounted on the front or the rear of the source. Therefore, if multiple shunt bars are required, it is important to add them in the following sequence:

Step	Action
1	Mount the first shunt bar atop the coil shield, as shown in Figure 4-1, using the socket-head screws and nuts supplied with the shunt bars.
2	If additional shunting is required, attach a second shunt bar magnetically to the rear of the source, in the rearward position shown in Figure 4-1.
3	If a third shunt bar is required, mount it above the initial shunt bar. Use the mounting hardware provided to hold both shunt bars in place atop the coil shield.
4	If the beam is still not in the correct position, attach a fourth shunt bar magnetically above the one already mounted on the rear of the source.

CAUTION

Do not attempt to attach a shunt bar magnetically to the front of the source. If you do so, the permanent magnet's field will pull the bar strongly and rapidly toward the pole piece extensions, possibly alternating their position and causing minor finger injuries.

Figure 4-1 Correct Mounting Locations for Shunt Bars



4.2.2 Adjusting the Emission Current

The *emission current* is the value of the electron beam's high-voltage DC current. Emission current control provides the only means if varying total beam power during a run, as the acceleration voltage value must be kept constant to ensure correct beam positioning. However, this value is not controlled directly but rather by varying the lower-voltage AC current supplied to the gun's filament by the e-beam power supply. The value of this current, which is termed the *gun current* or the *filament current*, is set via the e-beam power supply's gun control circuit. Even if you are adjusting the filament current, an emission current readout should be available on either the HV control panel or the gun control panel of the e-beam power supply.

For instructions on adjusting the emission current, and for a more complete explanation of the relationship between the emission current and the filament current, see the manual for your e-beam power supply.

CAUTION

Never set the emission current so high that the gun's operating- power rating of 10 kW is exceeded. Operating above that power level may result in damage to the crucible or other parts of the source. At 10 kV acceleration voltage, the emission current should be limited to 0.7 A. At 8 kV, the current limit should be 0.875 A.

4.2.3 Adjusting the Deflection Current

A permanent magnet mounted at the rear of the source creates a powerful magnetic field that is the primary force acting on the electron beam. This shape of this magnetic field is modified by the pole pieces that form the sides of the source. The beam's direction can also be affected by operation of the gun's electromagnetic deflection coils. However, with no deflection current applied, the primary magnetic field should keep the beam spot centered laterally, while its longitudinal position is determined by the interaction between the acceleration voltage and the strength of the primary magnetic field along the gun's longitudinal axis.

The deflection coils are contained in a U-shaped metal enclosure mounted in the front of the coil housing. There are two coils for lateral beam-position control and one coil for longitudinal control. Varying the current to these coils affects the position of the beam spot within certain limits.

For information on using the e-beam power supply to move the beam-spot longitudinally, see the manual provided with the power supply. For instructions on using the EBC to control beam-spot position, see section 5.5.2 of the EBC manual.

4.2.4 Adjusting the Positions of the Pole Piece Extensions

In addition to the usual external pole pieces, PopTop sources are equipped with internal pole piece extensions for enhanced control over the size and shape of the beam spot. Adjusting these extensions to alter the size and shape of the beam spot affects beam-spot position and beam uniformity as well as beam density.

In general, the beam spot is the smallest, densest, and most uniform when the pole piece extensions are adjusted all the way in toward the center of the source. As the extensions are adjusted outward, the spot becomes larger, less dense, and less uniform.

In addition, as the extensions are adjusted outward, the beam spot moves toward the rear of the source and will eventually fall beyond the rear edge of the pocket. If you adjust the pole piece extensions outward to obtain a diffuse beam, it may be possible to bring the beam spot forward to the correct position by either lowering the acceleration voltage or applying longitudinal deflection current, or both.

However, if your process calls for a very diffuse beam with the source operating at its design acceleration voltage, keeping the spot in the correct position may require having the permanent magnet regaussed to increase its field strength.

The external pole piece extensions are mounted on top of the source (see Figure 4-2). Adjusting these extensions affects the beam spot most strongly when it is near the rear edge of the pocket. In that area, the beam spot tends to become long and narrow. Moving the external pole piece extensions all the way in minimizes this tendency, shortening the spot without significantly broadening it. Adjusting these extensions outward allows the spot to lengthen.

The internal pole piece extensions extend into the source in the area between the coil shield and the crucible. Adjusting these extensions affects the beam most strongly when it is near the front of the pocket. In that area, the beam tends to assume the shape of a crescent spread laterally around the edge of the pocket. Moving the internal pole piece extensions all the way in minimizes this tendency, compressing the beam spot laterally while chopping off the thin edges of the crescent.

Although the two sets of pole piece extensions affect the beam most strongly at opposite ends of the pocket, each set has some effect on the beam spot at any point in the pocket. For this reason, the two sets of extensions must always be adjusted in tandem. Bear in mind, however, that small movements of the pole piece extensions strongly affect the position of the beam spot as well as its size and shape. As the extensions are adjusted outward, the beam is deflected farther back toward the rear of the source. Consequently, the pole piece extensions should be adjusted in increments of 1/8" at a time.

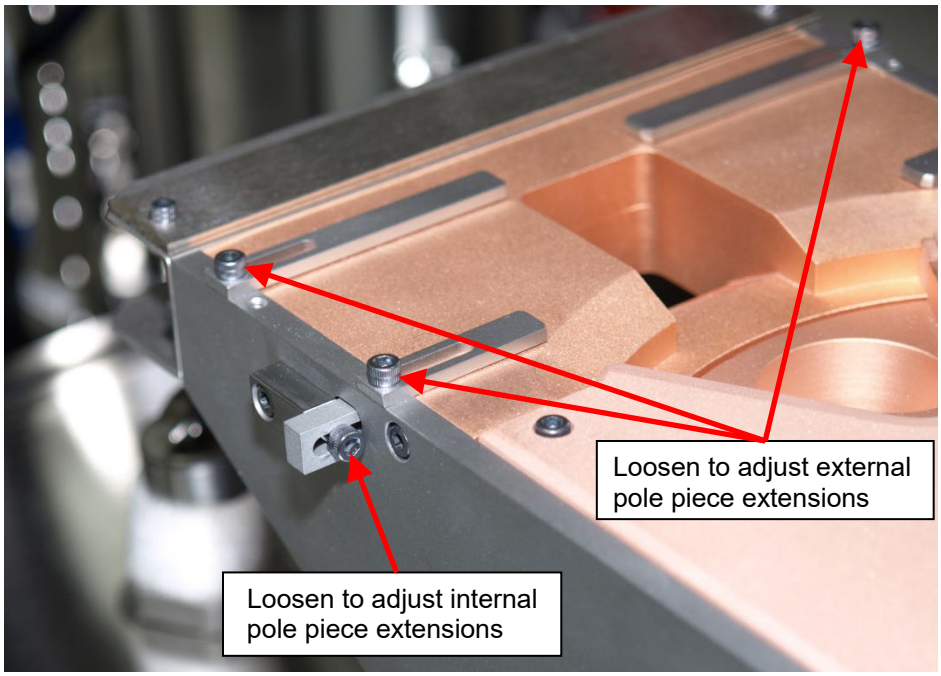
To change the position of the external pole piece extensions, loosen the screws that secure the extensions to the source, move them equal distances in the desired

direction, and retighten the screws. To change the position of the internal pole piece extensions, first loosen the screws that secure them to their mounting blocks, as indicated in Figure 4-2. (Do not loosen the screws that secure the mounting blocks to the sides of the source.) Then move the two extensions equal distances in the desired direction and retighten their mounting screws.

NOTE

The internal pole piece extensions are made with a step in the middle, so that one end of each extension is wider than the other. If you remove these extensions, remember to reinstall them with the step facing UP. Installing the extensions with the step facing down will make the beam broader and more diffuse when it is near to the front of the pocket and reduce beam uniformity regardless of beam-spot position.

Figure 4-2 Internal and External Pole Piece Extensions



4.3 Initial Operation

Follow the procedure described below in operating the source for the first time. Before beginning this procedure, make sure that the following conditions are met:

- The source has been installed in accordance with the instructions in Section 2.
- The main circuit breaker on the electron beam power supply is in the OFF position.
- The facility breaker supply power to the e-beam power supply is in the OFF position.
- Use the EBC to disable its sweep control function, putting it in position-control-only mode.

NOTE

When operating the source at emission current levels above the bias level, do not observe it through the viewport unless you are wearing polarizing lenses or some other appropriate form of eye protection. Depending on the type of material being evaporated and the observed effective lumens, which may range as high as 45,000 lx, multiple polarizers or types of eye protection equipment may be required. Failure to observe this precaution may result in serious damage to the operator's vision.

Step	Action
1	With the vacuum chamber at atmosphere, fill the crucibles at least half-way with the material to be evaporated.
2	Perform the following steps:

a) Discontinue the air flow to the system and bleed pressure out of the air lines.

b) Discontinue the air flow to the system and bleed pressure out of the air lines. Connect air to the feedthrough using the parts contained in the Air System for PopTop Sources (PN 0627-3010-0; refer to drawing 625-2634). The speed controllers (Item 62) in that kit can be installed anywhere on the tube line where they are easily accessible. The speed controllers should be set 1/4 –1/3 turn from fully closed. **Note**: The very short tube at the bottom of the air/water feedthrough is the vent, so do not attempt to install any fittings on it.

c) Add source actuation air solenoids to the air solenoid manifold. Run 1/4" air-line solenoid to the 1/8" stainless steel pipe fittings.

d) Test the source by rotating the crucible manually from the operator station.

e) Raise the source tray to its sealing position.

CAUTION

Evaporating with a crucible less than half-full may cause damage to the source.

3	Close the vacuum chamber.
4	Switch on the facility breaker supplying power to the e-beam power supply.
5	Switch on the e-beam power supply's main circuit breaker.
6	Using the EBC, move the beam to the center of the pocket.
7	Open the EBC's Details screen, verify that the **Tank, Vacuum, Auxiliary, Water,** and **Position** LEDs are lit. If any of these LEDs are not lit, take appropriate action to ensure that the associated interlock(s) are made. Be particularly certain that the GUN WATER interlock is made.

8 Open the Temescal Control System's Service Source #1 screen and use its **SOURCE POPTOP GO UP** button to raise and lower the crucible cover. As you do so, verify that the **Poptop Down** LED on the EBC's Details screen is lit when the cover is in its Down position and unlit when it is in its Up position. Also verify that the **Pocket Good** LED on the same screen is lit when the crucible cover is down and unlit when it is up.

9 Evacuate the vacuum chamber to a pressure less than 5 x l0-4 Torr.

NOTE

Continuous operation at pressures higher than 5 x l0-4 Torr drastically reduces filament life and may result in severe arcing within the chamber.

10 Switch on the high voltage and set the HV control for the desired acceleration voltage.

11 Adjust the longitudinal deflection current so that it will keep the beam spot away from the edge of the pocket. If this current is controlled by either the e-beam power supply or a standard (i.e., non-bipolar) beam sweep controller, adjust the control for that current to .5 A. If the deflection coils are controlled by a bipolar beam sweep controller, set the longitudinal current to 0 A.

12 Use the EBC to set the emission current control to 0 A.

CAUTION

It is critical to make sure that the emission current is set for 20 mA or less before you switch on the filament current. Failure to do so could result in damage to the source. The safest way to ensure that this is the case is to turn the emission control on the e-beam power supply all the way counterclockwise.

13 Switch on the gun (i.e., the filament current).

14 Slowly turn up the filament current until the emission current readout indicates 20 mA. Looking at the source through a viewport, you should now see fluorescence on the surface of the evaporant material. This fluorescence should be somewhere between the center and the rear edge of the pocket.

If no fluorescence appears, or if it appears somewhere along the edge of the pocket or on some other part of the source, the limits for the beam position interlock may be set improperly. If you conclude that that is the case, switch off the filament current and the high voltage and perform the procedure for setting the beam limits (See section 4.8.3 of the EBC manual). Then begin this procedure again from Step 1.

CAUTION

Do not increase the emission current above 20 mA in an attempt to find the beam spot. Doing so may result in serious damage to the source.

15 Using the EBC, adjust the longitudinal deflection current until the fluorescence is centered longitudinally in the pocket. (With no lateral deflection current applied, the beam should automatically be centered laterally in the pocket. If it is not, consult Section 6 of this manual.)

NOTE

The beam spot should move toward the emitter assembly as you increase the longitudinal deflection current. If increasing the current moves the beam in the opposite direction, touch the Longitude Normal button on Page 2 of the EBC's Config>Sweep screen to reverse the polarity of the coil. Do not operate the gun with the polarity of the longitudinal coil current improperly set. Doing so will distort the beam and seriously shorten the lifetime of the permanent magnet.

16 Once the fluorescence is centered in the pocket, use the controls on the EBC's Operations>Sweep screen to check the beam position interlock limits. If the limits are not set properly, switch off the high voltage and the filament current and follow the procedure described in section 4.5.2 of the EBC manual to set them correctly. Then repeat this procedure again from Step 10.

CAUTION

If the beam impinges on the edge of the crucible, copper will be evaporated and the run will be contaminated. Serious damage to the crucible will also result if the source is allowed to continue operating with the beam spot in this position.

17 Once you have verified that the position interlock limits have been set correctly, slowly increase the emission current until the beam spot appears in the same area as the fluorescence.

18 If you are using a sweep controller, switch on its sweep function and establish an appropriate pattern. If not, readjust the beam spot's position as desired to optimize the heating and evaporation of the target material. For many materials, evaporation rates can be improved if the beam spot is slightly behind pocket center.

19 Slowly increase the emission current until the desired evaporation level is reached.

Operation from this point on will vary from application to application. If you encounter any problems in operating the source, refer to the troubleshooting procedures in Section 6.

CAUTION

Whenever you prepare to vent the system, allow two to three minutes for the filament and the rest of the emitter assembly to cool first. Exposing a hot filament to atmosphere will cause rapid oxidation and shorten filament life.

4.4 Routine Inspection

4.4.1 Inspection Upon Venting

Perform the following checks each time the system is vented to atmosphere.

Step	Action
1	Check to see that each pocket is at least half-full. Add evaporant material as required to maintain the desired pool level.
2	Examine the crucible for residual waste from the previous evaporation run. If left in the crucible, such material can contaminate other evaporant materials, prevent the cover from closing properly, cause thermal shorts, and reduce the evaporation rate.
3	Inspect the cover for excessive evaporant build up. Remove and clean.

NOTE

Ensure cover is in the up position before trying to remove the attaching screws. See the Note on Removing the Crucible Cover.

4	Look for loose flakes of evaporant and other debris on and around the other parts of the source. Be sure to inspect the area around the emitter assembly, the high-voltage leads, and the high-voltage feedthroughs. Debris and flakes in these regions can cause short circuits. Use an industrial vacuum cleaner to remove any loose material from these areas.

4.4.2 Periodic Inspection

The intervals for this inspection are process dependent, varying with the thickness of the layers deposited, the material used, the source-to-substrate distance, and other factors. The user must therefore set the schedule for this inspection.

Step	Action
1	Perform the checks described above.
2	Check all feedthroughs for fouled components and clean any that are found.
3	Remove the emitter assembly from the source and examine its high-voltage spacing insulators and flanged insulators. (These components can be inspected without disassembling the emitter.)
4	Check the emitter assembly for evaporant buildup. When the buildup begins to look as though it is affecting the emitter's performance, disassemble and clean the emitter.
5	Examine the outer surface of the anode. You need not be concerned about discoloration, but look for any signs of distortion or burning caused by arcing. On high-performance emitters, pay especially close

attention to the anode surface just in front of the gap between the two beam formers. If you find any burned spots, replace the anode.

6 Examine the filament as closely as possible without removing it from the emitter assembly. Replace the filament if you observe any of the following conditions:

- Breaks in the filament.
- A misaligned filament, which can cause poor emitter performance.
- Thin spots in the filament, which can cause hot spots in the evaporant.
- A warped filament or one that sags in the center, which usually results from operating the source at very high temperatures. A sagging filament will eventually burn the anode.
- Severe oxidation above the areas where the filament legs contact the filament clamps. Severe oxidation in these areas may indicate that a layer of insulation has formed between the filament and the filament clamps, reducing continuity and emitter efficiency.

7 If you replace the filament, be sure to clean the V-shaped grooves in the filament clamps. Use 400-grit (or finer) emery paper to surface the grooves, as coarser emery or sandpaper can roughen the metal surface enough to cause arcing in the chamber. After using the emery paper, remove residues from these parts by thoroughly cleaning them, either ultrasonically or using isopropyl alcohol.

8 Once the filament is installed, use an ohmmeter to check the resistance between the two emitter bus bars. If the meter reads infinity or a value significantly greater than 0.3 ohms, replace the filament. A reading of infinity indicates a broken filament. Too-great resistance between the two bus bars confirms that an insulating oxide layer has developed between the filament legs and the contact areas around them.

4.5 Crucible Removal and Reinstallation

The 2PT and 3PT sources are designed to provide easy access to the crucible and easy crucible removal, all without source disassembly. The removable crucible cover is secured by only three screws, and removing the cover does not necessitate blowing the water out of the source. Crucible removal does require blowing down the source, but once that is done, removing the crucible is a simple matter of removing eight socket-head screws.

Follow the instructions provided below when performing either of these procedures.

4.5.1 Removing the Crucible Cover

NOTE

Before loosening the cover screws, all the pressure and force between the cover and the coil housing must be removed. As a result, the potential of galled threads and screw breakage between the mounting screws and push rods is reduced. A backing wrench (to prevent loosing of the spider plate and push rod connection) should be used on the hex portion of the push rods when removing the cover screws.

NOTE

To remove the cover, command the source to go to Pocket 1. When the rotation is complete, turn the indexer off (the power switch is located on the front panel of the indexer in the operators station), then unplug the power cord from the back to prevent the indexer from being inadvertently turned on. When the indexer is turned off the cover defaults to, and maintains, the raised position. With the cover in the raised position, remove the three mounting screws. The cover needs to be reinstalled in the same raised condition.

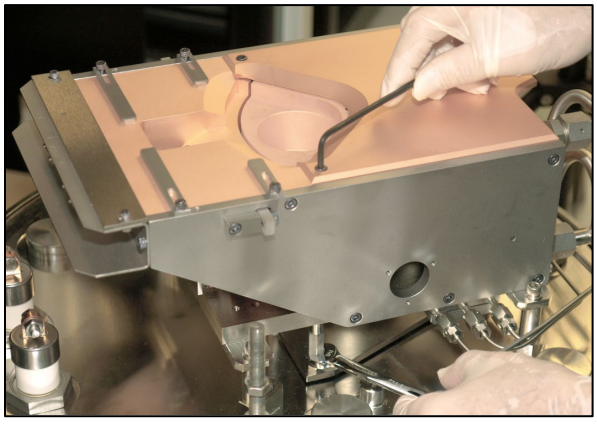
WARNING

When the indexer is turned back on, the cover momentarily lowers (closes) and then raises (opens) until communication with the TCS is re-established. To avoid a pinch hazard, precautions should be taken to ensure the indexer is not powered on during cover removal or reinstallation.

The removable crucible cover used on PopTop sources provides quick access to the crucible, making it easy to clean the crucible cover and the upper surfaces of the crucible, or remove the crucible. Follow the procedure described below when removing the cover for any of these reasons.

Step	Action
1	Using the Allen wrench provided with the unit, remove the three socket-head screws that secure the crucible cover to the push rods (see Figure 4-3) and remove the cover. To ensure that the connection between the push rods and spider plate are not inadvertently loosened, use a backing wrench on the push rods.

Figure 4-3 Correct Use of Wrenches When Removing Crucible Cover



NOTE

The water circuit can remain active while you remove the crucible cover, as cooling water does not flow through the cover.

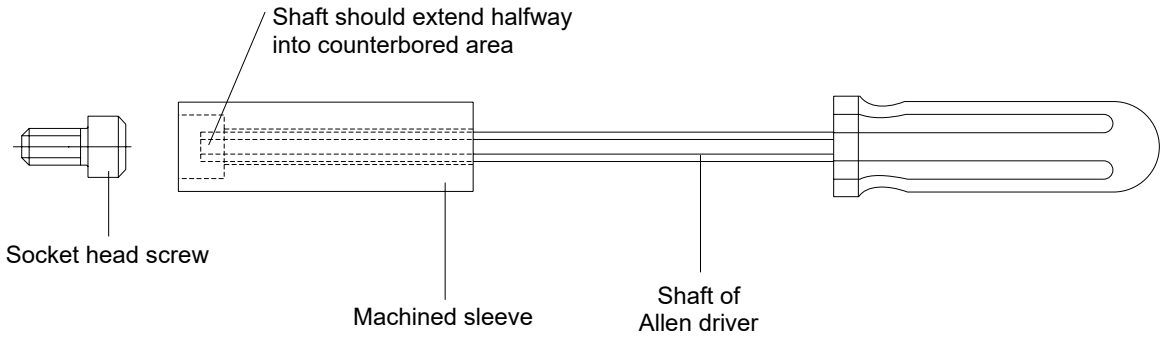
2 Check the crucible and cover for flakes of debris and excessive evaporant buildup. Pay especially close attention to the barriers between the pockets and to the edge of the cutout in the front of the cover. Build-up along these surfaces can impede proper seating of the cover to the coil housing during operation. Remove any buildup from the edge of the cover's cutout, or, if you have a clean cover on hand, replace the cover and set the used one aside for thorough cleaning and glass-bead honing. If the cover has become warped or has rough surfaces, smooth and straighten. Clean the buildup on the crucible's barriers as thoroughly as possible without risking contamination of the material in the pockets.

4.5.2 Removing the Crucible

The 2PTT and 3PTT sources enable you to remove the crucible without extensive source disassembly, making it easy to clean the crucible thoroughly, switch crucibles, or check the condition of the O-ring in the crucible mounting flange. Follow the procedure described below when removing the crucible for any of these reasons.

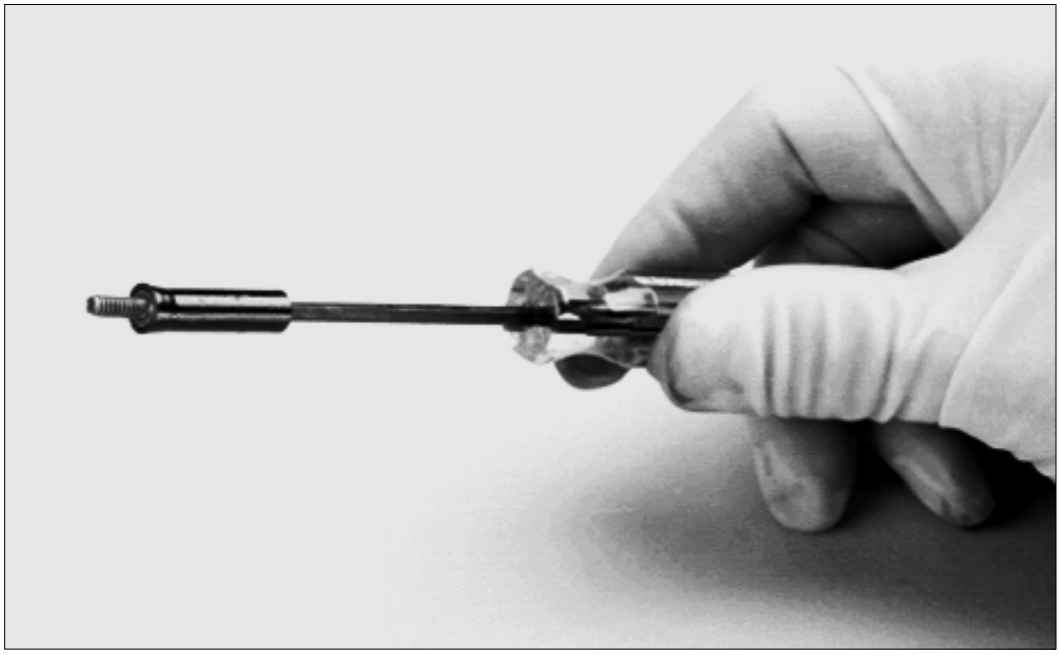
Step	Action
1	Remove the crucible cover, following the procedure described above.
2	Turn off the water flow to the source.
3	Shut off the inlet water supply and apply compressed air to the inlet to blow the remaining water out of the source. If your system has a pressurized return line, the air line you connect should have a check valve to prevent water from entering the air line. For best results, shut off the water supply to the return line just before shutting down the compressed air.
4	Now you are ready to remove the screws that secure the crucible to the crucible-mounting flange. To do so, use the special Allen tool provided with the source. This tool consists of a standard 7/64" Allen driver (7/64" driver for a 2PT source, 9/64"for a 3PT gun) with a machined sleeve fitted over its shaft, as shown in Figure 4-4). If you are not experienced using this tool, perform step 5 of this procedure. If you are already proficient at using the tool, skip step 5 and proceed to step 6.

Figure 4-4 Correct Arrangement of Machined Sleeve on Allen Driver



5 Screw one of the screws you removed from the crucible cover back into one of the holes in the coil housing. Using the special Allen tool, practice inserting the end of the tool into the hexagonal socket in the end of the screw while ensuring that the sleeve extends down far enough over the screw's head so that the screw is held securely by the sleeve after the screw is removed from its threaded hole.

Figure 4-5 Socket-Head Screw Correctly Retained on Allen Driver

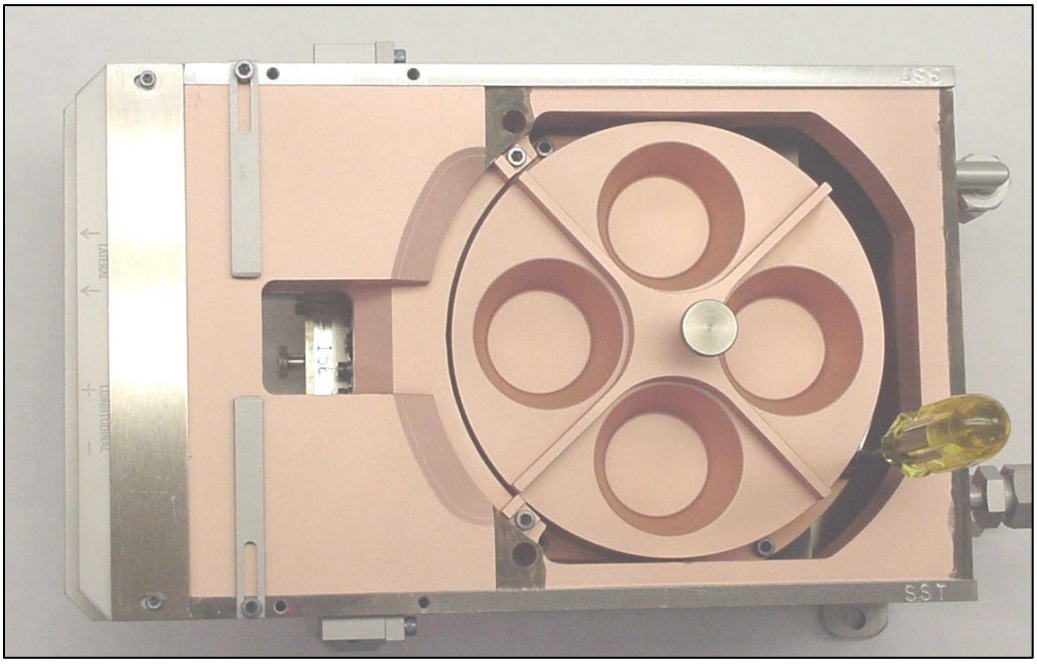


6 Remove the screws securing the crucible to its mounting flange. There are eight of these screws, and six of them will be accessible if you turn the crucible to the position shown in Figure 4-6. Perform the following steps in removing these screws:

CAUTION

It is important to follow the procedure described below in removing the crucible mounting screws. The compressed O-ring exerts considerable upward force against the crucible, and the counter-pressure exerted by the mounting screws must be relieved evenly to prevent damage to the screws or the threads in the crucible-mounting flange.

Figure 4-6 Removing Crucible Mounting Screws



a) A. Remove the two screws in the back of the crucible.

b) B. Rotate the crucible 180° and loosen the six remaining screws 1/2 turn, beginning with the two screws that are now in the rearmost position.

c) C. Remove these six screws, beginning with the two in the rearmost position.

7 Screw the knurled thumbscrew into the tapped hole provided for it in the top of the crucible. Then rotate the crucible so that the off-center thumbscrew is toward the rear of the source, as shown in Figure 4-7.

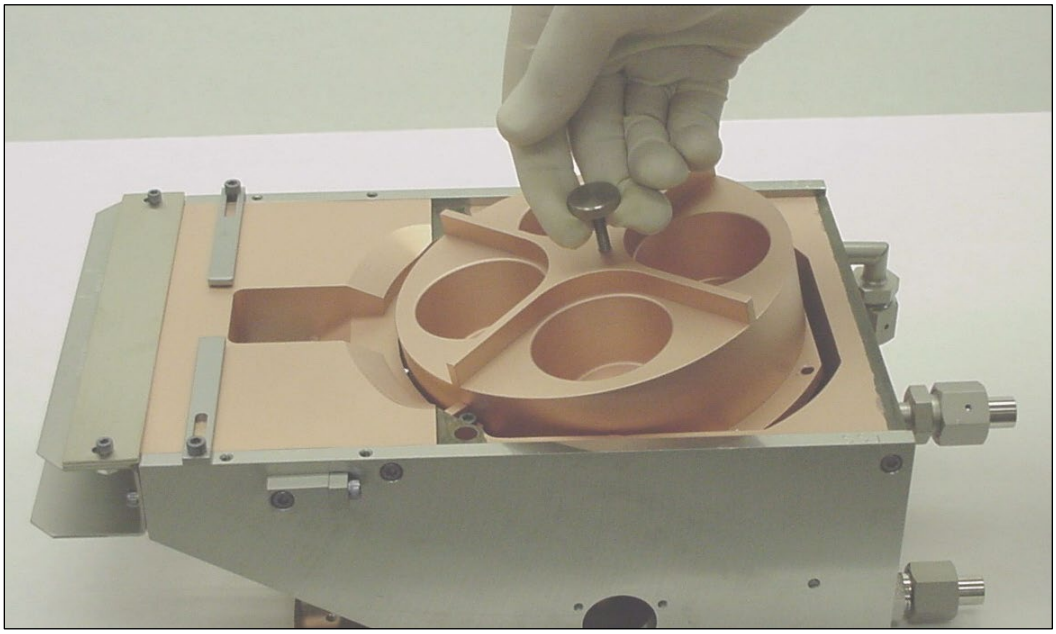
8 Remove the crucible from the source, following the steps described below to avoid damaging the O-ring-sealing surface on the base of the crucible. If scraped against the stainless steel water baffle protruding beneath the exposed pocket, this surface can easily be scratched deeply enough that the O-ring in the crucible-mounting flange will no longer seal correctly.

a) A. Grasp the knurled thumbscrew and use it to lift the crucible straight up as far as it will go.

b) B. Raise rear edge of the crucible until it just clears the surface of the coil housing just behind the crucible.

c) C. Pull the crucible clear of the coil housing by angling it upward and backward at the same time, as shown in Figure 4-8. (Note: That illustration shows a 2CK source, but the procedure is identical for a 2PT or 3PT source.) As you remove the crucible, take great care not to scrape the crucible's O-ring-sealing surface on the water baffle.

Figure 4-7 Removing Crucible from Source (Note Angle of Withdrawal)



4.5.3 Crucible Replacement

Perform the steps described below when installing a new crucible or reinstalling the same crucible. Be sure to follow the correct procedure when placing the crucible into the crucible well and lowering it onto the crucible-mounting flange. It is also critical to follow the correct procedures when replacing the crucible mounting screws. In particular, avoid dropping screws down into the source, as it may not be possible to retrieve them without disassembling the source further. For best results, ensure the special Allen tool is used for each screw, shown in Figure 4-5, before attempting to insert the screw in place.

1 Make sure the crucible-mounting flange is in a position that allows you to see six of the eight screw holes.

2 Angle the crucible into the position shown in Figure 4-8. Then lower its rear end so that its bottom surface is horizontal, and lower it straight down onto the O-ring.

CAUTION

Be careful not to scrape the underside of the crucible against the stainless steel water baffle, as doing so may damage the O-ring-sealing surface on the bottom of the crucible.

3 Rotate the crucible until all six threaded holes are visible through the holes in the crucible's base.

4 Insert screws into the six accessible holes and screw them down enough to partially compress the O-ring. As you do so, work your way around the periphery of the crucible in a star-shaped pattern, tightening all sides evenly and gradually.

5 Rotate the crucible so that the other two screw holes are visible, insert screws into them, and tightening them about the same amount as you have already tightened the other six screws.

6 Working your way around the crucible in a star-shaped pattern, continue tightening the screws in two more stages, until you can tell that the O-ring is completely compressed.

7 Replace the crucible cover.

5 Source Disassembly

5.1 Section Overview

This section describes in detail the correct procedure for disassembling the source. The procedures described in this section should be followed whenever the source is partially or completely disassembled for cleaning or for replacement of O-rings or other parts. Section 5.2 provides general working guidelines and describes the procedures for removing the source from the vacuum system and disassembling its major components, leaving only the emitter assembly, the bearing housing assembly, and the drive assembly intact. Section 5.3 describes how to disassemble the pneumatic drive assembly is disassembled, and Section 5.4 and 5.5 provides the same information for the hearing housings and the drive shaft. For information on rebuilding emitters, contact Temescal Customer Service for access to videos showing those procedures.

For information on rebuilding the source's emitter assembly, contact Temescal Customer Service for access to a video demonstrating that procedure.

5.2 Source Removal and Disassembly

5.2.1 General Guidelines

Follow the guidelines described below when performing any disassembly procedure. The purpose of these guidelines is to limit risks to the person performing the disassembly, to minimize vacuum system contamination, and to simplify reassembly wherever possible.

Step	Action
1	Make sure the electron beam power supply is switched OFF. If the power supply is on its own keylocked circuit, open the circuit breaker at the service panel and lock it out. If not, switch off the power supply with its keylock, if it is equipped with one, and keep the key in your possession while working on the source.
2	Use a properly connected grounding hook to discharge any residual high-voltage charge in and about the vacuum cabinet. Components that should be discharged with a grounding hook include the filament transformer, the high-voltage feedthroughs, and the in-vacuum high-voltage leads.
3	To minimize system contamination, wear some form of lint-free head covering and rubber surgical gloves when removing the source from the vacuum chamber. During the actual source disassembly process, wear the rubber gloves when handling any parts that will not be chemically cleaned before reinstallation.

5.2.2 Perform Preliminary Procedures

Follow the procedure described below before proceeding with source disassembly.

Step	Action
1	Switch off the circuit breaker that supplies power to the high-voltage power supply.
2	Lock out and tag out this breaker in compliance with applicable local safety regulations.
3	Touch a properly connected grounding hook to the high-voltage feedthroughs.
4	Remove the shielding from the in-vacuum high-voltage leads.
5	Touch the grounding hook to these high-voltage leads.
4	Disconnect the high-voltage leads from the source's emitter bus bars.

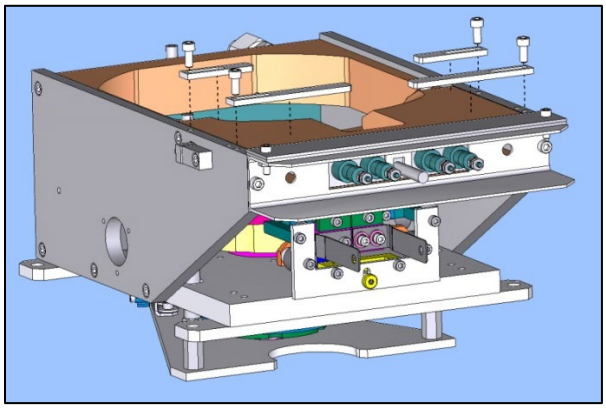
5.2.3 Remove the Crucible Cover, the Crucible, and the Emitter Assembly

Perform the following steps with the source in situ on the source tray.

Step	Action
1	Remove the crucible cover and crucible, following the procedure described in section 3.5.
2	Remove the emitter assembly, following the procedure described in section 5.2.

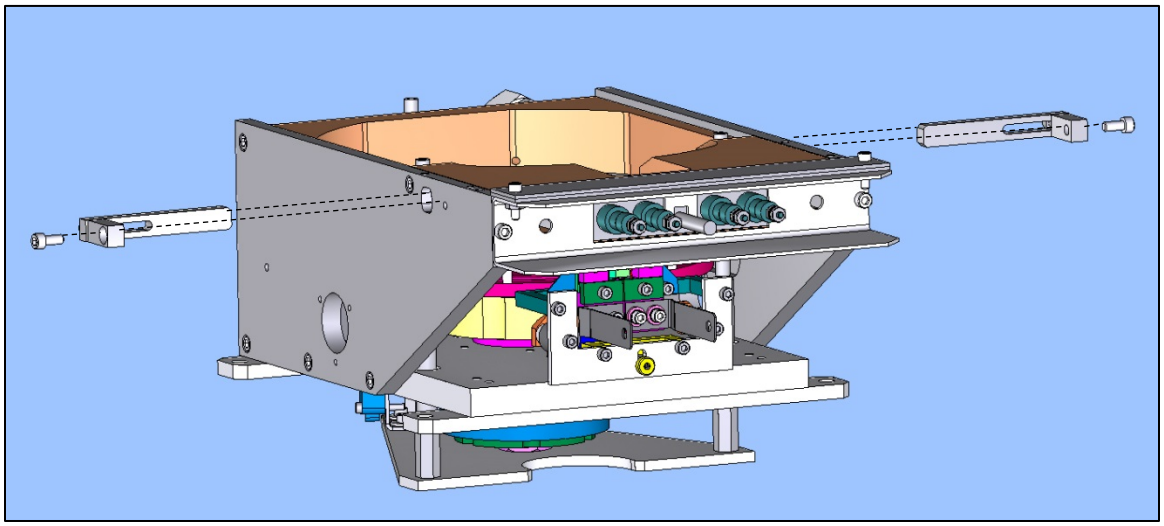
3 Remove the external pole piece extensions, as shown in Figure 5-1

Figure 5-1 Removing the External Pole Piece Extensions



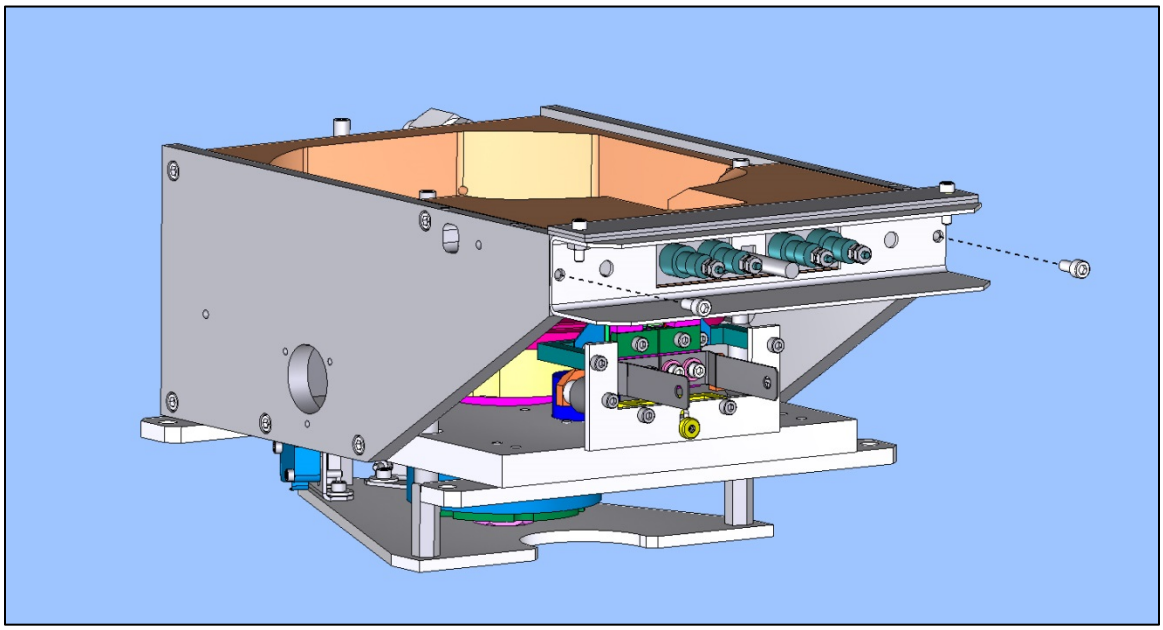
4 Remove the internal pole piece extensions, as shown in Figure 5-2.

Figure 5-2 Removing the Internal Pole Piece Extensions



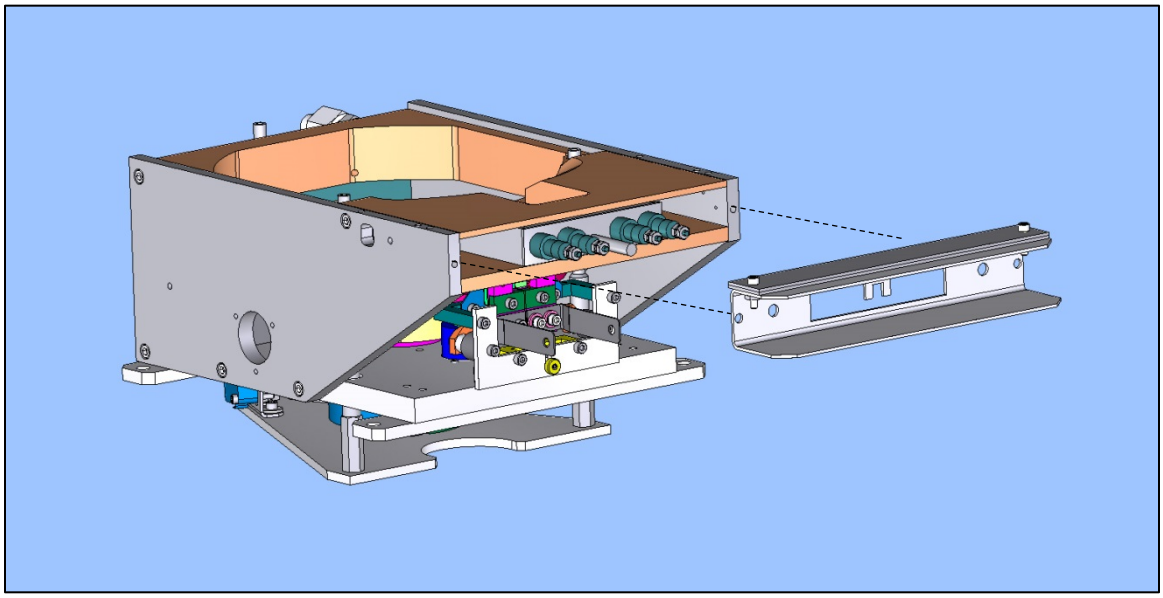
5 Remove the screws that secure the coil shield to the pole pieces, as shown in Figure 5-3

Figure 5-3 Removing the Screws Securing the Coil Shield



6 Remove the coil shield, as shown in Figure 5-4.

Figure 5-4 Removing the Coil Shield



7 Pull the coil assembly straight out of the coil housing.

5.2.4 Remove the Source from the Vacuum Chamber

Follow the procedure described below in disconnecting power and water from the source and removing it from the vacuum chamber.

Step	Action
1	Disconnect the deflection coil leads from the source's deflection coil terminals.
2	Switch off the source's water supply.
3	Disconnect the water supply and outlet lines at some point outside the vacuum chamber.
4	Connect a compressed air line to the water supply line you just disconnected and use compressed air to blow the water out of the source.
5	Disconnect the water supply and outlet lines from the source.
6	Turn off the gun's air supply and safely release any compressed air left in the lines.
7	Disconnect the air supply, return, and vents VCR lines from the source.
8	Disconnect the external rotary drive to the source. If the source is a bottom drive unit, disconnect the source's drive shaft from the rotary feed-through in the source tray. If this is a side-drive unit, disconnect the gun's drive shaft from the coupling that connects it to the drive shaft from the rotary feed-through in the side of the chamber.
9	Remove the bolts that secure the source's mounting straps to the source tray.
10	Remove the source from the source tray and place it upside down on a suitable work bench.

5.2.5 Disassembling the Major Source Components

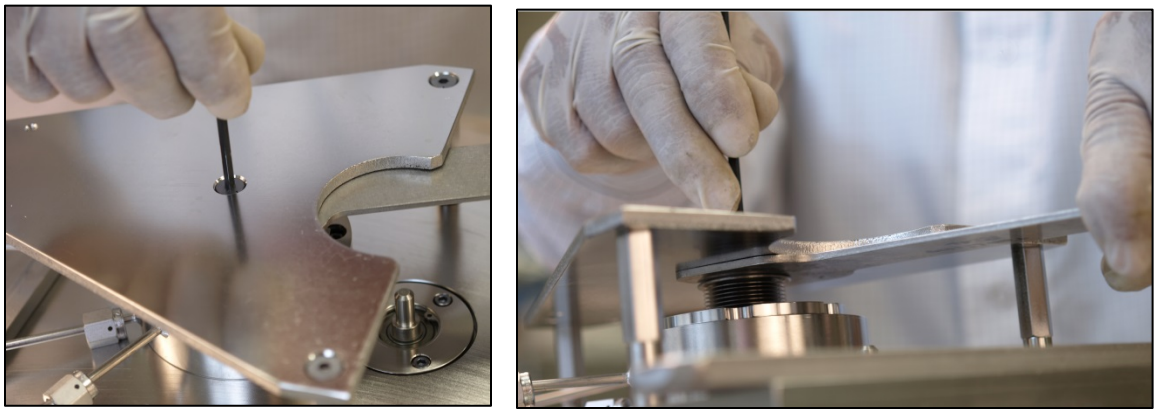
The following procedure describes how the source is disassembled to the point shown in Figure 5-37 for the 2PT source and Figure 5-38 for the 3PT source. In general, it is best to avoid disassembling anything that does not have to be disassembled. In particular, avoid removing the magnet stops and the pneumatic cylinder from the source's base plate or the ring gear from the crucible mounting flange, unless it is absolutely essential, as realignment of these parts is somewhat complicated. The slotted magnet stops can only be replaced accurately if you put the permanent magnet in place beforehand and check its placement with respect to the parts that must abut it when the source is fully assembled. Detailed instructions for aligning the ring gear are provided in section.

CAUTION

Pay attention to the lengths of the screws you remove at each stage of this disassembly procedure. There are several different screw lengths, and it is critical to replace the correct screws in each location.

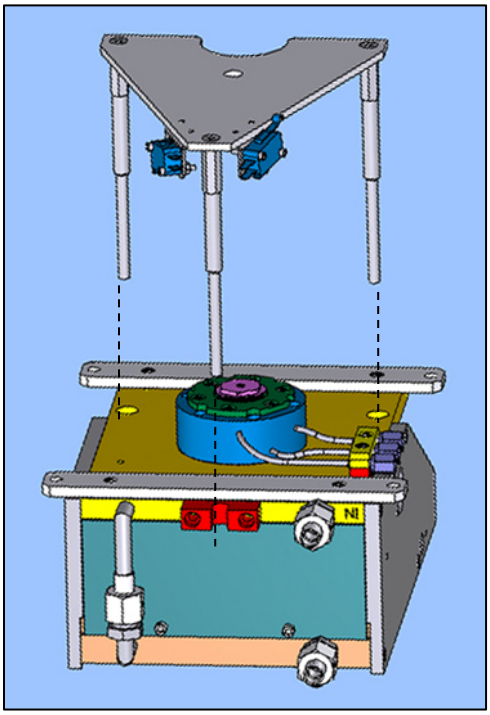
Step	Action
1	With the source resting upside down on a clean work surface, remove the 10-32 flat-head screw from the center of the spider plate (see Figure 5-5). Note: To avoid twisting the bellows as you loosen this screw, hold the hex adapter attached to the bellows with the thin 7/8" open-end wrench supplied with the Spares Kit.

Figure 5-5 Removing the Screw Securing Spider Plate to Pneumatic Cylinder



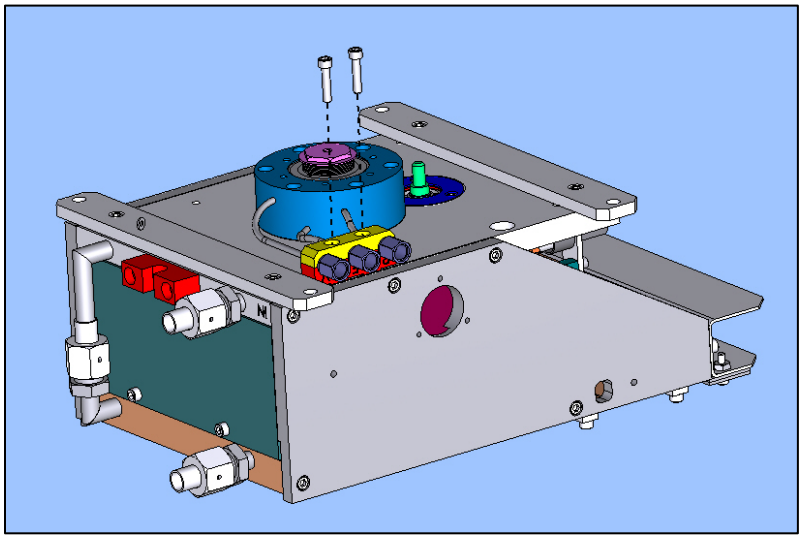
Step	Action
2	Pull the spider plate, with push rods and limit switches attached, straight up until the pushrods are clear of their holes in the baseplate (see Figure 5-6). Push rods, limit switches, and limit switch brackets can now be replaced as necessary.

Figure 5-6 Removing Spider Plate, Pushrods, and Limit Switches



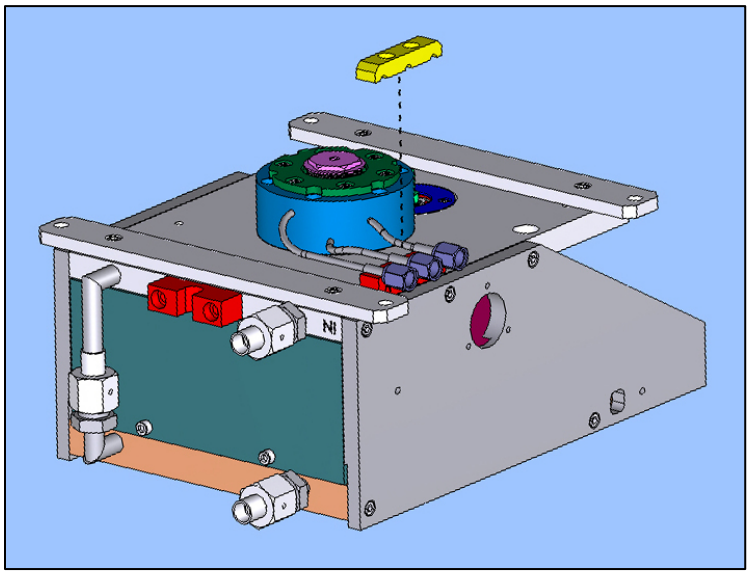
3 Remove the screws that secure the VCR clamp block to the source baseplate, as shown in Figure 5-7 .

Figure 5-7 Removing Screws Securing VCR Clamp Block to Source Baseplate



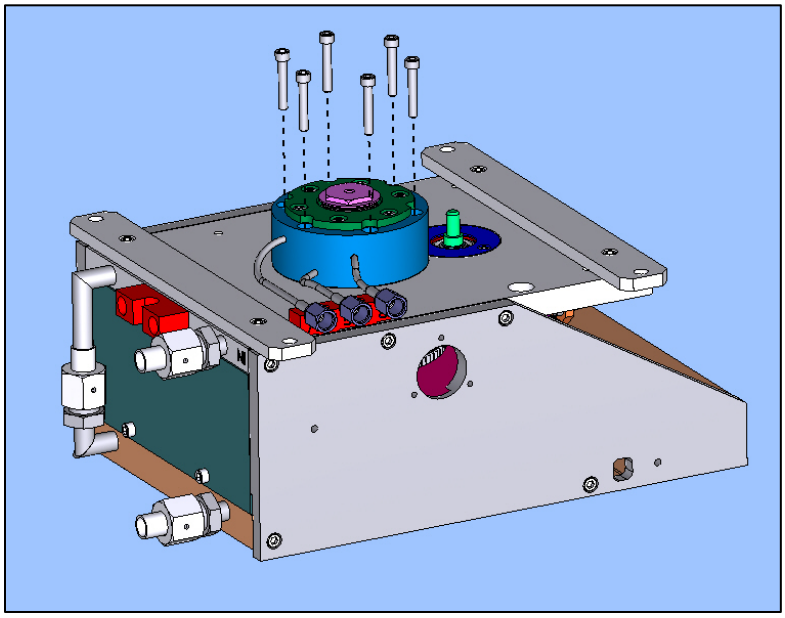
4 Remove the cap of the VCR clamp block, as shown in Figure 5-8.

Figure 5-8 Removing Cap of VCR Clamp Block



5 Remove the six socket head screws (see Figure 5-9) that secure the pneumatic assembly to the baseplate.

Figure 5-9 Removing Screws Securing Pneumatic Assembly to Source Baseplate



6 Remove the pneumatic assembly, with airlines and VCR fittings attached (see Figure 5-10). For detailed instructions on disassembling the pneumatic assembly, see section 0.

Note

Try to remove the sealing disk along with the pneumatic assembly. Alternatively, hold the sealing disk in place with one hand, as shown in Figure 5-11, while you remove the pneumatic assembly with the other. If you do neither of these things, the sealing disk will be drawn forcefully toward the rear mounting strap by the permanent magnet.

Figure 5-10 Removal of Pneumatic Assembly

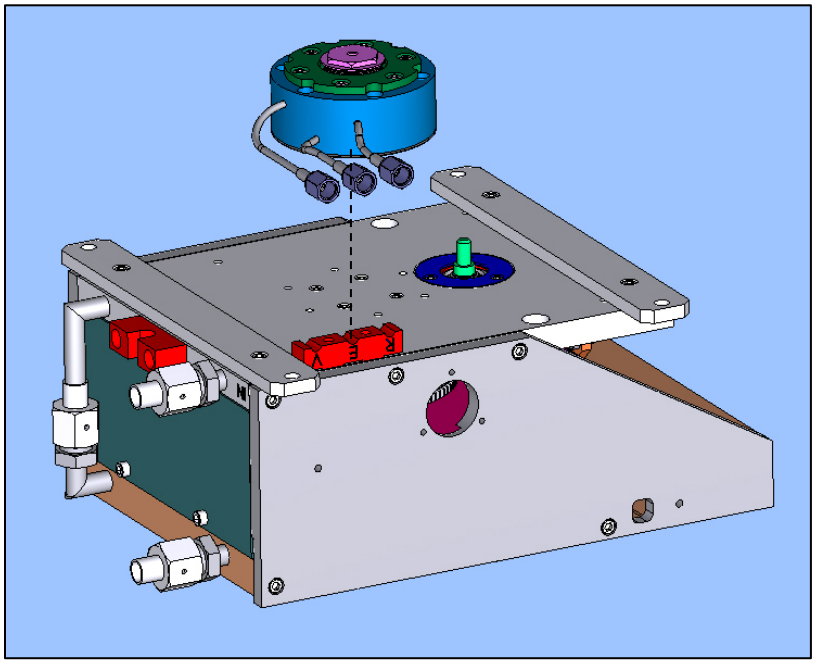
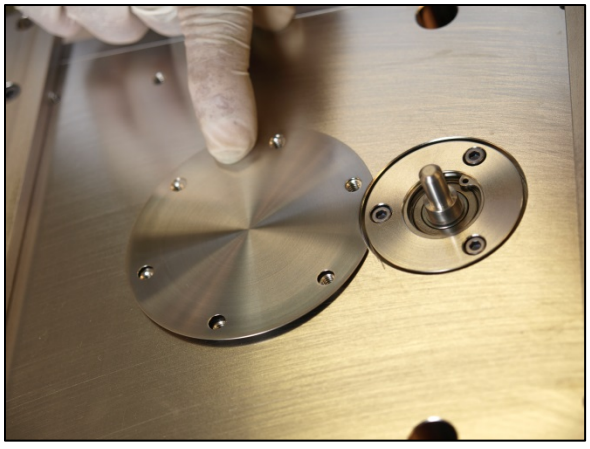


Figure 5-11 Sealing Disk Held in Place Against Force of Permanent Magnet

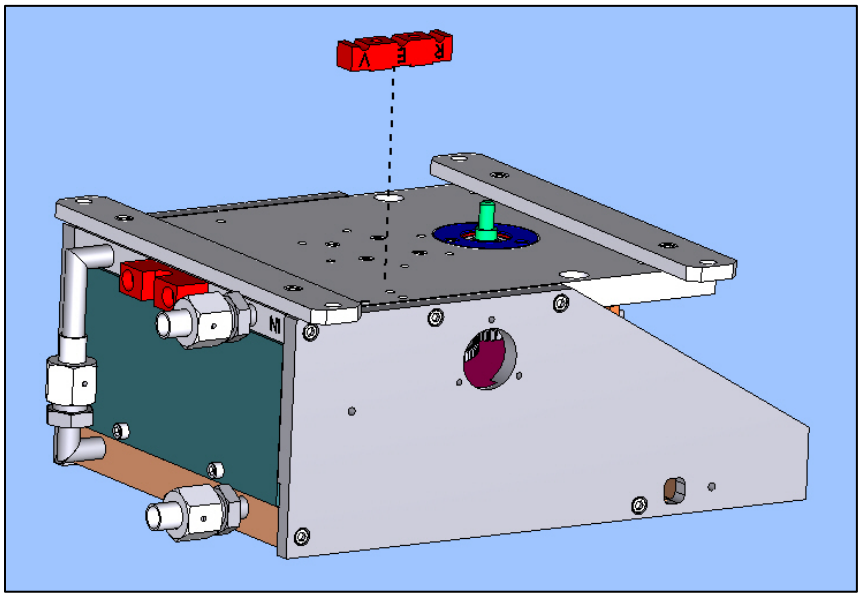


Note orientation of sealing disk, with its cutout for the drive assembly.

7 Remove the sealing disk, if you did not do so in Step 6.

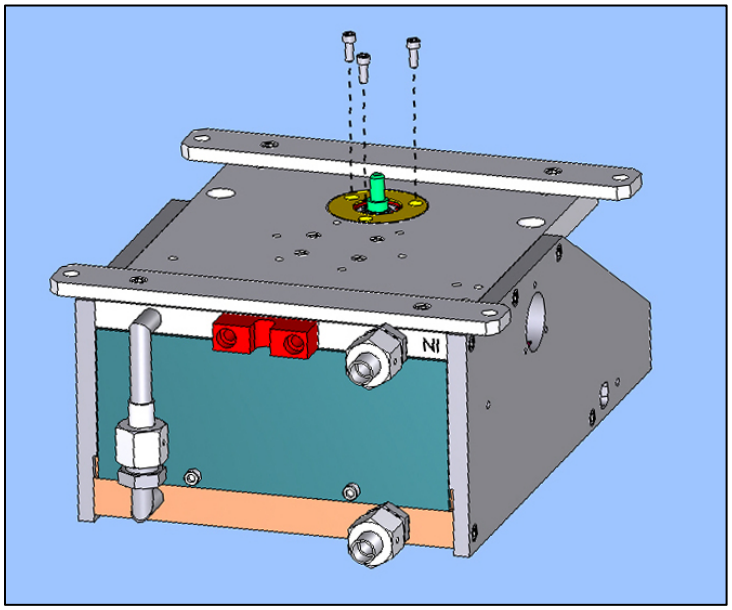
8 Lift away the base of the VCR clamp block, as shown in Figure 5-12.

Figure 5-12 Removing Base of VCR Clamp Block



9 If this is a bottom-drive source, turn it over and remove the three screws that secure the drive assembly to the source (see Figure 5-13) and remove the drive assembly. For instructions on disassembling the drive assembly, see section 5.5.

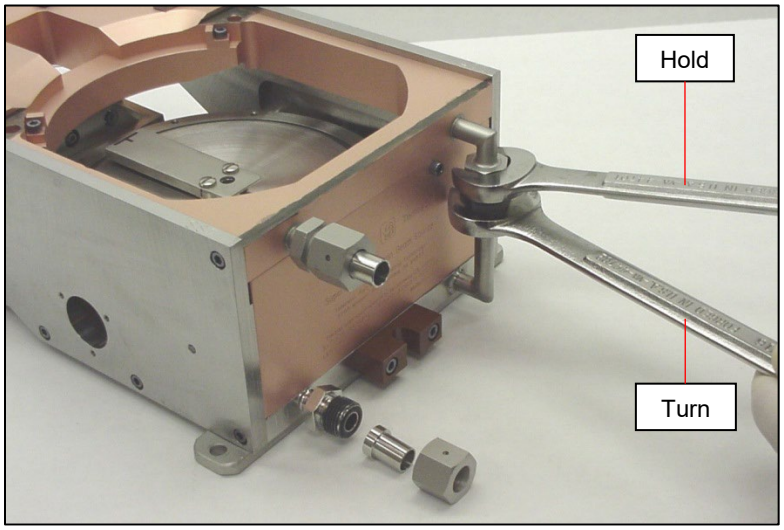
Figure 5-13 Removing Screws Securing Bottom Drive Assembly



10 If this is a side-drive gun, remove the screws that secure the side-drive assembly to the left- or right-hand pole piece, as the case may be. Then remove the drive assembly.

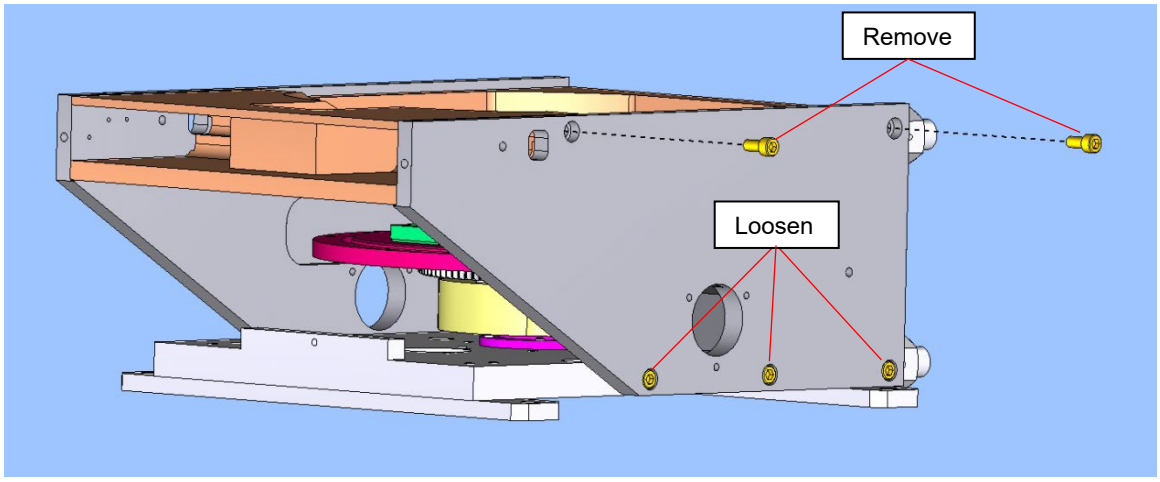
11 Turn the source over and uncouple the tube that connects the gun's upper and lower water circuits. Using appropriate wrenches, hold the nut soldered onto the fitting connected to the coil housing while turning the coupling on the fitting connected to the base plate (see Figure 5-14).

Figure 5-14 Uncoupling the Water-Crossover Tube (2CK Gun Shown)



12 Remove the screws that secure the right-hand pole piece to the coil housing and loosen the screws that secure that pole piece to the source base plate (see Figure 5-15).

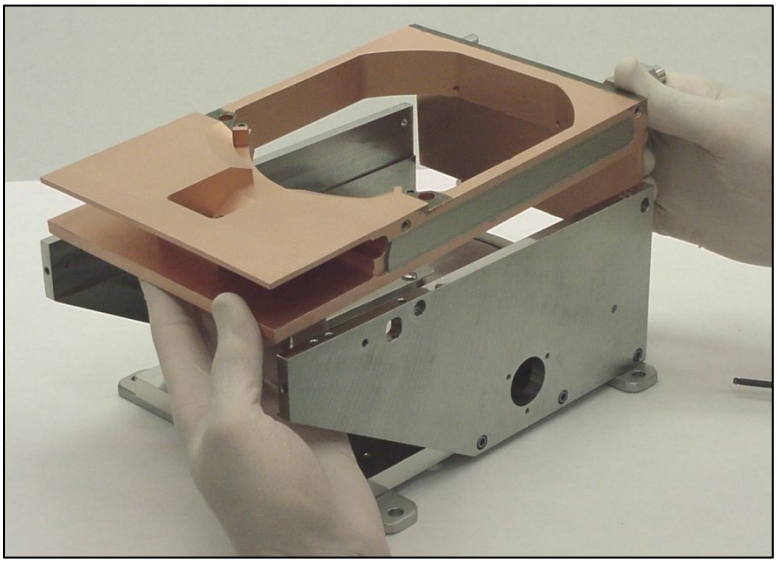
Figure 5-15 Removing Screws Securing RH Pole Piece to Coil Housing



13 Remove the screws securing the left-hand pole piece to the coil housing.

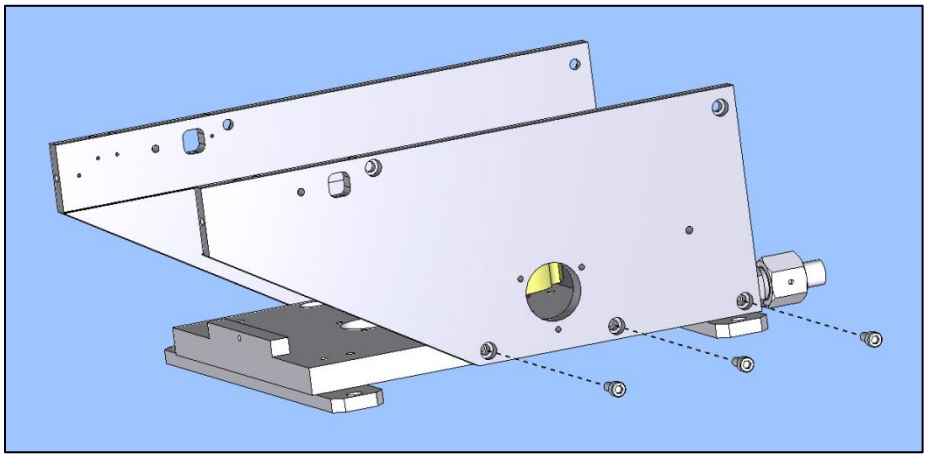
14 You should now be able to lift the coil housing free of the pole pieces, as shown in Figure 5-16. If not, loosen the bottom row of screws that secure the left-hand pole piece to the source base plate.

Figure 5-16 Removing the Coil Housing



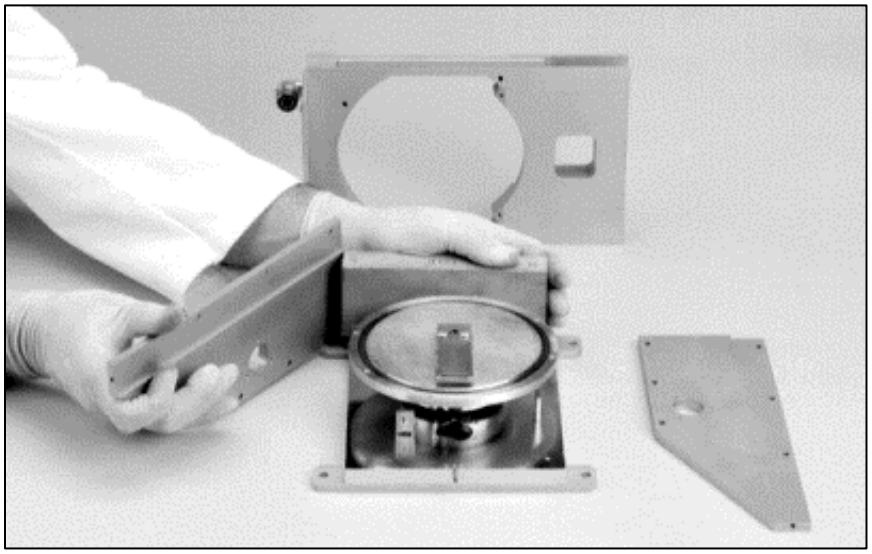
15 Remove the screws that secure the pole pieces to the source base plate (see Figure 5-17).

Figure 5-17 Removing Screws that Secure LH Pole Piece to Base Plate



16 Remove the pole pieces from the remainder of the source. To do so, grasp the permanent magnet with one hand and the angled front end of the pole piece with the other, as shown in Figure 5-18. Then swing the front of the pole piece away from the source and carefully separate it from the rear edge of the magnet, rocking it slowly up and down if necessary to break it free from the magnet's very strong field.

Figure 5-18 Correct Technique for Detaching a Pole Piece



Caution

As you perform this step, take care to avoid getting your fingers between the pole piece and any other part of the source. One or more of your fingers could easily be injured if the pole piece should slip from your grasp. In that event, the pole piece could snap back tight against the magnet and base plate with great speed and force, resulting in possible injury to a finger caught between two metallic parts.

17 Carefully remove the permanent magnet from the base plate. To do so, push it to one side until it is clear of the crucible mounting flange (see Figure 5-19). Then raise the end extending beyond the baseplate and pull the magnet away from the baseplate (see Figure 5-20).

Figure 5-19 Pushing Magnet Clear of Crucible Mounting Flange

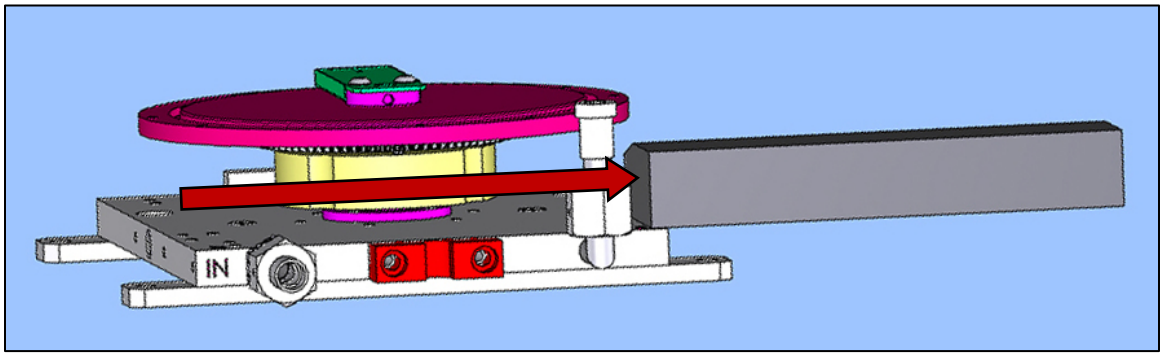
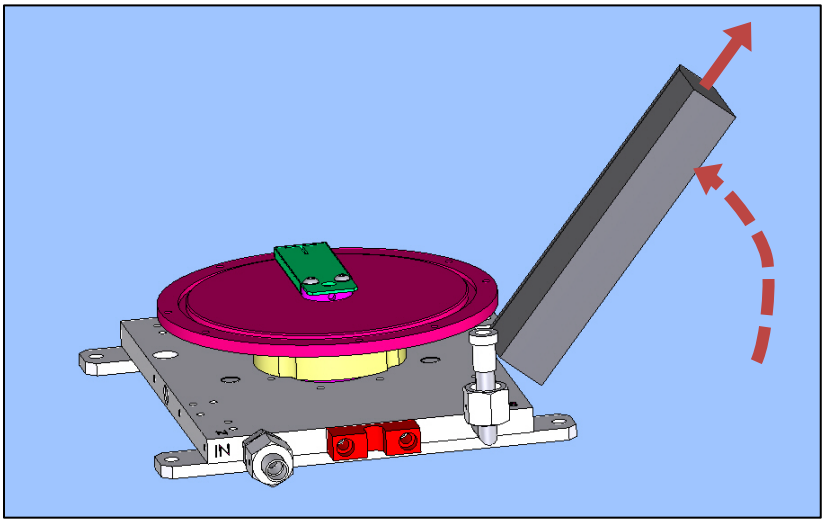


Figure 5-20 Detaching Magnet from Baseplate

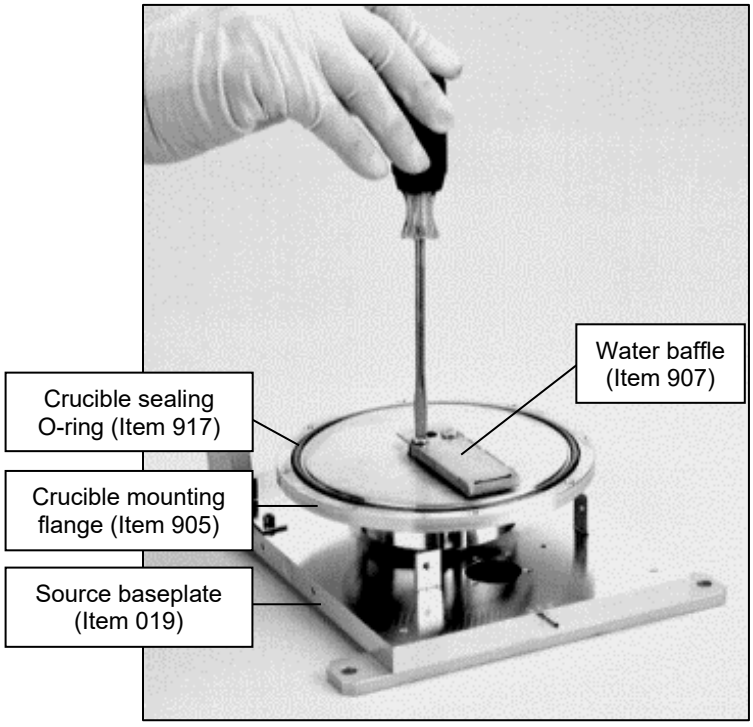


Caution

To minimize the risk of degaussing the magnet, always place it on a nonmagnetic surface such as plastic or wood when it is not installed in the source. When handling the magnet, make sure that it does not ×drop onto or otherwise strike any hard surface.

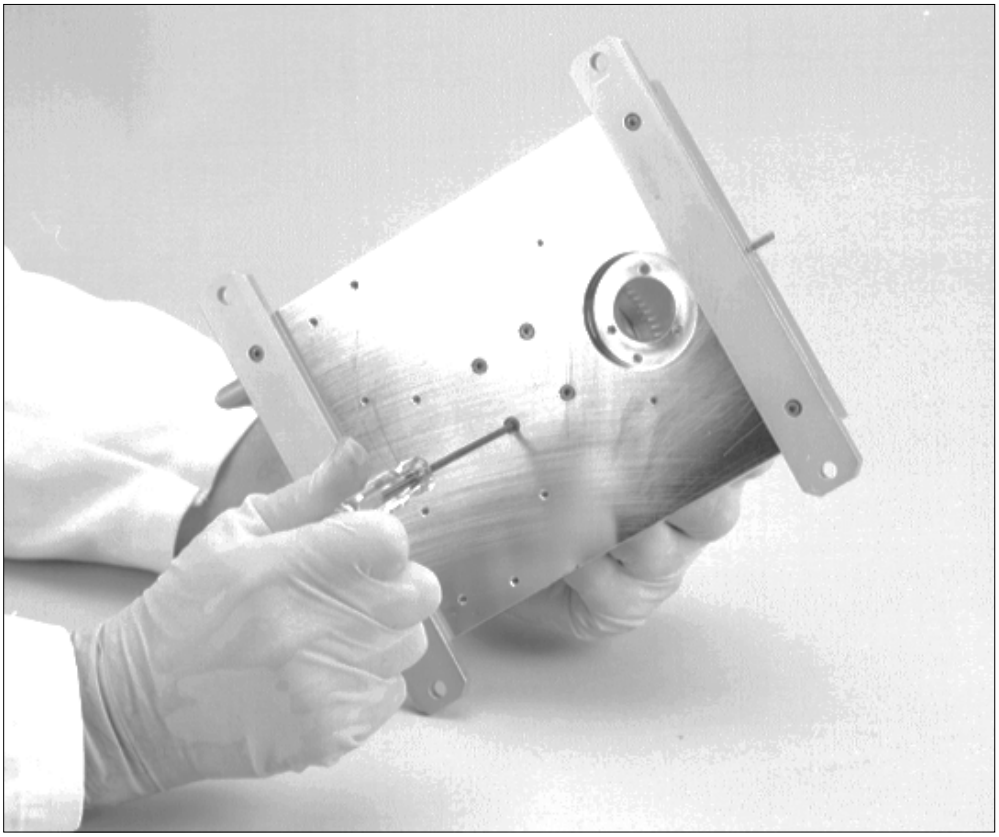
18 Remove the two 8-32 × 1/5-in. screws (Item 913) that secure the water baffle to the pivot shaft (see Figure 5-21) and remove the water baffle.

Figure 5-21 Removal of Screws Securing Water Baffle



19 Holding the source by the crucible mounting flange, as shown in Figure 5-22, remove the four screws that secure the pivot shaft of the bearing housing assembly to the source baseplate. Then you can remove the bearing housing assembly and the crucible mounting flange from the baseplate.

Figure 5-22 Removing Screws that Secure Crucible Mounting Flange and Bearing Housing Assembly to Source Baseplate

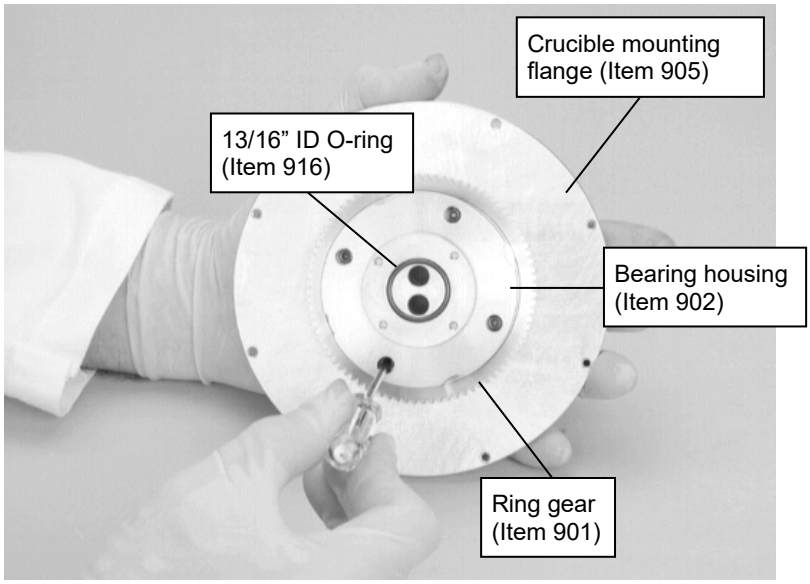


Note

The four holes in the base plate for mounting the bearing housing assembly are not arranged in a rectangle but are asymmetrical, with one hole slightly farther off center with respect to the other four. This arrangement ensures that the bearing housing assembly can be mounted in only one orientation, that is, with the water baffle point toward the front of the source. When reassembling, make sure that you can see all four tapped holes in the pivot shaft through the holes in the base plate before you insert and tighten any screws.

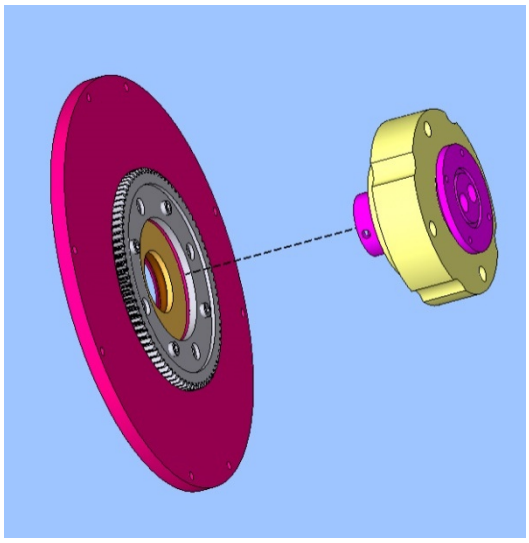
20 Holding the crucible mounting flange as shown in Figure 5-23, remove the four screws that secure the bearing housing assembly to the ring gear, which is attached to the crucible-mounting flange. To do so, use the 7/64" Allen driver supplied with the source. For detailed instructions on disassembling the bearing housing assembly, see section 0.

Figure 5-23 Removing Screws Securing Bearing Housing Assembly to Ring Gear



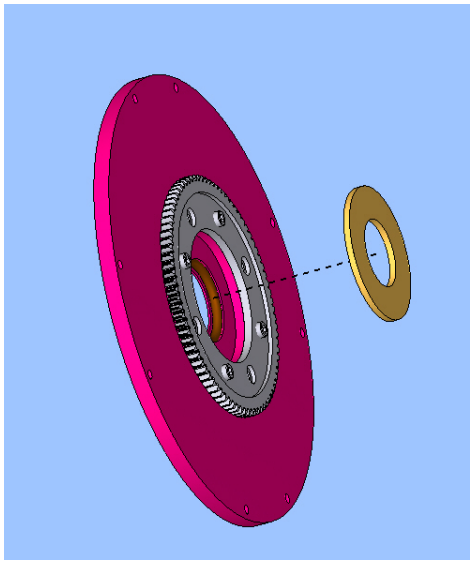
21 Holding the crucible mounting flange as shown in Figure 5-23, remove the bearing housing assembly from the crucible mounting flange, as shown in Figure 5-24.

Figure 5-24 Removing Bearing Housing Assembly from Ring Gear



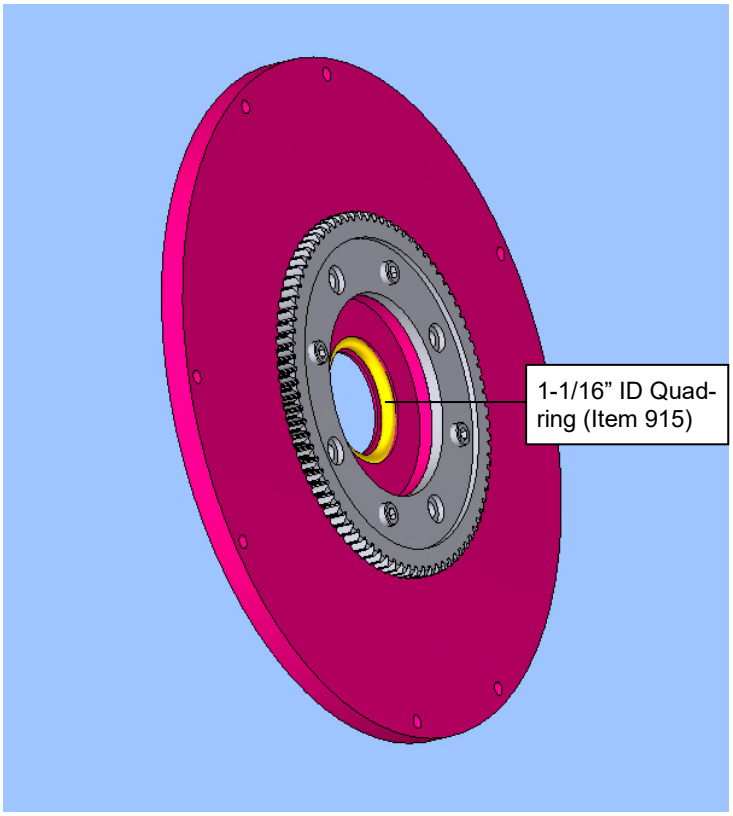
22 Remove the bronze backup washer (Item 909) from the crucible mounting flange, as shown in Figure 5-25.

Figure 5-25 Removing Bronze Backup Washer from Crucible Mounting Flange



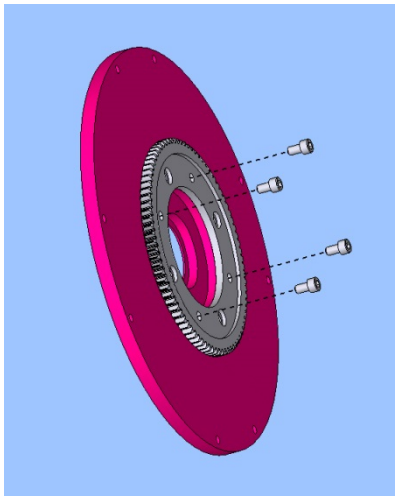
23 Remove the 1-1/16" ID quad ring (highlighted in Figure 5-26) from the crucible mounting flange.

Figure 5-26 Quad Ring Highlighted in Crucible Mounting Flange



24 If necessary, remove the ring gear from the crucible mounting flange. To do so, remove the four screws shown in Figure 5-27.

Figure 5-27 Removing Screws Securing Ring Gear to Crucible Mounting Flange

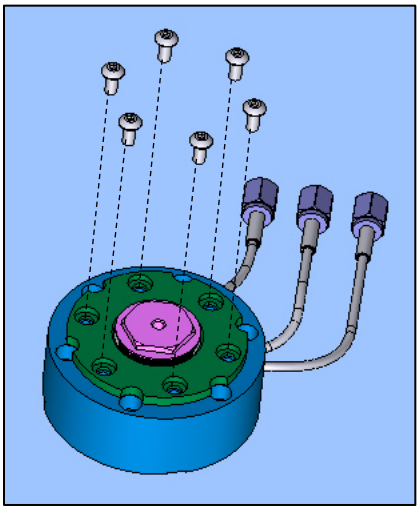


5.3 Disassembling the Pneumatic Drive Assembly

Step Action

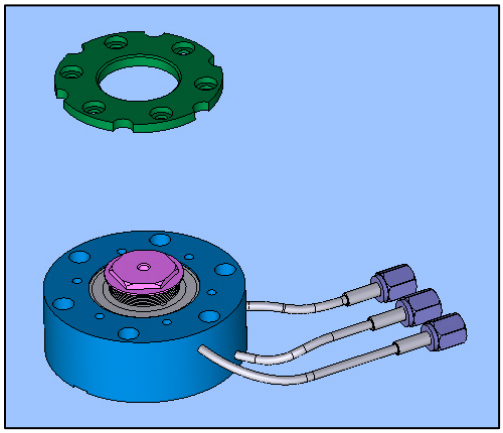
1 Remove the eight buttonhead screws that secure the clamp ring to the top of the pneumatic cylinder (see Figure 5-28).

Figure 5-28 Removing Screws that Secure Clamp Ring to Pneumatic Cylinder



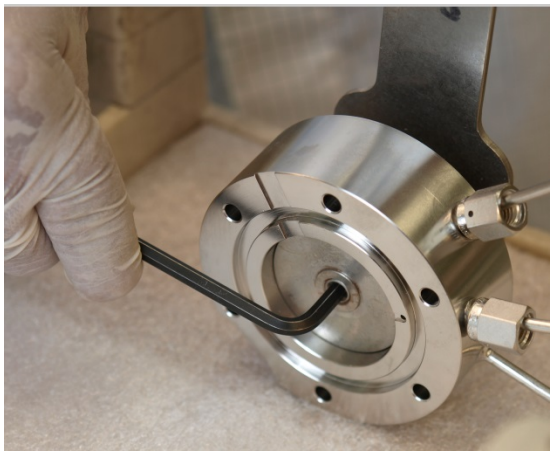
2 Lift away the clamp ring as shown in Figure 5-29, taking care to ensure that the central surface of the clamp ring does not touch the bellows.

Figure 5-29 Removing Clamp Ring from Pneumatic Cylinder



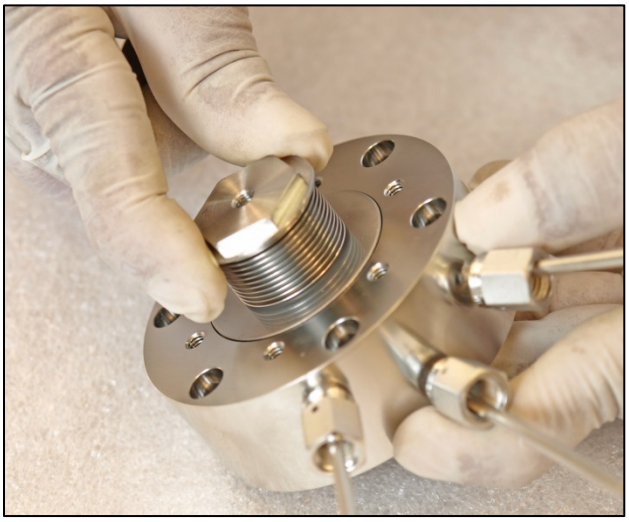
3 Loosen the hex adapter that secures the bellows to the piston. To do so, use the thin 7/8” wrench supplied with the Spares Kit to turn adapter while holding a 5/32” Allen key wrench in the set screw in bottom cylinder, as shown in Figure 5-30.

Figure 5-30 Loosening Bellows from Piston of Pneumatic Drive Assembly



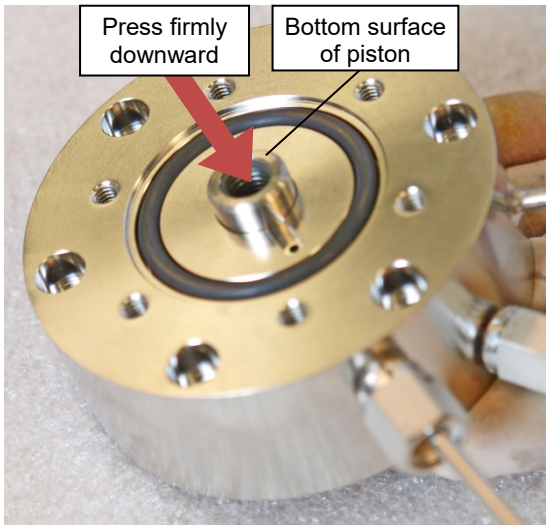
4 Manually unscrew the adapter and bellows from the piston (see Figure 5-31) and remove them from rest of the assembly.

Figure 5-31 Manually Unscrewing Adapter and Bellows from Piston



5 Push the piston out of the pneumatic cylinder, as shown in Figure 5-32.

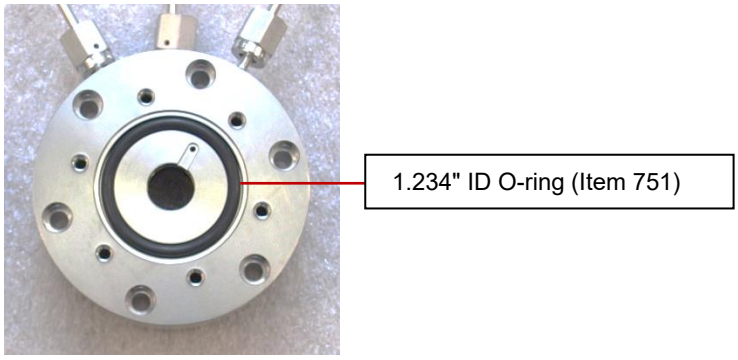
Figure 5-32 Removing Piston from Pneumatic Cylinder



6 Remove the 1.234" ID O-ring (Item 751) from the piston.

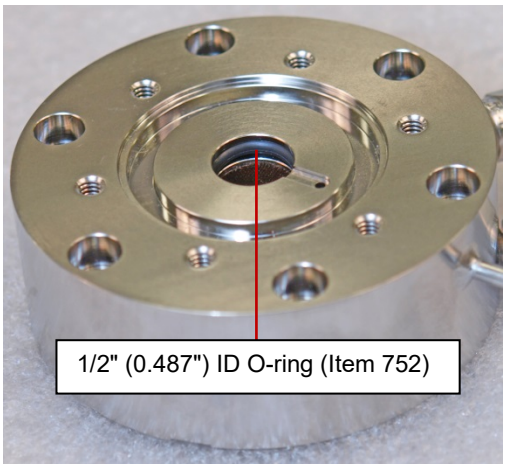
7 Remove the 1.234" ID O-ring (also Item 751) from bottom of the pneumatic cylinder (see Figure 5-33).

Figure 5-33 Removing O-Ring from Bottom of Pneumatic Cylinder



8 Remove the 1/2" ID O-ring from center of the pneumatic cylinder (see Figure 5-34).

Figure 5-34 Removing O-Ring from Center of Pneumatic Cylinder



9 Remove the 1.859" ID O-ring from the top of the pneumatic cylinder (see Figure 5-35).

Figure 5-35 Removing O-Ring from Top of Pneumatic Cylinder

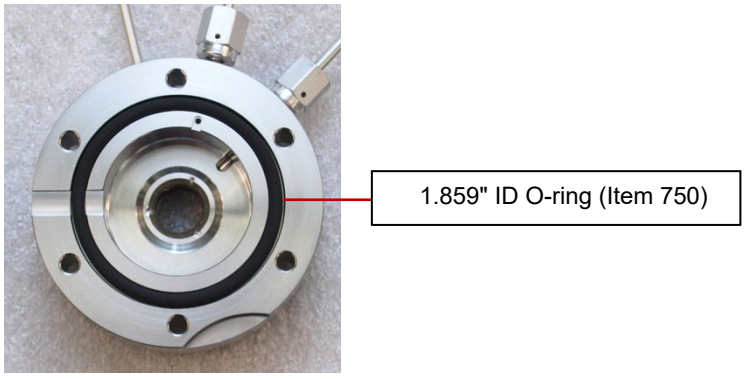
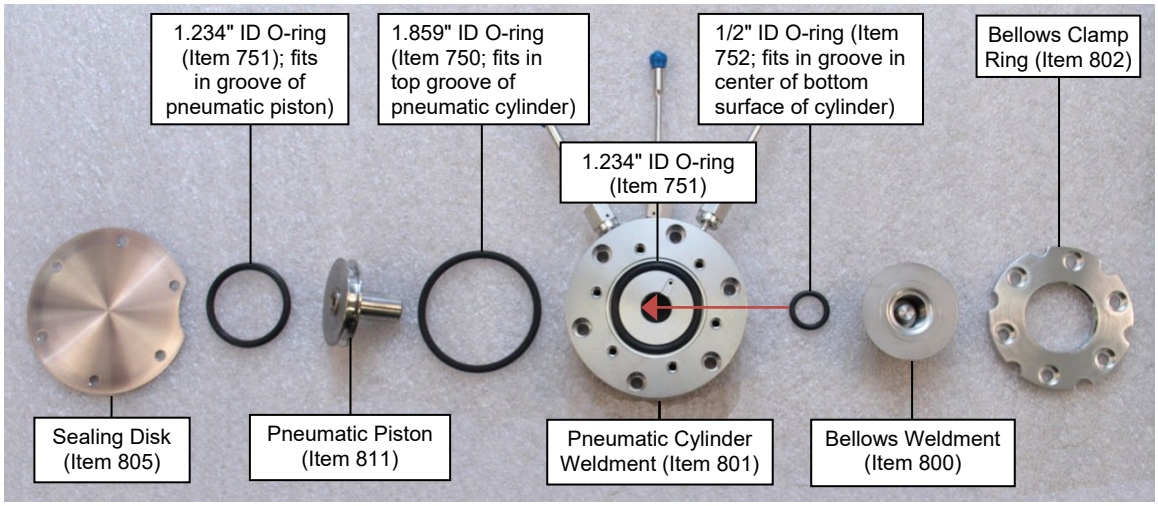


Figure 5-36 shows the parts that make up the pneumatic drive assembly.

Figure 5-36 Parts of Pneumatic Drive Assy. (Bottom of Pneumatic Cylinder Shown)



Figures 5-37 and 5-38 show the parts of the 2PT and 3PT sources as disassembled so far, with the following subassemblies still intact:

- The emitter assembly (for disassembly and reassembly instructions, see the emitter rebuild videos available from Temescal Customer Service).
- The bearing housing assembly (for disassembly instructions and parts ID, see section 5.4)
- The rotary drive assembly (for disassembly instructions and parts ID, see section 5.5)

To identify the piece parts shown in Figure 5-37, see Table 5-1. To identify the piece parts shown in Figure 5-38, see Table 5-2.

Figure 5-37 Major Piece Parts and Subassemblies of 2PT Source

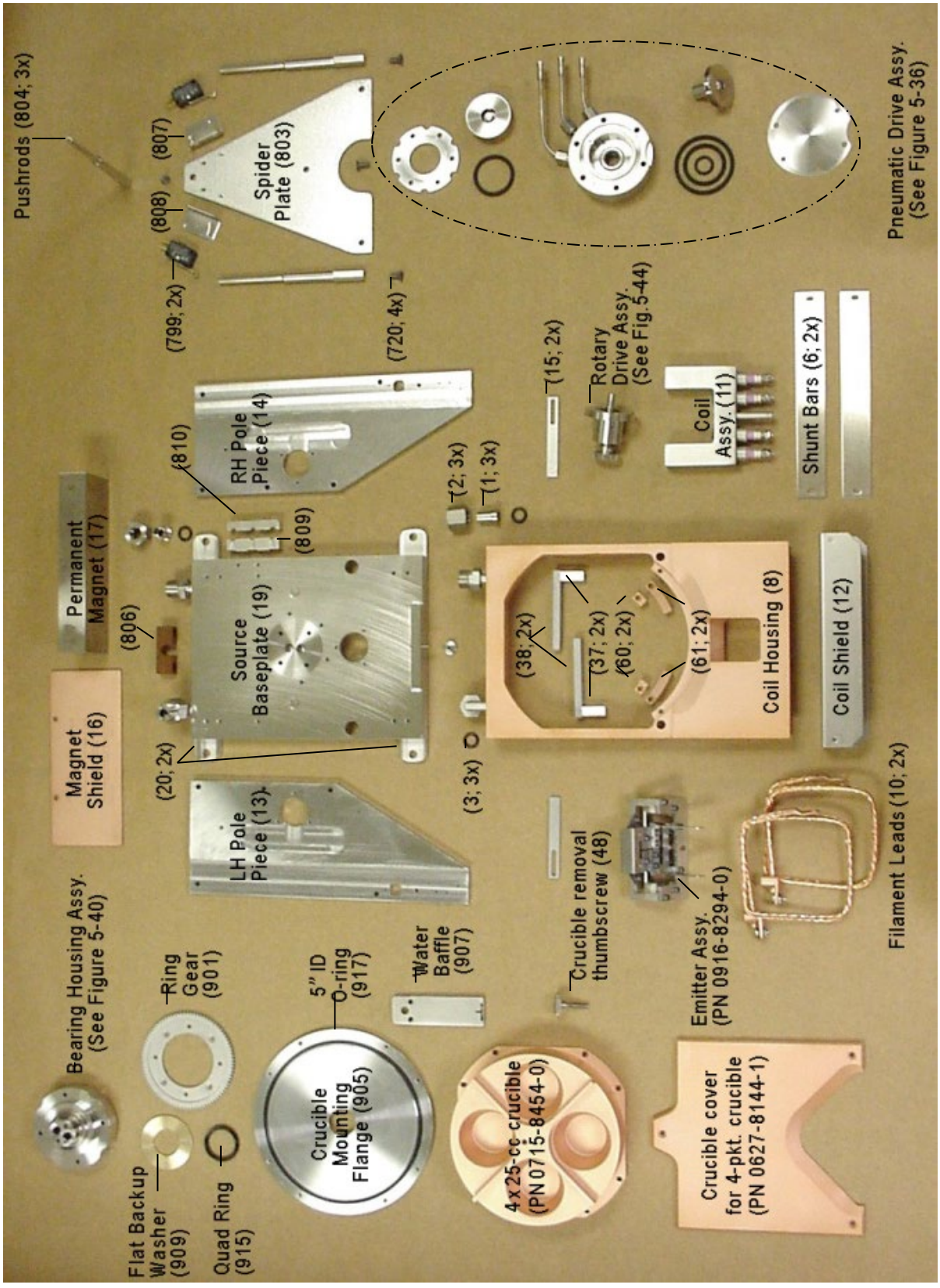


Table 5-1 Piece Parts and Subassemblies Shown in Figure 5-37

Item	Part Number	Description
001	0420-1141-2	3/8" Solder nipple, SST
002	0420-0011-2	3/8" Hex nut, SST
003	2231-0110-1	O-Ring, 3/8" ID X 3/32" W, VITON
006	0215-9311-0	Shunt Bar, STIH-270-2C
008	0626-7435-0	Coil Housing brazement W/VCO PT
010	0303-3292-0	Filament lead
011	0312-6923-0	Coil Assy.
012	0412-1452-0	Coil shield, STIH270-2C
013	0626-3785-1	Pole piece, LH W/STEP, -2CKE
014	0626-3785-2	Pole piece, RH W/STEP, -2CKE
015	0715-9412-3	External pole piece extension, 38" X 2.50" X .12" SST
016	0412-1482-1	Magnet Shield, STIH 2702 FOR -2 PT
017	0413-3902-0	Magnet, STIH 270-2M
019	0626-4355-0	Base Plate, STIH270-2 PT
020	0412-1542-0	Mounting strap, STIH-2
037	0715-9212-0	Mounting block for internal pole piece extension
038	0715-9222-3	Internal pole piece extension
048	1349-4035-0	Crucible removal thumbscrew
060	0715-8173-1	Anti-cross-contamination insert for 5-Pkt 2PT source
061	0715-8173-2	Anti-cross-contamination insert for 6-Pkt 2PT source
799	6156-1210-0	Up/down crucible cover position switch
803	0627-4833-0	Spider plate, SST
804	0627-4812-0	Pushrod, Solid, for 2PT source
806	0627-2702-0	Guide block, Vespel
807	0627-2742-0	Bracket, Limit SW, RH, PopTop
808	0627-2752-0	Bracket, Limit SW, LH, PopTop
809	0627-2722-0	Base of VCR clamp block
810	0627-2732-0	Cap of VCR clamp block
901	0503-2762-0	Ring gear
905	0412-1323-0	Crucible mounting flange
907	0412-1342-0	Water baffle assembly STIH2
909	0415-5712-1	Flat, bronze quad ring backup washer
915	2108-0215-0	Quad ring, 1-1/16" (1.046") ID X 1/16" CS
917	2231-0250-0	O-Ring, 5" ID X 1/8" W VIT
	0916-8295-0	High-performance emitter
	0627-8145-1	Crucible cover
	0715-8455-0	5-pocket crucible

Pneumatic drive assembly. To identify its piece parts, see Figure 5-36
Bearing housing assembly. To ID piece parts, see Figure 5-40.
Rotary drive assembly. To ID piece parts, see Figure 5-45.

Figure 5-38 Major Piece Parts and Subassemblies of 3PT Source

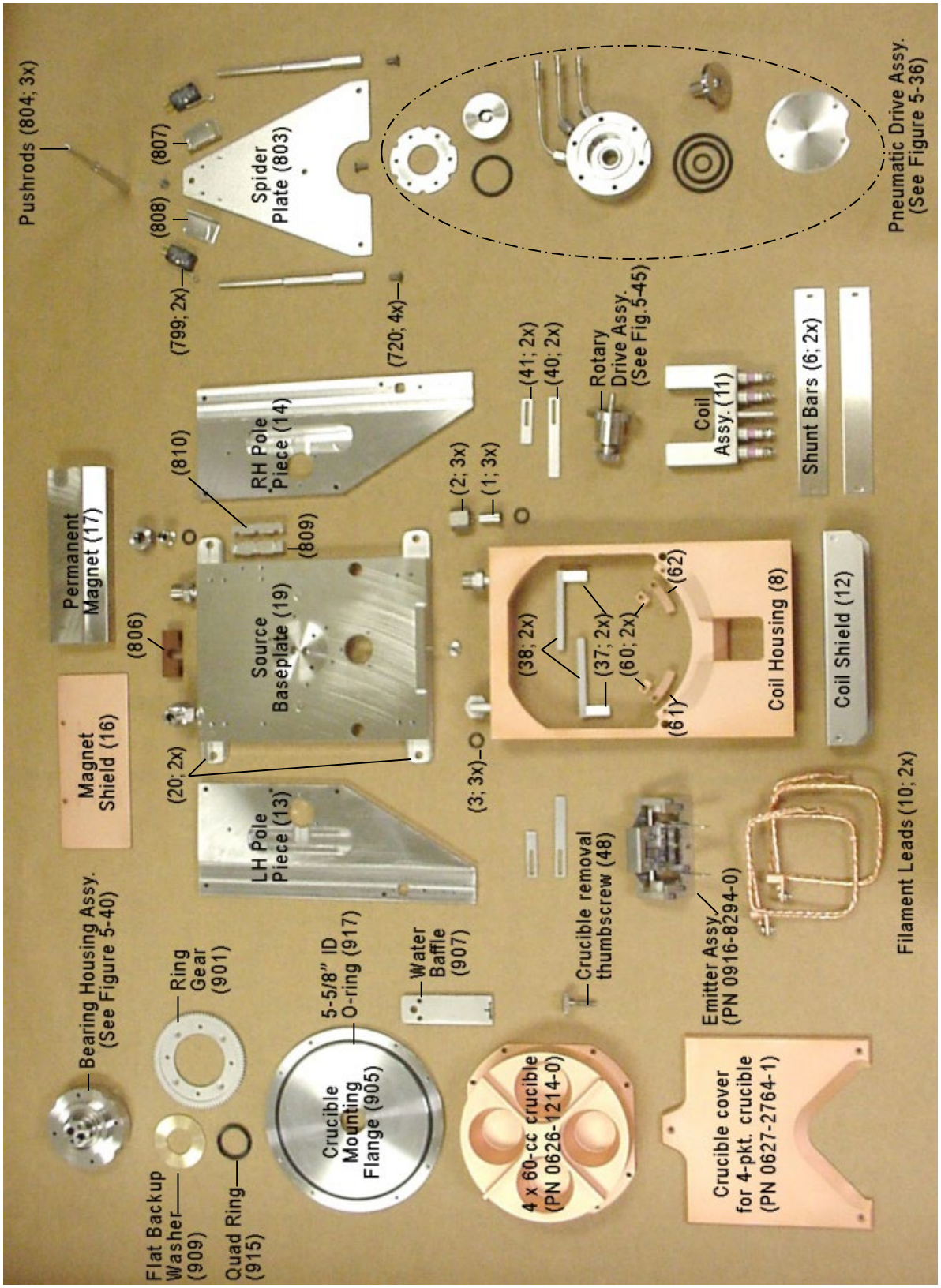


Table 5-2 Piece Parts and Subassemblies Shown in Figure 5-38

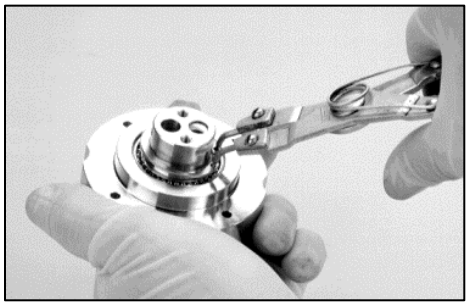
Item	Part Number	Description
001	0420-1141-2	3/8" Solder nipple, SST
002	0420-0011-2	3/8" Hex nut, SST
003	2231-0110-1	O-Ring, 3/8" ID X 3/32" W, VITON
006	0215-9311-0	Shunt Bar, STIH-270-C
008	0626-7435-0	Coil Housing brazement W/VCO PT
010	0303-3292-0	Filament lead
011	0312-6923-0	Coil Assy.
012	0412-1452-0	Coil shield, STIH270-3C
013	0626-3785-1	Pole piece, LH W/STEP, -3C
014	0626-3785-2	Pole piece, RH W/STEP, -3C
016	0412-1482-1	Magnet Shield for 3PT source
017	0413-3902-0	Magnet, STIH 270-3c
019	0626-4355-0	Base Plate, STIH270-3 PT
020	0412-1542-0	Mounting strap, STIH-3
037	0715-9212-0	Mounting block for internal pole piece extension
038	0715-9222-3	Internal pole piece extension
040	0626-1052-0	Long external pole piece extension, -3C
041	0715-9412-3	Short external pole piece extension, -3C
048	1349-4035-0	Crucible removal thumbscrew
060	0626-1382-0	Anti-cross-contamination insert for 5-Pkt 3PT source
061	0626-1163-0	LH anti-cross-contamination insert for 6-Pkt 2PT source
061	0626-1163-1	RH anti-cross-contamination insert for 6-Pkt 2PT source
799	6156-1210-0	Crucible cover up/down position switch
803	0627-2673-0	Spider plate for 3PT source, SST
804	0627-2792-0	Pushrod, Solid, for 3PT source
806	0627-2702-0	Guide block, Vespel
807	0627-2742-0	Bracket, Limit SW, RH, PopTop
808	0627-2752-0	Bracket, Limit SW, LH, PopTop
809	0627-2722-0	Base of VCR clamp block
810	0627-2732-0	Cap of VCR clamp block
901	0503-2762-0	Ring gear
905	0626-1145-0	Crucible mounting flange
907	0626-1153-0	Water baffle assembly STIH3
909	0415-5712-1	Flat, bronze backup washer for quad ring
915	2108-0215-0	Quad ring, 1-1/16" (1.046") ID X 1/16" CS
917	2231-0255-0	O-Ring, 5-5/8" ID X 1/8" W VIT
	0916-8295-0	High-performance emitter
	0627-2765-1	Crucible cover for 5-pkt. crucible
	0626-1215-0	4 × 60-cc crucible

Pneumatic drive assembly. To identify its piece parts, see Figure 5-36
Bearing housing assembly. To ID piece parts, see Figure 5-40.
Rotary drive assembly. To ID piece parts, see Figure 5-45.

5.4 Disassembling the Bearing Housing Assembly

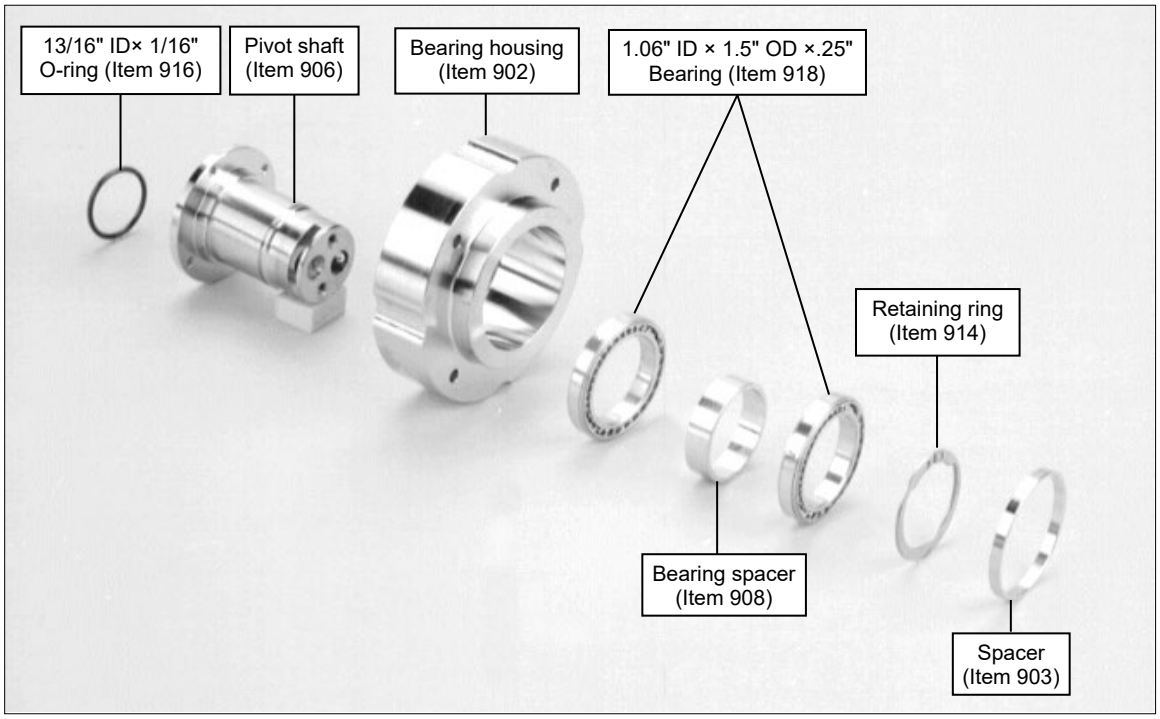
Step	Action
1	Hold the bearing housing right-side up and remove the loose spacer from the housing's inner cylindrical surface, if the spacer has not already fallen out of place.
2	Using a snap ring tool fitted with correct-sized prongs, spread the retaining ring and remove it from the pivot shaft (see Figure 5-39).

Figure 5-39 Removing Retaining Ring that Secures Pivot Shaft



Step	Action
3	Remove the pivot shaft, the upper and lower bearings, and the bearing spacer from the bearing housing. Figure 5-40 shows the parts that make up the bearing housing Assembly in a 2PT source.

Figure 5-40 Parts Layout, 2PT and 3PT Source Bearing House Assembly



5.4.1 Reassembling and Installing the Bearing Housing Assembly

Follow the procedures described below when reassembling and installing the bearing housing assembly. Perform these procedures in the order in which they appear.

Parts Inspection

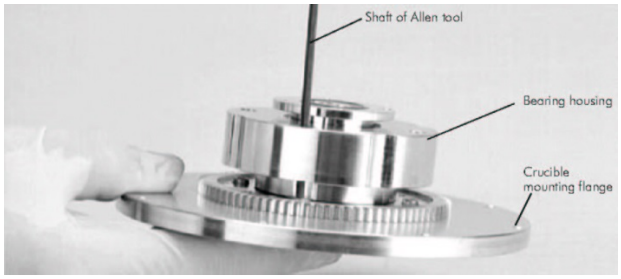
Carefully inspect the pivot shaft before reassembling the bearing housing assembly, paying close attention to the top of the pivot shaft and its quad ring-sealing surface. The top of the pivot shaft must be free of burrs to prevent the quad ring from being damaged during assembly. Use Scotchbrite or similar products to polish small mars out of the quad-ring-sealing surface. If deep scratches remain, replace the pivot shaft.

Drive Gear Installation

Perform this procedure only if you have removed the drive gear from the crucible-mounting flange.

Step	Action
1	Using the correct mounting screws, loosely secure the drive gear to the crucible mounting flange, so that the gear can still be moved about slightly.
2	Insert the bearing housing assembly into the hole in the crucible-mounting flange and use the outer surface of the bearing housing to center the ring gear. Caution: **Take care to avoid jamming or scratching these parts during this step, as the fit between the bearing housing and the crucible-mounting flange is very close.**
3	Rotate the bearing housing until its through-holes line up with the screws that secure the drive gear to the crucible-mounting flange.
4	Insert the Allen driver through these holes and tighten these screws, as shown in Figure 5-41.

Figure 5-41 Allen Driver Inserted Through Hole in Bearing Housing



5 Remove the bearing housing from the crucible-mounting flange.

Reassembly of Bearing Housing Assembly

Step	Action
1	Put the pivot shaft in place inside the bearing housing, making sure that both parts face the correct direction. Figures 6-16 and 6-17 show these parts correctly assembled.
2	Carefully slide the two bearings and the thicker bearing spacer into the space between the pivot shaft and the bearing housing. Be very careful to avoid jamming any parts or scratching the pivot shaft as you do so. Caution: **The bearings in this assembly are precision bearings and must be handled carefully.**
3	Put the retaining ring in place, using the same snap-ring tool you used during disassembly.

Note: There will be approximately 1/8" of vertical play between the parts of this assembly until it is secured to the crucible mounting flange.

Quad Ring Installation

Step	Action
1	Check to make sure that the bronze backup washer and the crucible-mounting flange will slide over the pivot shaft without binding.
2	Place the crucible-mounting flange upside down on a clean work surface (i.e., with the counterbored seat for the quad ring facing upward).
3	Liberally lubricate the quad ring with a low vapor pressure (Apiezon L or equivalent). When the ring is correctly lubricated, all four of its grooves should be at least partially full of grease.
4	Carefully work the quad ring into the counterbore in the crucible-mounting flange.

Attaching the Bearing Housing Assembly to the Crucible Mounting Flange

Step	Action
1	With the crucible mounting flange in the same position, put the bronze backup washer in place in its counterbore, directly on top of the quad ring.
2	Place the bearing housing assembly right-side-up on the work surface (i.e., with the assembly resting on the pivot shaft's lower end, which has the O-ring groove).

3 Set the thinner bearing spacer in place in the top bore of the bearing housing.

4 Pick up the crucible-mounting flange and turn it over, holding the bronze backup washer against the quad ring to keep it from moving.

5 Holding the backup washer this way, carefully work the mounting flange onto the pivot shaft, twisting or rocking the flange slightly to allow the quad ring to slide over the top lip of the pivot shaft. If your technique is correct, stretching the quad ring over the pivot shaft should require only a light downward pressure.

Caution: **Do NOT force the quad ring onto the pivot shaft. Doing so may damage the quad ring, rendering it incapable of providing a water-tight seal.**

6 When you have pushed the leading edge of the quad ring past the water outlet slot, let go of the backup washer and withdraw your fingers. Then push the mounting flange all the way down onto the pivot shaft.

7 Once the mounting flange is all the way down on the pivot shaft, hold these two parts together and rotate the mounting flange until the holes in the bearing housing are lined up with the threaded holes in the mounting flange.

8 Install the four 6-32 x 5/8-in. mounting screws, snugging them down gradually in a crosswise patter to prevent the bearing housing from becoming cocked in the mounting flange's bore. Torque the mounting screws to 8 in-.lbs.

9 Rotate the pivot shaft by hand to make sure there is no binding as it turns.

10 Secure the water baffle to the top of the pivot shaft, using the pan-head screws provided (see Figure 5-21).

11 Check again for any trace of binding during pivot shaft rotation. This time, hold the mounting flange in one hand and push the water baffle with one finger of the other hand to rotate the pivot shaft. The quad ring should produce a light, even resistance as the pivot shaft rotates. If the resistance is heavy or uneven, remove the mounting flange from the bearing housing assembly and check to see that the quad ring has not become cut or twisted. Check also for parts that seem improperly installed or are out of tolerance.

Before reinstalling this assembly on the source baseplate, apply low vapor pressure (Apiezon L or equivalent) to the O-ring that fits between the baseplate and the pivot shaft and place this O-ring in the groove in the bottom of the pivot shaft.

Vacuum Leak Check of Assembly

Perform the following check after the gun is fully reassembled, except for the crucible cover.

Step	Action
1	Connect the gun to a leak detector with a sensitivity of 1 \ 10^{-9} std. Atm cc/sec or better.
2	Initiate the instrument's test mode and note its base leak rate (i.e., its leak rate before helium is applied to the gun). This reading indicates whether there is any residual helium in the detector that should be removed before you test the gun. Alternatively, the base rate can be subtracted from the test reading.
3	Apply helium to all the external surfaces of the gun while observing the leak rate, which should not exceed 3 x 10-9 std. Atm cc/sec at any point.
4	Rotate the crucible while directing the helium flow toward the area where the quad ring resides (i.e., the area where the crucible mounting flange fits around the pivot shaft). The leak rate there should not exceed 5×10^{-9} std. Atm cc/sec.
5	If the leak rate indicated following either Step 3 or Step 4 is higher than the value specified for that step, remove the helium from the gun and give the detector time to stabilize at its base leak rate. Then repeat Steps 2-5. If the base leak rate is still high when you repeat Step 2, then you can conclude that residual helium is building up within the detector during the testing procedure, so there is probably not a significant leak in the gun. However, if repeating Step 2 yields a base leak rate close to the value you obtained when you first performed Step 2, and if you obtain a high reading upon repeating either Step 3 or Step 4, you can conclude that there is a leak in the gun. In that event, locate the source of the leak and correct it. Then repeat the test.

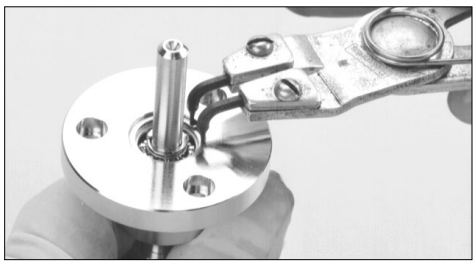
5.5 Disassembling/Reassembling Drive Shaft Assembly

5.5.1 Disassembling the Drive Shaft Assembly

Follow the steps described below when disassembling the drive shaft assembly.

Step	Action
1	Hold the drive shaft assembly in one hand, with the shaft extending toward you, as shown in Figure 5-42. Using a snap-ring tool with the correct-sized prongs, remove the retaining ring that holds the outer drive bearing in place in the bearing housing.

Figure 5-42 Removing the Retaining Ring that Secures the Outer Crucible Drive Bearing in the Bearing Housing



2 Using a small flat-bladed screwdriver, pry up and outward on one point of the retaining ring that fits around the drive shaft (see Figure 5-43).

Figure 5-43 Removing the Retaining Ring that Retains the Drive Shaft

3 Holding the bearing housing in the same position, withdraw the drive shaft from the assembly.

4 Turn the bearing housing over and drop the bearings and the spacer into your other hand. Do NOT let the bearings fall onto the floor or a work surface, as they are easily damaged.

In most cases, it will not be necessary to remove the drive gear from the drive shaft. However, doing so is simply a matter of loosening the two set-screws that secure the gear to the shaft and then working the gear off of the shaft. If yours is a bottom-drive source, there will be no Woodruff key. Instead, the gear will be secured to the shaft with a roll pin. In the case of side-drive unit, the gear is held in place on the shaft by a woodruff key. Supporting the bottom of the gear hub, drive out the shaft using a hammer and a small diameter drift. When hammering the drift, ensure that the woodruff key does not rotate in its seat and jam in the keyway.

5.5.2 Reassembling the Drive Shaft Assembly

Follow the steps described below when reassembling the drive shaft assembly. Figures 5-44 and 5-45 identify the piece parts of the 2PT and 3PT drive shaft assemblies, respectively.

Step	Action
1	Reattach the drive gear to the drive shaft, if you have disassembled these parts.
2	Put the two bearings and the spacer in place inside the drive-bearing housing.
3	Insert the drive shaft into the assembly.
4	Replace the retaining ring that secures the drive shaft. To do so, place the points of the retaining ring against the groove in the drive shaft. Then squeeze the ring against the shaft with a pair of needle-nosed pliers until the ring snaps into place around the shaft. Make sure the retaining ring is properly seated in its groove in the drive shaft.

The following steps apply only to bottom-drive sources:

5	Insert the drive shaft assembly through the hole of the base plate so that the pinion gear meshes with the ring gear.
6	Loosely tighten the three mounting screws.
7	Gently rotate the crucible-mounting flange and check for proper meshing of the pinion gear.
8	Firmly tighten the three mounting screws of the drive shaft assembly.

The following steps apply only to 2PT side-drive sources:

5	Slightly loosen the two set-screws that are holding the gear onto the drive shaft.
6	Insert the drive shaft assembly through the side hole of the source assembly so that the bevel pinion meshes with the ring gear.
7	Tighten the three mounting screws
8	Adjust the position of the bevel pinion the drive shaft so that the pinion meshes with the ring gear properly. Check the assembly by rotating the crucible-mounting flange.
9	Tighten the two set-screws on the bevel pinion.

Figure 5-44 Exploded View of 2PT Source Drive Shaft Assembly

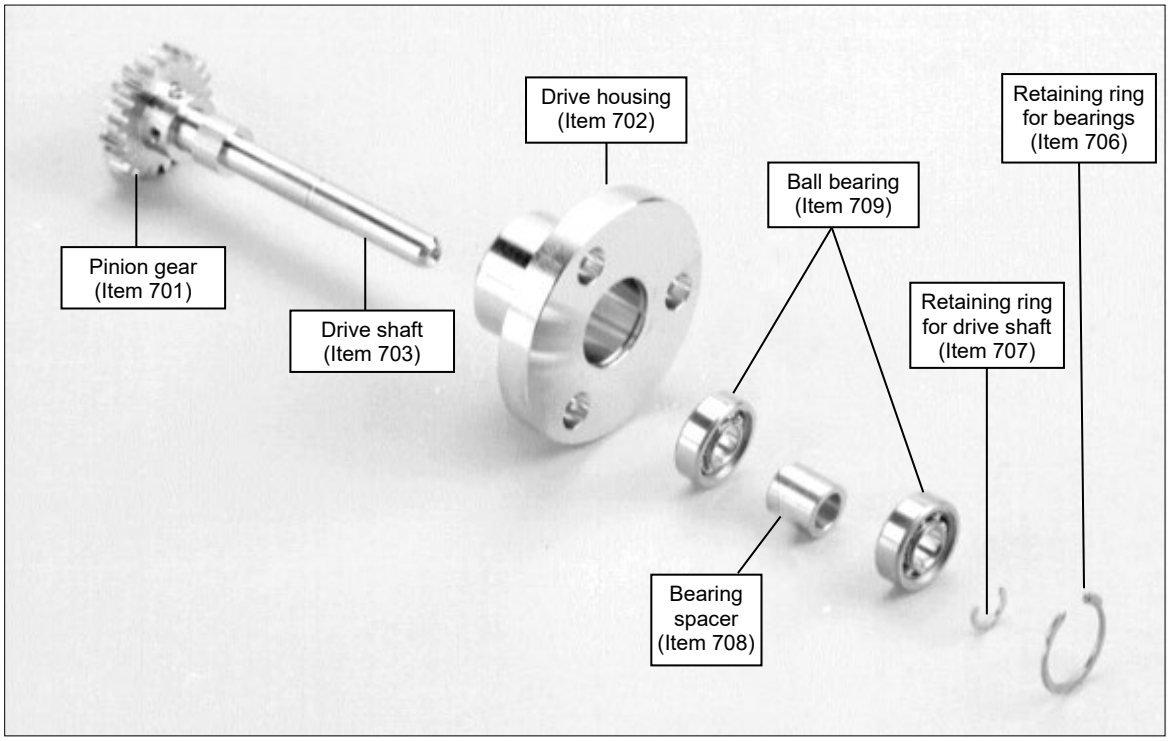
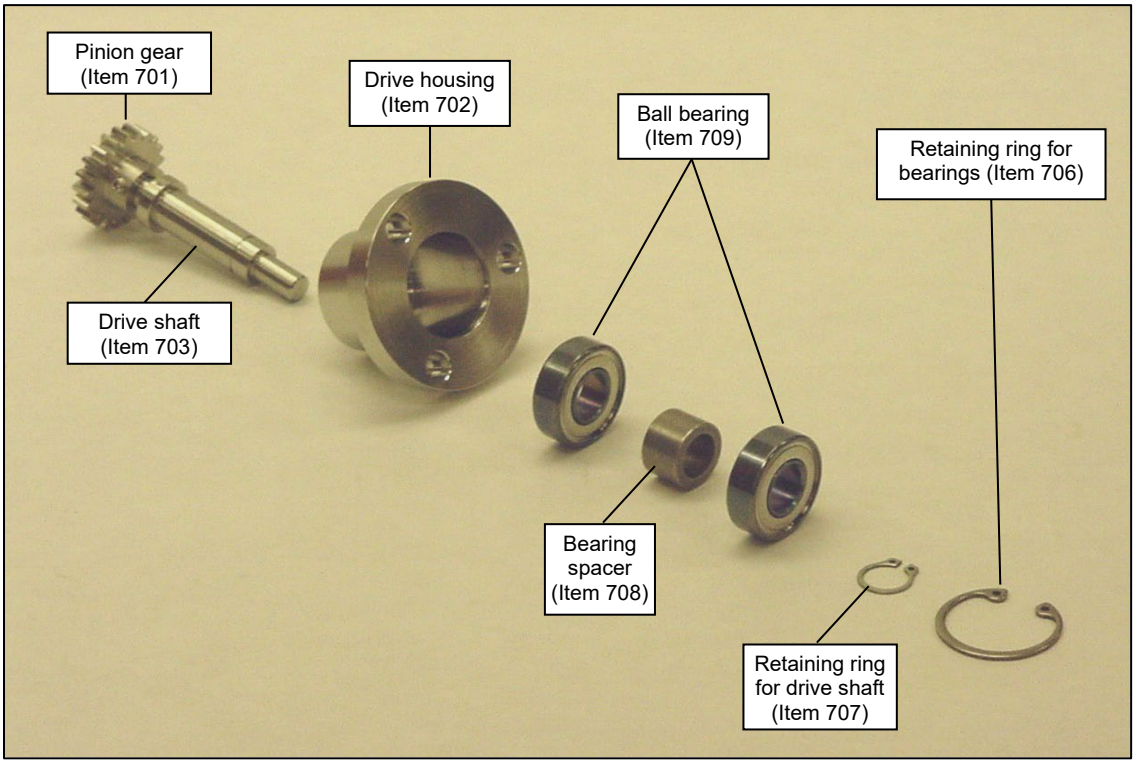


Figure 5-45 Exploded View of 3PT Source Drive Shaft Assembly



6 Troubleshooting

6.1 Section Overview

This section provides a troubleshooting guide that correlates specific symptoms to probable causes and suggested corrective actions. To facilitate your troubleshooting efforts, these symptoms are classified according to type of malfunction and organized in the following subsections:

6.2 Difficulties Generating or Maintaining a Beam

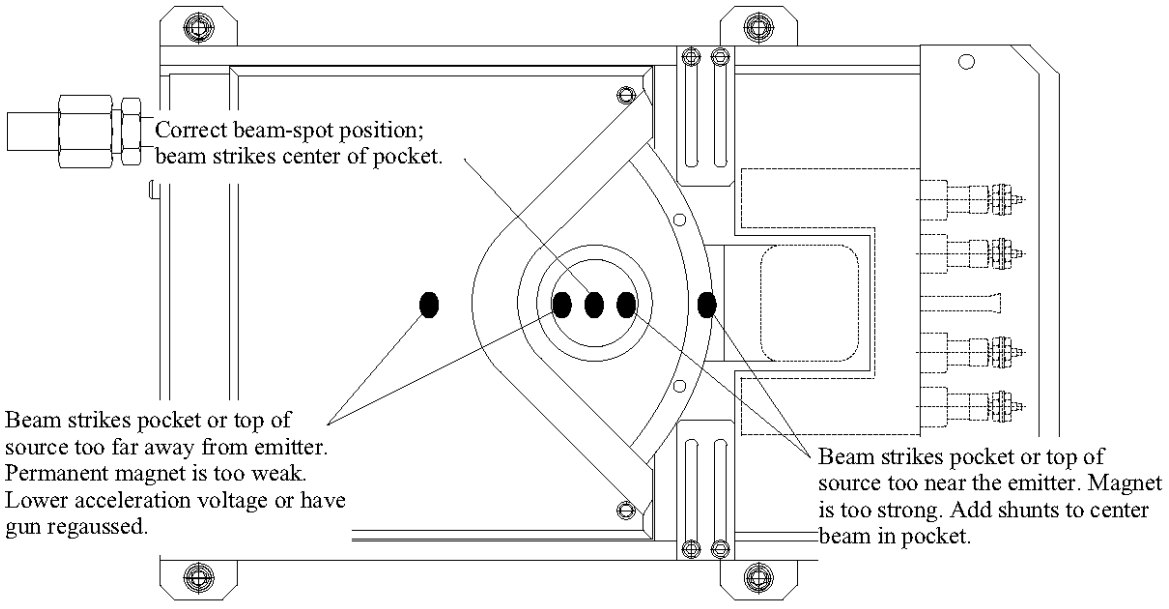
No.	Symptom	Probable Cause	Correction
1	High voltage is nominal, but there is no emission current and no filament current. (See power supply instruction manual for nominal operating values.)	(a) Filament is broken or loose.	(a) Using ohmmeter, check continuity between filament bus bars. Make sure that filament legs are properly seated in V-grooves and that the filament clamp screw is tight.
		(b) Resistance between bus bars is high because of oxide buildup on filament clamps.	(b) Use ohmmeter to test resistance between bus bars. Reading should be no more than 0.3 ohms. If greater, replace filament after cleaning oxides from contact surfaces.
		(c) Fault in circuit supplying filament current.	(c) Check the e-beam power supply's gun control circuit and the connections between that circuit and the gun.
2	HV ramps up but immediately falls back to zero; HVPS front panel LEDs indicate an Output Arcing fault and a PS Latching fault.	High voltage is shorted to ground.	Check for broken insulators or shorted emitter, filament leads, or HV feedthroughs. Replace parts found to be defective.
3	No filament current.	(a) Filament is broken.	(a) Check continuity between filament clamps. If infinite resistance is indicated, filament is broken; replace it.
		(b) Heavy oxide buildup on contact surfaces to which filament mounts.	(b) Use ohmmeter to check resistance between filament bus bars. If greater than 0.3 ohms, replace filament after cleaning oxides from contact surfaces.
		(c) HVPS front panel LEDs indicate a Filament Load fault.	(c) Refer to troubleshooting instructions in your HVPS manual.

6.3 Unsatisfactory Performance During Deposition

No.	Symptom	Probable Cause	Correction
1	High voltage and emission current values go up and down independently of controls, and there is visible arcing or heating at the high-voltage insulators.	(a) Insulating capability of one or both HV feedthroughs is breaking down because they are fractured or coated, but they are not yet shorted to ground.	(a) Examine the HV insulators. If they are coated, clean them by glass-bead honing.* If damaged, replace them.
		(b) In-vacuum HV lead(s) dirty and making contact only intermittently.	(b) Clean leads by glass-bead honing and reconnect securely.
2	High voltage and emission current are nominal, but filament current is high. (See power supply instruction manual for nominal operating values.)	Two or more loops of the filament's coils are shorted together.	Examine filament carefully; replace it if the coil's loops are touching each other.
3	High voltage, emission current, and filament current are all nominal, but melted material is either alloying with or eroding the crucible. Cooling water may also be boiling. *NOTE: Alloying creates a direct thermal short, which will destroy crucible in time. If wetting has occurred, the material MUST be decoupled from the copper before operation is resumed. This can only be accomplished by glass-bead honing the crucible.*	(a) Stationary beam spot is too close to the edge of the pocket.	(a) Apply beam sweep, if possible, or adjust deflection current(s) so that the beam is centered in the pocket.
		(b) Inadequate cooling of exposed pocket.	(b) Check to see that the gun's cooling water is chilled to max. 20° C and that its flow rate is at or above the minimum value specified in section 1.4.2.
4	Emission current is limited at some value below its maximum (= 600 mA for CV-6SLX, 1200 mA for CV-12SLX).	(a) *Standard emitter only:* Beam former is shorted to right-hand cathode block.	(a) Either the locating insulator is fractured or coated, or the beam former is warped enough so that part of it touches the cathode block. Disassemble and examine these parts. Replace locating insulator if fractured or coated.* Replace beam former if it is warped enough so that part of it touches the cathode block.
		(b) Emission current is limited because: (1) Filament is installed backwards; (2) not enough filament is exposed; (3) there are shorted loops on the filament's coil; (4) the filament is badly warped; or (5) anode is too far from filament.	(b) Check condition of filament. If it is installed incorrectly, has shorted turns, or is warped, replace it. If no filament problems are detected, check position of anode relative to filament. For information about the correct anode position with respect to the filament, see the videos on filament rebuild procedures available from Temescal Customer Service.
		(c) One of the flanged insulators in the emitter assembly is badly coated.	(c) Disassemble emitter far enough to check condition of flanged insulators. If coated, replace them.*
		(d) Bad connections to HV leads, which may involve the connections to the filament bus bars, the connections to both sides of the HV feedthroughs, or the connections to the filament transformer.	(d) Check for loose connections or oxidized surfaces at all HV terminals. If surfaces appear oxidized, sand or file them until bright. Clean in-vacuum filament leads by glass-bead honing and reattach them, being sure to make tight, secure connections.
5	Short filament life.	Vacuum chamber does not evacuate properly below 5 $x10^{-4}$ Torr.	Leak-check the vacuum chamber. Clean system. If hivac pump is a diffusion pump, change its oil. If a cryopump, regenerate it and then change its trap. Refer to pump's manual for other possible corrective measures.
6	Pronounced drop in deposition rate.	(a) Beam density may be too high, causing cavitation of molten pool.	(a) Reduce beam density by exposing more of the filament or by changing the position of the pole piece extensions.

No.	Symptom	Probable Cause	Correction
		(c) The permanent magnet is so weak that the beam cannot be centered longitudinally.	(c) With gun operating at low power, check beam-spot position with zero longitudinal coil current applied. If spot is too far toward rear of source (see Figure 6-1), replace permanent magnet or have it regaussed.
		(d) Other magnetic fields are affecting beam position.	(d) Make sure gun is isolated as completely as possible from any other possible source of magnetic interference.
		(e) Inadequate cooling.	(e) Check to see that cooling water is chilled to max. 20° C and that its flow rate is at or above the minimum (see section 1.4.2).
7	Beam power will not go above 5 kW.	Filament is installed backward.	Install new filament, making sure that it is installed the right way around.
8	Emission current drifts after a long period of operation.	One or more of the emitter's flanged insulators is cracked.	Disassemble emitter far enough to check condition of the flanged insulators. Replace any that are found to be cracked.
9	Evaporation rate drops and, concurrently there is a significant broadening of the beam spot. In addition, the cooling water may boil if the lateral `tails' of the beam spot touch the edges of the pocket.	Filament has become warped.	Replace the filament, making sure that 1/4 to 1/3 of the filament's coil is visible below the beam former.

Figure 6-1 Beam-Spot Problems Due to Over/Understrength Permanent Magnet

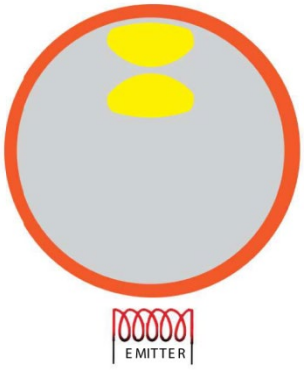


6.4 Problems with Beam Position, Shape, or Density

No.	Symptom	Probable Cause	Correction
1	High voltage, emission current, and filament current are all nominal, but excessive longitudinal current is required to center beam in pocket. (See power supply manual for nominal operating values.)	Weak permanent magnet.	Check beam-spot position with 0 A longitudinal deflection current applied. If spot is too far toward rear of source (see Figure 6-1), replace permanent magnet or have it regaussed.
		Longitudinal deflection coil is partially shorted internally.	Test internal resistance of longitudinal coil. Replace coil assembly if measured resistance is not between 2.2 and 2.4 ohms.
2	High voltage, emission current, and filament current are all nominal, but the beam is not centered longitudinally.	(a) Longitudinal deflection current is set to incorrect value.	(a) Adjust longitudinal deflection current.
		(b) The permanent magnet is weak.	(b) Check beam-spot position with 0 A longitudinal deflection current applied. If spot is too far toward rear of source (see Figure 6-1), replace permanent magnet or have it regaussed.
3	High voltage, emission current, and filament current are all nominal, but beam spot is either off center or asymmetrical in the lateral axis.	(a) Lateral deflection coil is energized.	(a) Check to see whether any lateral deflection current is being applied. If so, adjust it to 0 A.
		(b) The midpoint of the filament is not aligned exactly between the pole pieces.	(b) Make sure that the filament is positioned correctly and that it is not warped or sagging.
		(c) Pole pieces or pole piece extensions are damaged.	(c) Examine these parts for signs of damage; replace parts as necessary.
		(d) Pole pieces are not mounted tight against permanent magnet.	(d) Loosen screws securing pole pieces to coil housing and source baseplate. Readjust position of pole pieces as needed to ensure that both are touching the magnet, then retighten screws to 8 ft.-lbs.
		(e) Pole piece extensions are not adjusted symmetrically.	(e) Check positions of extensions and adjust them as necessary (see section 4.2.4 for instructions).
		(f) Either the two lateral deflection coils are shorted together, or one of them is shorted internally or to ground.	(g) Using ohmmeter, test resistance between the two lateral terminals of the coil assembly and between each of these terminals and ground. There should be infinite resistance between either terminal and ground. Resistance between the two terminals should measure between 3.0 and 3.2 ohms. Replace coil assembly if lateral coil fails either test.
4	Adjusting beam-position controls has no effect on beam position in either axis.	No deflection current is being applied to coils.	Coil leads are disconnected or shorted internally. Make sure they are properly connected. Then check them for shorts.
5	Complete loss of lateral and longitudinal beam control.	No voltage at coil terminals, or incorrect internal resistance in coils.	Check leads to coils. If the leads are properly connected and their continuity is OK, check voltages across both sets of terminals. If meter indicates a voltage across both sets of terminals, then check internal resistance of coils. The readings should be: Longitudinal: 2.2 to 2.4 ohms Lateral: 3.0 to 3.2 ohms If the readings do not fall within these values, replace the coil assembly.

No.	Symptom	Probable Cause	Correction
6	Beam spot changes position as source becomes heated.	The material in the exposed pocket is a new slug of magnetic material such as Ni or Fe. When heated past a value called the Curie point, these materials become nonmagnetic, strongly altering beam-spot position.	Control beam position manually when melting such slugs, so that you can observe beam-spot position and correct it after the material passes its Curie point. *NOTE: This effect occurs only the first time a slug of magnetic material is melted.*
7	Electron beam spot cannot be moved toward rear of source along the longitudinal axis.	The source is being operated at less than 10 kV.	Add shunt bars on front of source as appropriate (see section 4.2.1).
8	Cannot sweep entire surface of evaporant material with a tight beam.	The permanent magnet's field is too strong.	Add shunt bars on front of source as needed (see section 4.2.1).
9	Beam position is too far toward rear of source.	(a) Permanent magnet is too weak.	(a) Check beam-spot position with 0 A longitudinal deflection current applied. If spot is too far toward rear of source (see Figure 6-1), replace permanent magnet or have it regaussed.
		(b) Leads to longitudinal coil are reversed and coil is energized.	(b) If coils are controlled by an e-beam power supply or a non-bipolar beam sweep controller, make sure polarity of longitudinal coil connections is correct. Refer to manual of component in question.
		(c) Unneeded shunts mounted on source.	(c) Remove one or more shunts.
		(d) Acceleration voltage is set too high.	(d) Check acceleration voltage setting and adjust to correct operating value.
10	Beam position is too close to emitter assembly.	(a) Acceleration voltage is set too low.	(a) Make sure acceleration voltage is set to the correct operating value.
		(b) Longitudinal coil is energized when unintended.	(b) Check the output of the device that controls the longitudinal coil.
11	Beam is highly non-uniform.	Pole piece extensions are not adjusted symmetrically.	Check positions of extensions and adjust them as necessary (see section 3.2.4 for instructions).
12	Beam is too broad and diffuse.	Pole pieces are adjusted too far out.	Adjust pole pieces inward (see section 4.2.4 for instructions).
13	Beam is too narrow.	Pole pieces are adjusted too far in.	Adjust pole pieces outward (see section 4.2.4 for instructions).
14	Beam separates into two spots near rear of pocket (see Figure 6-2).	Front set of pole piece extensions adjusted too far out.	If problem persists when front pole piece extensions are adjusted all the way in, the permanent magnet has become too weak. Either have it regaussed or replace it.

Figure 6-2 Longitudinal Beam Spot Separation Toward Rear of Pocket



Beam has separated into two spots near the rear of the pocket, and the rear-most of the two spots may strike the body of the source outside the pocket.

6.5 Other Source Malfunctions

No.	Symptom	Probable Cause	Correction
1	Cooling water is boiling, as indicated by a medium-frequency whine coming from the chamber.	(a) Alloying of melted material is causing a thermal short because stationary beam is at edge of pocket.	(a) Apply beam sweep, if possible, or adjust deflection current(s) so that the beam is centered in the pocket.
		(b) Inadequate cooling of exposed pocket.	(b) Make sure that cooling water is chilled to max. 20 C and that its flow rate is at or above the minimum value specified in section 1.4.2.
		(c) Weak permanent magnet.	(c) Check beam-spot position with 0 A longitudinal deflection current applied. If spot is too far toward rear of source (see Figure 6-1), replace the permanent magnet or have it regaussed.
2	Rapid loss in field strength of permanent magnet.	(a) Gun is being affected by fields from leads connected to some other AC device inside the chamber.	(a) Reroute the leads of the other AC device as far away from the gun's permanent magnet as possible. Then check beam-spot position with 0 A longitudinal deflection current applied. If spot is too far toward rear of pocket (see Figure 6-1), replace permanent magnet or have it regaussed.
		(b) Magnet has been dropped or struck against a hard surface.	(b) Check beam-spot position with 0 A longitudinal deflection current applied. If spot is too far toward rear of source (see Figure 6-1), replace permanent magnet or have it regaussed.
		(c) Gun has been heated above its maximum bakeout temperature of 150° C.	(c) Same as (b).
3	Anode is burned through.	(a) Anode has become directly exposed to the electron beam.	(a) Install new anode, making sure that beam former completely shields anode from filament. For instructions on correctly aligning these parts see the videos on emitter rebuild procedures available from Temescal Customer Service.
		(b) *Standard emitter only:* Beam former is shorted to right-hand cathode block, causing the beam former to emit electrons that burn a hole through the anode.	(b) Replace anode and check beam former for signs or burning and warping. If any are apparent, replace the beam former. Also check condition of HV locating insulator, which is probably either coated or fractured (or both), causing beam former to short out against right-hand cathode block. Replace insulator if coated or fractured.
4	Ion gauge indicates a pressure burst when crucible is rotating.	Water is leaking past the gun's quad ring.	Replace quad ring. Remember to lubricate the new quad ring properly with Apiezon L or an equivalent product.
5	Crucible sticks or is difficult to rotate.	(a) Quad ring is inadequately lubricated.	(a) Replace quad ring. Remember to lubricate the new quad ring properly with Apiezon L or an equivalent product.
		(b) Worn bearings in bearing housing assembly or drive shaft assembly.	(b) Check bearings and replace as necessary.
		(c) Misaligned parts in bearing housing assembly.	(c) Remove the crucible mounting flange and the bearing housing assembly from the gun and disassemble the bearing housing assembly. Check the condition of its bearings, the pivot shaft, and the bronze washer that sandwiches the quad ring seated in the crucible mounting flange. Replace any parts that show signs of wear or damage and reassemble the source.