

MODEL 241/247/248
MULTI-POCKET
ELECTRON BEAM SOURCES

INSTRUCTION MANUAL

not a model 248
245 a 247

Part Number 241-0001-1

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SAFETY WARNING

HIGH (POTENTIALLY LETHAL) VOLTAGES ARE PRESENT WITHIN AN EVAPORATION SYSTEM. GREAT CARE MUST BE EXERCISED WHEN PERFORMING MAINTENANCE. **HUMAN CONTACT WITH THE VOLTAGES CAN BE FATAL.**

SHORT ALL HV FEEDTHRU CONNECTIONS WITH A GROUNDING HOOK.

DANGER - HIGH VOLTAGE

WARRANTY

This Electron Beam Source is guaranteed against faulty materials and workmanship for a period of 12 months after delivery from Telemark.

This warranty is valid only for normal use where regular maintenance is performed as instructed. This warranty shall not apply if repair has been performed or an alteration made by anyone other than an authorized Telemark representative or if a malfunction occurs through abuse, misuse, negligence, or accident. No charge will be made for repairs made under warranty at Telemark's facilities. Defective parts will be repaired or replaced at Telemark's option. Customer will be responsible for freight charges to Telemark's facility.

For the safety of the Telemark Technicians customers are requested to supply a list of materials which have been evaporated in the crucible when the E-source is returned for repair.

USER RESPONSIBILITY

The user is responsible for proper operation and ordinary maintenance of the equipment, following procedures described in this manual, including reference documents. Proper operation includes timely replacement of parts that are missing, broken, or plainly worn. If the user has a reasonable doubt about understanding the use or installation of a component, Telemark or your local representative should be called.

It is vitally important that the user properly install the equipment as described in Chapter 3 (Installation) of this manual, with particular attention to correct grounding methods as described in Chapter 3. **The Warranty will be void if the equipment is improperly installed and/or improperly grounded.**

Alteration of the design or any function of the equipment voids the warranty and is entirely the responsibility of the user.

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UNPACKING

Your Model 241/247/248 electron beam source is packed into a specially designed double strength box surrounded with two and a half inches of rigid foam padding. Since packaging the source for safe shipment is otherwise difficult, please save the box in the event that the source may ever need to be returned for servicing. We cannot be held liable, and may not be able to fix without charge, sources that are damaged in transit as a result of improper packaging.

Inside the box will be the source, this manual and the Installation Kit that includes spare parts and a set of tools. Please check the package against the list on page 1-2 to make sure no damage has occurred in transit. Inspect the emitter assembly for alignment of the filament, anode plate and beam former. The source is ruggedly built and packaged tightly so no damage should occur. In the event of any deficiencies please report them to your vendor immediately. Also take care to read the warranty on page iii as to the limits of our liabilities.

The finish on your source is the highest available on both copper and stainless. The source is assembled under clean conditions and sealed in a polyethylene bag for shipment. A set of white gloves is provided for your use in unpacking and setting up the source to help you minimize contamination.

Installation Kit

Part #241-0723-1, Shipped with 241 and 247 E-Sources

Part #248-0723-1, Shipped with 248 E-Source

| Part Number | | Description | Qty. |
|-------------|------------|----------------------------|-------|
| 241 | 248 | | |
| 211-5008-1 | 211-5008-1 | Thumbscrew, Crucible | 1 ea. |
| 213-0700-2 | 213-0700-2 | Emitter Rebuild Kit | 1 ea. |
| 241-0090-1 | 241-0090-1 | Shunt Bar | 2 ea. |
| 231-2000-1 | 238-2000-1 | Gasket Kit | 1 ea. |
| 271-4007-1 | 271-4007-1 | Allen Wrench, 7/64" | 1 ea. |
| 271-5003-1 | 271-5003-1 | White Gloves, Nylon, Large | 1 pr. |
| 273-0037-1 | 273-0037-1 | Strap, Copper | 2 ea. |

See page 5-17 for kit listings.

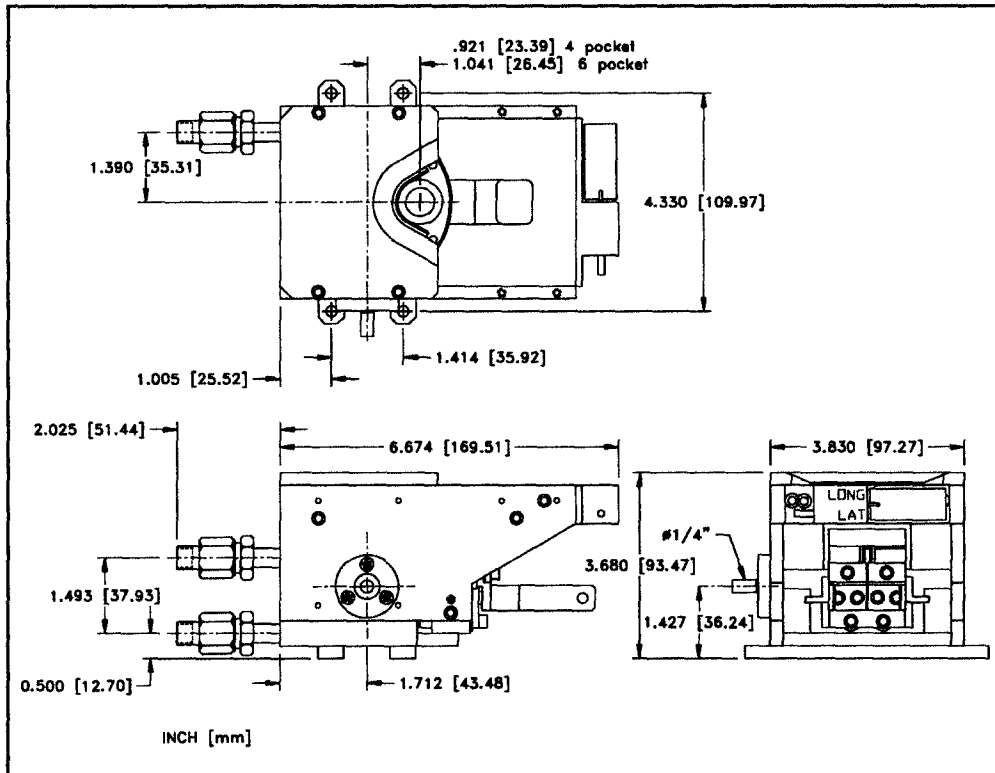


DESCRIPTION

The source's most notable features are:

- 1** *After water has been blown out of the lines. The crucible is removable from above by simply removing the crucible cover, rotary water union, loosening sleeve clamp and pulling out. This is described and illustrated on page 5-1. The crucible can be bead-blasted and otherwise cleaned without disassembling the entire source.*
- 2** *The emitter assembly is a critical component in the operation of the E-source. The parts that make up the emitter assembly are manufactured to exacting standards. TFI Telemark has developed several innovative changes in the emitter assembly which make it more reliable and easier to assemble. The assembly is outlined in chapter 5.*
- 3** *The main rotary seal on the 241 E-source is a quad ring in the Crucible Base Assembly. The 247 E-source has a quad ring the crucible assembly fits through. On the 248 E-source main rotary seal is a magnetic-liquid-sealed vacuum rotary feedthrough with the only O-ring on the source, sealing the crucible assembly.*
- 4** *The space between the front of the crucible and the front shield is flared, expanding gradually from center to the outside in both directions. The crucible itself has a double lip design. Both these steps were taken to essentially eliminate the possibility that chips of brittle materials, such as quartz and sapphire could, during production, fall out of the pockets and jam the crucible rotation. The elimination of jamming means that the crucible rotation can be reliably automated for production using a step-motor drive.*

Figure 2-A
241 Source
Reference
Dimensions



- 5 The sweep coils are surrounded by a stainless steel can. The sweep electrodes are also protected by a rugged shield. This means that the chance of damaging the coils thermally or mechanically during normal production or handling is virtually eliminated. So long as the water outflow interlock is not overridden (see section on interlocks) and care is taken not to bump electrodes when (rarely) removing the shield, the coils should last the lifetime of the source.
- 6 Other features, such as long-lasting all stainless steel drive gears, #6-32 screws in all fastening locations, and heavy-duty construction all round, are designed to make the source serviceable for years of production.

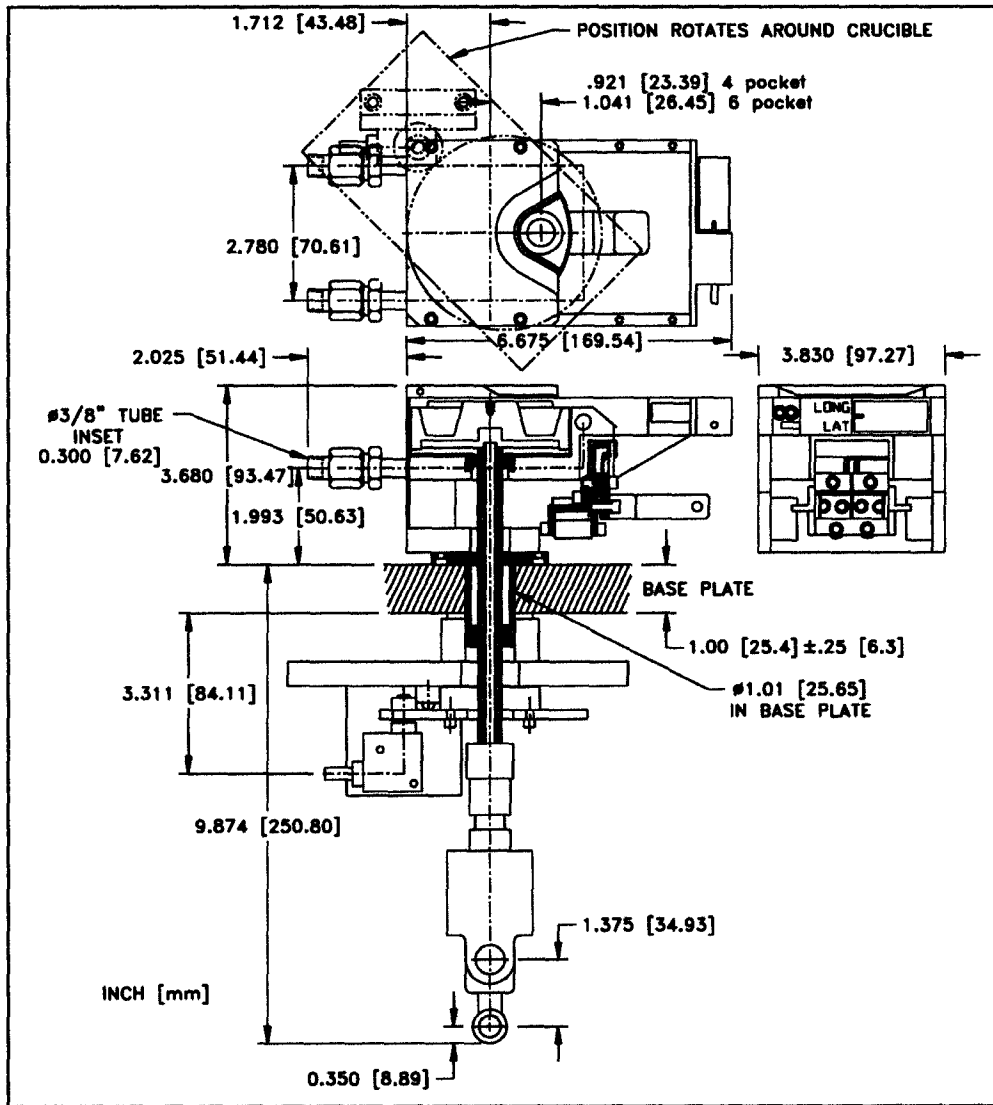
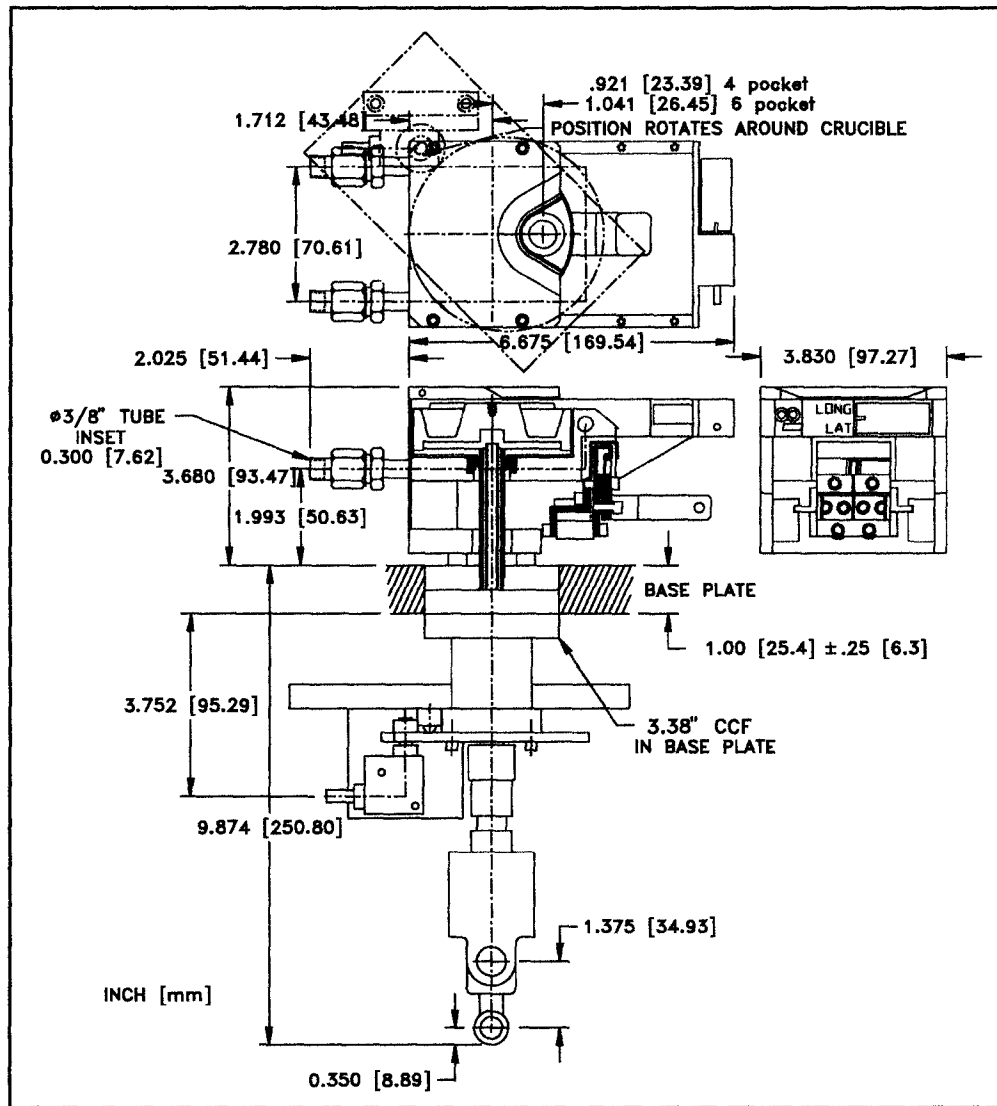


Figure 2-B
247 Source
Reference
Dimensions

Figure 2-C
248 Source
Reference
Dimensions



Specifications

| Specifications | 241/247/248 E-source |
|---|---|
| Electron Beam Deflection | 270° |
| Power Rating | 6 kW |
| Maximum High Voltage | 10 kV |
| High Voltage Range | 6 kV to 10 kV |
| Lateral Coil Resistance | 8.5 ohms |
| Longitudinal Coil Resistance | 7.5 ohms |
| Emission Current | 0 to 500 mA @ 10 kV |
| Filament Power | 600 watts maximum (50 Amps at 12 VAC max). |
| Sweep Lateral Coil | +/-1 amps |
| Sweep Longitudinal Coil | +/-1 amps |
| Water Requirements Input water temperature should be 60 F (15C) at a pressure of 60 psi (4.2 kg/cm ²), using a 3/8" (10 mm) line. | 2 gpm (min.) at 5 kW |
| Dimensions These dimensions include water lines up to weld fittings but do not include strap or drive shaft projections. | 3.68" high by 3.25" wide by 8.26" long (9.35 cm by 8.26 cm by 17.02 cm). |
| Crucible Volume See Figure 3-E | 4 Pockets, 7cc. 6 Pockets, 4cc |



INSTALLATION

Required Components

See figure 3-B

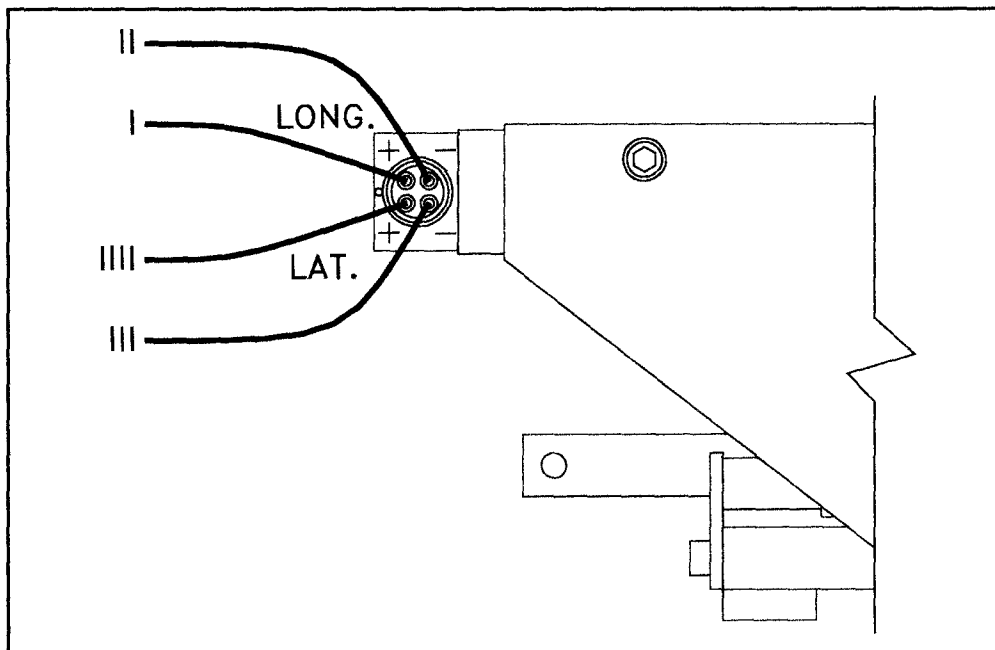
The following is the minimum list of components required for setting up the source for safe operation.

- 1** *Two high-voltage feedthroughs rated at 15 kV @ 70 amps. Bare copper straps are provided for use inside the chamber. Outside the chamber use #6 AWG copper wire with lugs for attaching the feedthrough to the transformer.*
- 2** *Use a solid copper strap or copper wire (#6 AWG or greater and up to seven strands, not copper braid) between tank and an 8 foot long copper clad steel grounding rod. Connections must be free of oxide and extremely tight.*
- 3** *Attach a grounding hook with at least six feet of copper wire to the grounding rod. As the first step in maintenance always use a hook to ground the system.*
- 4** *Mount filament (source) transformer as close to hi-voltage feedthroughs as possible. Build a 1/4" Plexiglas® cage around high voltage feedthroughs and transformer. Allow a minimum of two inches clearance all around. (The breakdown voltage of air is about 10,000 volts per inch so this is a safe distance.)*
- 5** *For the electromagnetic X-Y sweep coil a minimum of a four (4) pin low-voltage feedthrough is needed. Kapton® coated wire is supplied on the standard coil connector Telemark# 271-0125-1. Bare OFHC wire is used in the UHV assembly Telemark# 271-0125-3. Coil connector assemblies come with*

two feet of wire standard, optional lengths are available. See figure 3-A for reference code of marked wires.

- 6 3/8" O.D. x 1/16" wall 304 Stainless tubing. Weld into fittings provided with source and butt-weld to tubing dual water feedthrough. We do not recommend the use of bellows inside the chamber. Attach feedthrough tubing to 3/8" copper tubing outside chamber - use Swagelok® or other compression fittings.
- 7 Use standard removable water filter on the inlet. Position it away from chamber so that it is completely accessible for servicing.
- 8 Use three-way valve attached to air or nitrogen supply for blowout.
- 9 Use a flowmeter with interlock switch on the water outflow.
- 10 Interlocks - thermocouple, chamber door, water, transformer cage (if possible). Other interlocks may include temperature and ion gauge. The interlocks should be placed in series so that if anyone fails the source shuts off automatically.

Figure 3-A
Coil Wire
Reference
Code



Setting Up

Note that it is important **never** to use mild steel for electron beam source mounting. This includes mounting plates, standoffs, source shutters or crucible rotation hardware. Mild steel could affect the magnetic properties of the electron

beam source resulting in poor performance of deformed electron beam. The best material is non-magnetic 304 stainless steel.

Set the source level with required offset from chamber centerline. The source is easiest to work and observe in operation if placed facing forward and in front of chamber centerline. The source must be mounted on non-magnetic (stainless steel) standoffs on the vacuum chamber baseplate. Good contact between the base of the electron beam source and the baseplate of the vacuum chamber is important for purposes of grounding. A copper strap connected between the source mount and the chamber baseplate is good insurance of proper source grounding (See Fig. 3-C).

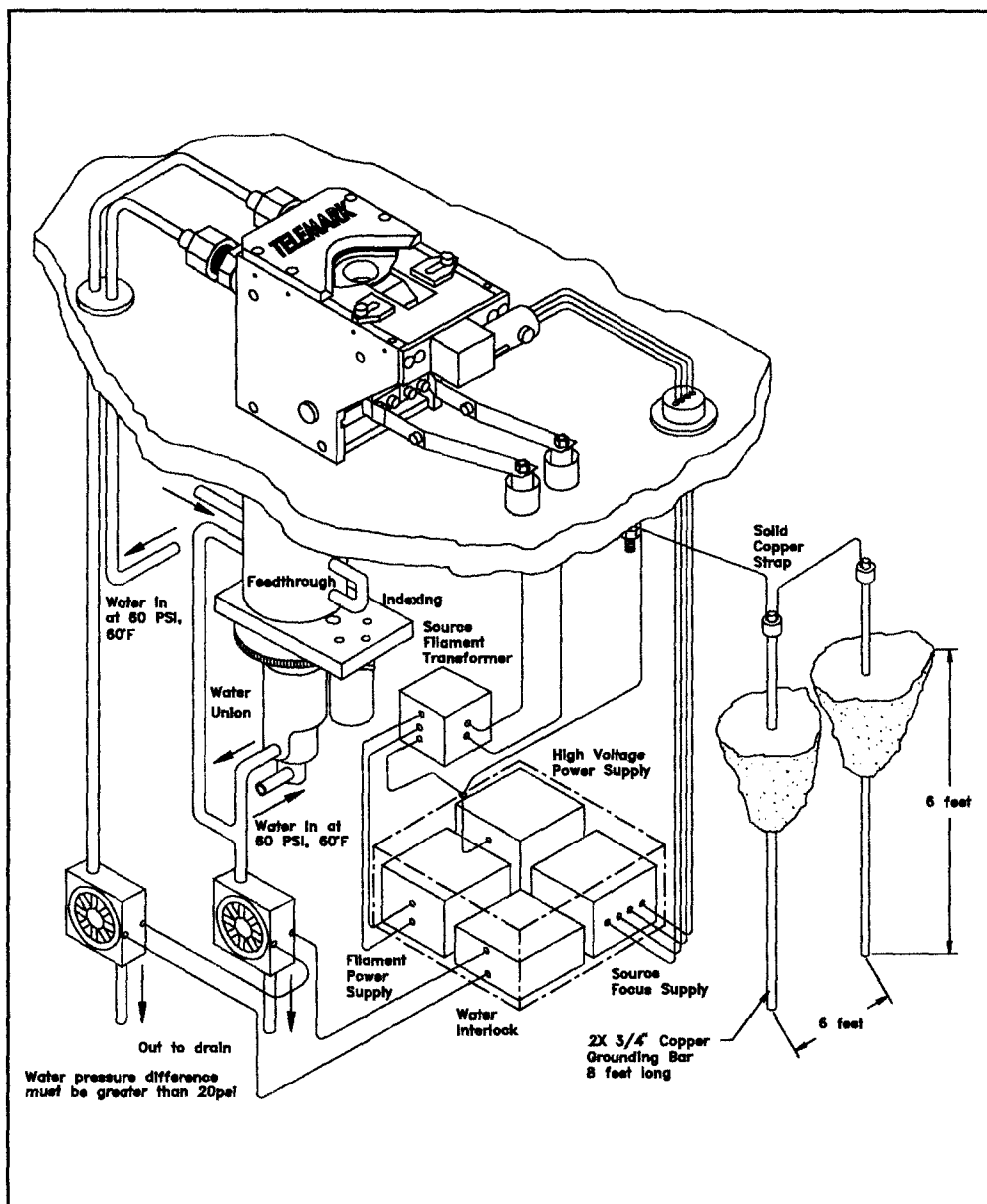


Figure 3-B
Suggested
Installation

A shutter should be mounted above and slightly behind the forward pocket. It is important because of the height of the electron beam that the minimum distance a shutter should be mounted from the top surface of the source is 3 inches. The shutter should obscure at least a one hundred degree cone above the pocket. A 1/8" stainless disc makes a good enduring shutter, provided it can be mounted ruggedly and detach easily for cleaning.

3/32" Copper straps are provided for the high voltage leads. These should be shortened to the smallest distance between source electrodes and feedthroughs, with a slight curve only to allow for thermal expansion and contraction.

Interlocks should all be in series (logically ANDed) so that the breaking of any interlock will turn off the source. See note on high voltage below as to why this is important.

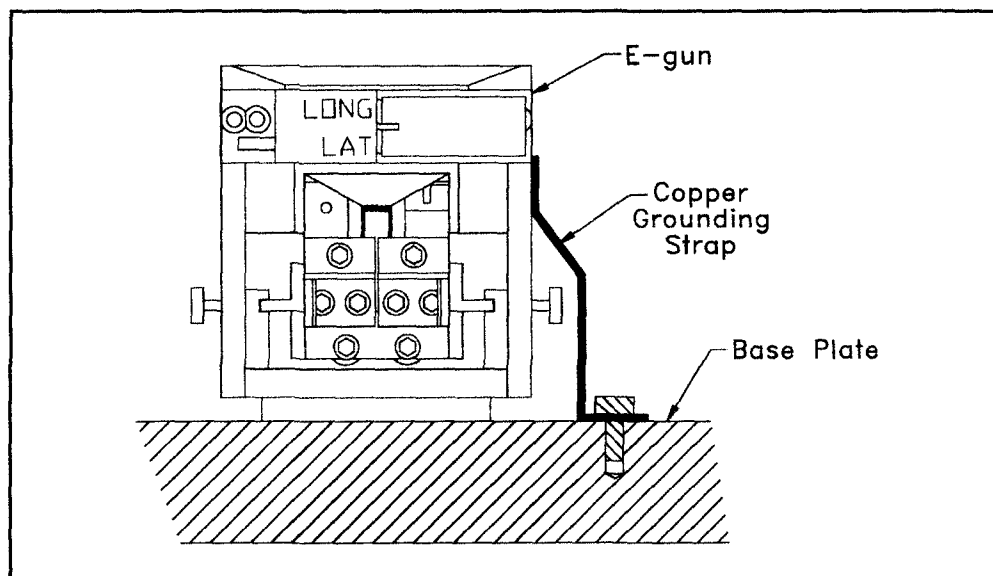
Vacuum Tank Ground

See Fig. 3-D

The vacuum tank and E-source must be connected to a good earth ground. Under normal conditions, a good earth ground will consist of two 3/4 inch diameter x 8 feet long copper clad steel rods driven through the floor and into the earth near the tank location.

The ground rods should be connected to the vacuum tank and the filament transformer by a #6 or larger gauge copper cable. If the distance from the grounding rods to the tank is more than 10 feet, but less than 20 feet, increase the size of the copper cable to #4 gauge. For distances of 20 to 60 feet, use 2 inch by .035 inch copper strap. For distances over 60 feet, consult the factory. **Do not use braided wire.** Be sure that the connection is made to clean metal. The rods must be approximately 6 feet apart and the resistance between the rods (without the cable connection) should be 3 ohms or less. The resistance of the soil can be

Figure 3-C
Source
Ground
Strap



reduced by adding copper sulfate or salt water around the rods. A drip system may be required to insure maintenance of a proper ground.

NOTE - BE SURE THAT THE POWER SUPPLY CANNOT BE TURNED ON DURING THE FOLLOWING TEST.

At least once a year the wire between the two rods should be disconnected and the soil resistance checked. The resistance should never be over 3 ohms. The climate and soil conditions in your area may dictate performing this test more often. After this test has been completed, connect the cable to both rods before returning the power supply to service.

If the equipment is to be installed in the upper floors of a building where the installation described above is not feasible, the system may be grounded by connecting the vacuum chamber to the steel structure of the building. This should be done only after verifying that the building structure itself has a good earth ground. If no building ground exists, rods must be driven in sufficient number and connected to the building structure to assure a suitable ground.

Do not depend on water pipes for the system ground connection. It is safe to assume that, because of multiple joints and sealing compounds, water pipes will not be an earth ground. Keep in mind that this is a high frequency as well as a DC ground. Do not make a ground loop by connecting the low impedance ground cable to the power supply incorrectly. As shown in Fig. 3-D, the ground cable runs from the ground source to the tank first. Then connect the cable from the tank to the source filament transformer.

The power supply is connected to ground using the HV cable's shield connection. The power supply may sustain major damage if power is applied before the ground is connected.

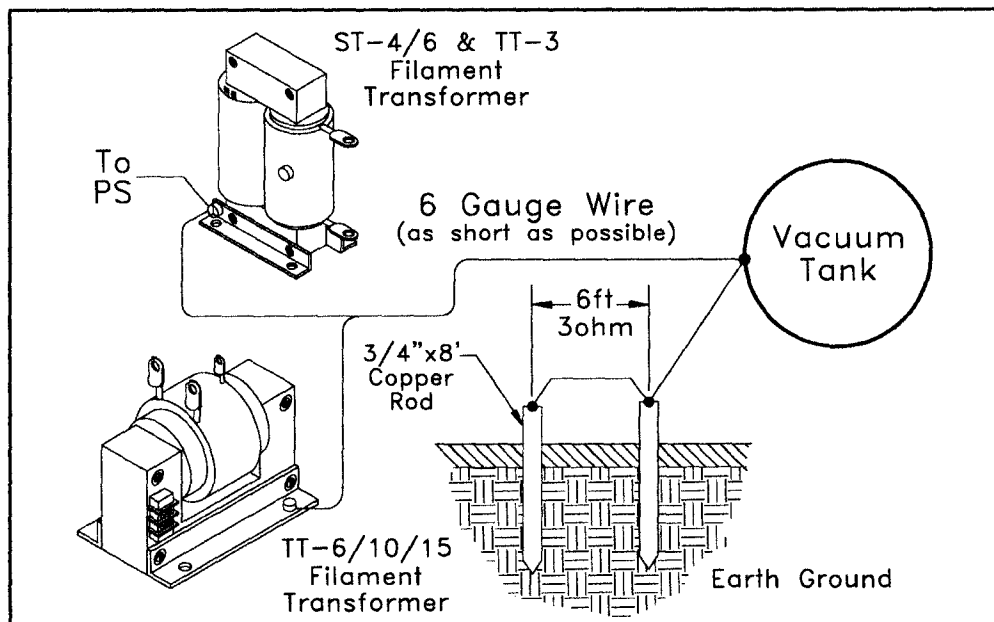


Figure 3-D
Vacuum Tank
Grounding
Installation

High Voltage

- 1** Use decals or other warning labels on the high voltage shield, at the front of the chamber, on the door to the room, to provide warning that lethal voltages are present. Do not put any part of the body or go under a chamber while source is running. **Always use grounding hook as a matter of habit before touching any potentially high voltage area, even when power supply is off.** Keep one hand in a pocket always. Always maintain a decent fear of high voltage: familiarity does not make high voltages safe.
- 2 Never jump interlocks,** Conversely make sure others have not jumped interlocks which are there for your safety. The best insulation in the world is of no avail if these protective mechanisms are bypassed.
- 3** Make sure high voltage enclosures are intact. High voltage interlocks must be properly reattached after each maintenance and checked for operation. One should also ensure that at least one other layer of insulation exists between the high voltages and operator. Quarter inch Plexiglas® panels on the front and sides of the chamber, easily detachable from the frame for maintenance, can create the required line of defense.
- 4 Warnings, as in item 1 above, should be given several times to each operator as to the lethality of high voltage. This, and maintaining a working interlock system, are the two best defenses against injury.**

Multi-Source Installation

See Fig 3-E

To have a two or more sources Installation work properly a magnetic shunt must be placed between the sources so that the magnetics of the sources do not interfere with the movement of positions of the other source's electron beams. The shunt is usually a sandwich alternating between magnetic and non-magnetic metal with an air gap between each piece. Magnetic metals used are Mew metal or a mild steel .020 to .030 inch (0.50 to 0.75 mm). Non-magnetic metals being non-magnetic stainless steel or copper .020 to .030 inch thick (0.50 to 0.75 mm). One way of mounting the shunt to the magnet arms is with 304 stainless steel straps, other fastening methods may need to be used. Sources must appose each other for the sweep coils to work properly.

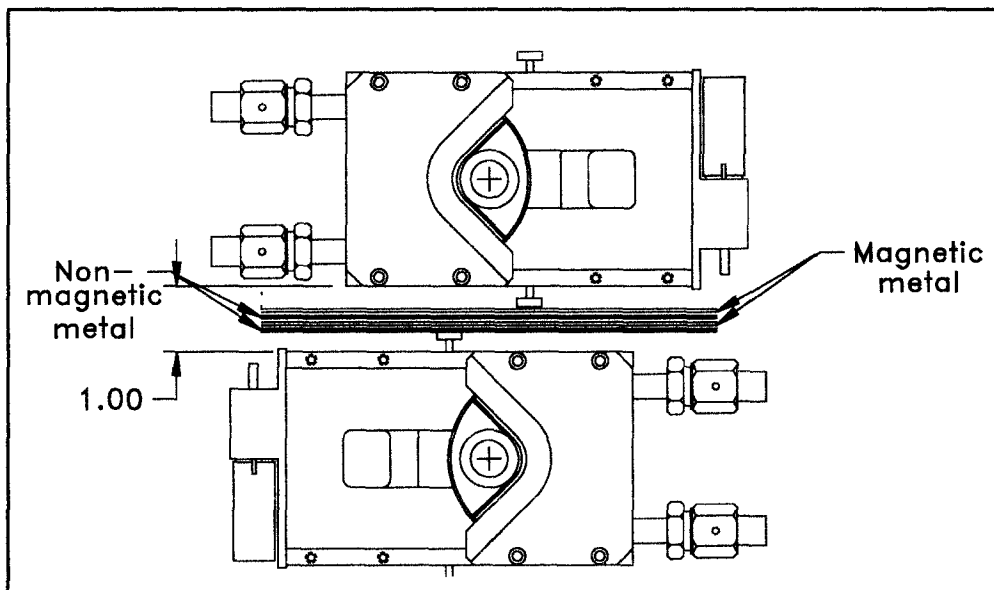


Figure 3-E
Multi-source
Installation

List of Accessories or Supplies

Recommended parts:

1 Power Supply. We recommend the ST-4 or ST-6 power supply from Telemark. However, this source will work well with all available power supplies that meet the operating specifications of the 241/247/248 electron beam source.

2 Telemark Feedthroughs

Feedthrough Kit for 241 E-source, Part# 275-0704-1 includes:

| | | |
|------------|-----------------------------------|-------|
| 275-0001-1 | High Voltage Feedthrough | 2 ea. |
| 275-0003-1 | Dual 3/8" Water Feedthrough | 1 ea. |
| 275-0006-1 | Right Angle Rotary Feedthrough | 1 ea. |
| 275-0008-1 | 8 pin Instrumentation Feedthrough | 1 ea. |

Feedthrough Kit for 247 E-source, Part# 275-0705-1 includes:

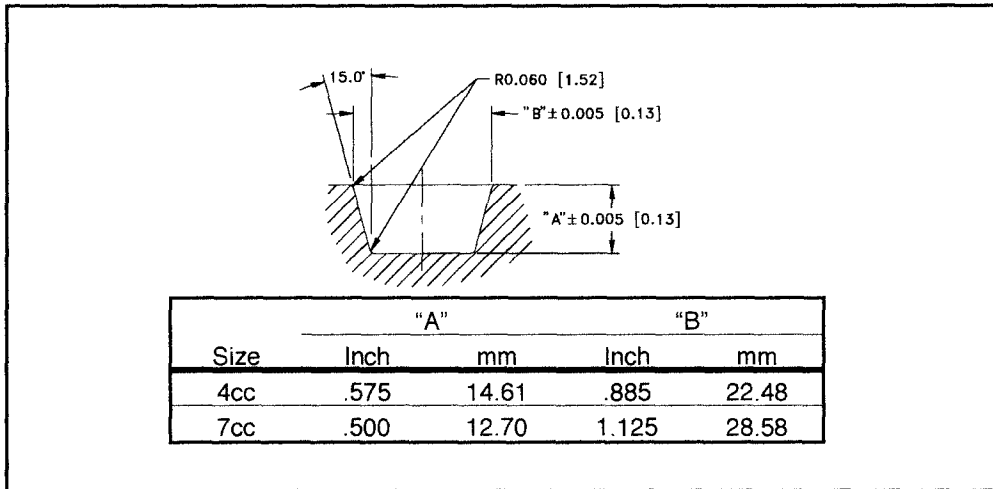
| | | |
|------------|-----------------------------------|-------|
| 275-0001-1 | High Voltage Feedthrough | 2 ea. |
| 275-0003-1 | Dual 3/8" Water Feedthrough | 1 ea. |
| 275-0008-1 | 8 pin Instrumentation Feedthrough | 1 ea. |

Feedthrough Kit for 248 E-source, Part# 275-0705-3 includes:

| | | |
|------------|--|-------|
| 275-0001-3 | High Voltage Feedthrough, CFF | 2 ea. |
| 275-0003-3 | Dual 3/8" Water Feedthrough, CFF | 1 ea. |
| 275-0008-3 | 8 pin Instrumentation Feedthrough, CFF | 1 ea. |

3 Flowmeter. Telemark part number 271-0831-1. This model uses 1/4" NPT fittings and is rated at 1-6 gpm adjustable.

Figure 3-F
Crucible
Dimensions



4 Crucible Indexer. For relay or manual operation of a 4 or 6 pocket E-source use the Crucible Indexer Model 376-8 (241) or Model 376-9 (247, 248). If continuous rotation is required or control of an banana pocket, then use Telemark Indexer Model 379-8 (241) or Model 379-9 (247, 248).

5 Crucibles

| 241/247 Part# | 248 Part# | # of Pockets | Size |
|---------------|------------|--------------|------|
| 241-0245-1 | 241-0245-3 | 4 | 7cc |
| 241-0281-1 | 241-0281-3 | 6 | 4cc |



OPERATION

General Operation - Startup

Load crucible up to first rim with vacuum grade material. Make sure view of the crucible is unobstructed from view port when chamber is closed. Welding glass (T9H is a convenient density) should be used when the beam intensity becomes too bright for direct viewing. (It is always a good idea to put a clean, removable piece of glass on the inside to prevent the port from being coated.) When chamber is in operating range on the order of 1×10^{-5} torr or better, set the operating voltage, set beam position to neutral, set emission to zero, reset sweeps amplitude to zero.

When you are satisfied that conditions are optimum, turn on high voltage. Keeping an eye on evaporant, very slowly turn up filament current. At around 100 ma the beam should become apparent on the melt. If not see the following paragraph. The beam should always be in the center of the crucible. As emission is increased, the sweep pattern can be enlarged to cover the melt. After the ion gauge has stabilized and the material has stopped out-gassing and spitting the shutter can be opened. After the required thickness level is reached, close the shutter and reduce the emission to zero.

If the beam is not visible at 100ma of emission current, then adjust beam position all the way in and then all the way out: also try adjusting the beam from left to right. **If the beam does not become apparent at this time do not under any circumstances try to increase the emission.** Instead, turn off source emission current and high voltage. Check longitudinal focus coil leads, be sure that they are not reversed and go through the check list under the section on troubleshooting.

General Operation - Shutdown

After terminating the final layer of the run sequence, turn down the filament current, turn off the high voltage, and allow the filament to cool for a few minutes before opening the chamber. The emitter assembly is surrounded by water-cooled components so by radiation the filament will cool quickly. (A yellow oxide forms around the filament cavity if vent is too fast.) Always use a grounding hook before working around high voltage.

Before removing the crucible for cleaning, make sure the water lines are blown out.

Adjusting the Electromagnetic Field

- 1 Position.** *The beam can be pulled towards the front of the crucible by either increasing the magnetic field or reducing the accelerating voltage. The ways of achieving this are: reducing the high voltage (which also reduces beam intensity), increasing the longitudinal coil current, removing the shunt bar, or bringing the pole pieces farther in. The beam can also be moved laterally by applying current to the lateral sweep coils.*
- 2 Shape.** *As in the discussion above, the shape of the beam can be concentrated by bringing the pole pieces all the way in. In general the beam shape is optimum for dielectrics if the pole pieces are two thirds of the way in, the shunt bar is added, and the accelerating voltage is around 6-7 kV.*
- 3 Intensity.** *The intensity of the beam is maximized by having the filament, beam former and anode plate aligned properly, see figure. 5-B. If the intensity seems limited, the filament alignment should be checked - it may be warped, too far up, or even in backwards. The beam intensity is increased by turning up the filament current.*



SERVICING

The first two items, the crucible and the emitter, are the ones most commonly removed for servicing.

Crucible Removal

Turn off the water and use the blowout valve to purge as much water from the source as possible. Undo the four #6-32 Allen Head screws, holding down the cover plate and remove the plate carefully, setting down on clean lint-free tissue to avoid contaminating. On the model 241 remove the screws holding the crucible down, insert the thumbscrew in the center of the crucible and lift out. On the 247 remove the rotary water union and loosen up the gear clamp and on the 248 the feedthrough clamp and on the source. Lift the crucible assembly out.

Crucible Replacement

Insert crucible assembly into the source and feedthrough, tighten clamps. Lower cover plate gently onto arms and tighten four holding screws. Turn on water, observing base of crucible for any leaks.

CAUTION: Make sure that a grounding hook is used to short all HV Connection before any work is performed on the emitter assembly.

Emitter Removal

Remove the two nuts and bolts holding the filament buss bars to the H.V. leads. The emitter is attached to the base with two #6-32 thumbscrews. In normal practice the emitter is extremely hot at this time. Remove the thumbscrews, then pull the emitter assembly straight out the front of the source.

Emitter Disassembly and Cleaning

You will need several things for the disassembly/cleaning process. Alcohol to help free the tight screws. Wire to string the metal parts of your emitter for cleaning. A bead-blaster to clean the parts. Wash and vapor dry the parts after bead-blasting. Some of your ceramics can also be cleaned in this fashion. Discard any cracked or broken ceramics.

The #6-32 x 1/4" screws (271-6030-1) that hold down the filament clamps and the beam former need to be discarded. They have been subjected to extreme heat and could possibly gaul if reused.

Filament Replacement

To replace the filament in the emitter assembly it is necessary to locate and remove the two filament clamp screws. CAUTION: If the screws seem tight, you can use alcohol to keep them from seizing. (See step 5 below).

Emitter Rebuilding/Reassembly

See Figure 5-A and 5-B, Photo 2

If the emitter is disassembled, refer to drawing. Ninety percent of system problems during production relate to the E-source emitter, so close attention to its assembly is of the utmost importance to trouble free runs.

In particular, pay meticulous attention to the following:

Length of screws. All screws must be clean and of correct length. (Refer to Figure 5-A) Tighten screws so that they are just snug. Do not overtighten screws going into or through ceramics. The ceramics will break, the resulting loss of ceramics can be both frustrating and expensive.

Relative position of anode plate, **beam former and filament must be precise to .005"**. (Refer to Figure 5-B) The filament (coils forward!) normally projects 1/3 of its diameter or slightly less below beam former. Clearance between these three elements should be judged, based on performance, with a well calibrated, experienced eye. The source will only work properly if these clearances are properly maintained.

Leads to filament. The voltage to the filament is only 12 volts so filament clamps, leads and high voltage feedthroughs must all be snugged firmly, but not overtighten, to reduce resistance. Make sure high voltage leads clear all objects inside chamber, especially leads to focus coil and aluminum foil or other shielding, by at least one inch.

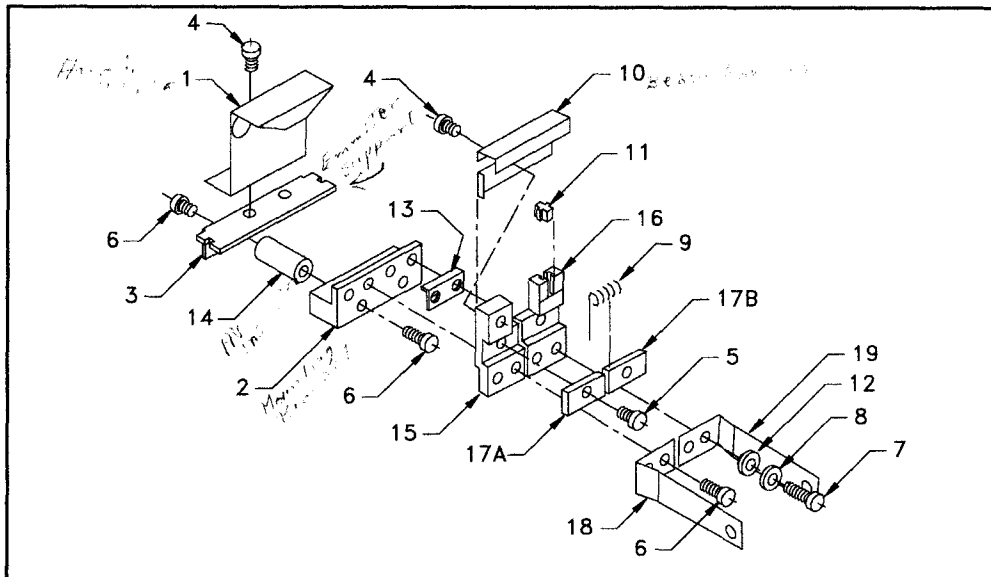
Do not tighten the screws all the way down until instructed to do so.

- 1** Assemble the Mounting Bracket (213-0017-2), the left hand Cathode Block (273-0031-1), and the left hand Buss Bar (273-0035-1) using two #6 x 3/8" screws (271-6050-1).

- 2** Add to the assembly the L Insulator (273-0008-1), the right hand Cathode Block (273-0032-1) and the right hand Buss Bar (273-0036-1), using two #6 washers (271-6242-1), two Collar Insulators (273-0006-1), and two #6 x 1/2" screws (271-6060-1).
- 3** Next mount the Cross Insulator (273-0005-1) and the Beam Former (273-0004-2) using one #6 x 1/4" (271-6030-1).
- 4** Now, stand this assembly up on a flat surface with the Buss Bars facing away from you. Gently tap the beam former into place, and snug the screw down. Turn the assembly so the buss bars are facing you. Press down gently on the beam former and gently snug the screws on the right hand Buss Bar. Check the gap between the two cathode blocks making sure that they are parallel. Snug the left hand Buss Bar screws.
- 5** Install the new filament making sure that the filament orientation is correct (see figure 5-B). Use new #6 x 1/4" screws, loosely mount the filament clamps in place. Gently tap the emitter assembly on a flat surface to settle the filament into place. Slide the filament clamp on the right cathode block until it is flush with the right side of the block. Snug the right #6 x 1/4" screws. Gently push the left hand clamp into place. **NOTE:** Sliding this clamp can cause the filament to warp or bow. Snug the left #6 x 1/4" screws. Now check the alignment of the filament to the beam former.
- 6** Loosely mount two, HV Insulators (273-0010-1) to the Emitter Support Bracket (213-0018-2) with two #6 x 1/4 screws.
- 7** Mount the Anode (213-0003-3) to the Emitter Support Bracket (213-0018-2) using two #6 x 1/4 screws.
- 8** Attach the emitter support bracket assembly to the mounting bracket assembly, using two #6 x 1/4 screws. Place this assembly on a flat surface with the emitter support hanging over an edge, gently push down on the support bracket and tighten the two #6 x 1/4 screws into the HV insulators. Next, carefully reach around and tighten the two #6 x 1/4 screws into the HV insulators.
- 9** Push down on the Anode, tighten the last two #6 x 1/4 screws. Now check the alignment of the Anode to the beam former (see figure 5-B).

The rebuilt emitter assembly is now ready to be installed back in the E-source.

Figure 5-A
Emitter
Assembly



| Ref | Part Number | Description | Qty. |
|-----|-------------|------------------------------------|-------|
| 1 | 213-0003-3 | Anode Plate | 1 ea. |
| 2 | 213-0017-3 | Mounting Bracket | 1 ea. |
| 3 | 213-0018-3 | <i>Emitter</i> Support Bracket | 1 ea. |
| 4 | 271-6030-1 | Soc. Head Cap Screw, #6-32 X 1/4" | 3 ea. |
| 5 | 271-6040-1 | Soc. Head Cap Screw, #6-32 X 5/16" | 2 ea. |
| 6 | 271-6050-1 | Soc. Head Cap Screw, #6-32 X 3/8" | 6 ea. |
| 7 | 271-6060-1 | Soc. Head Cap Screw, #6-32 X 1/2" | 2 ea. |
| 8 | 271-6242-1 | Flat Washer, #6, SS | 2 ea. |
| 9 | 273-0002-1 | Filament, 5 1/2 Turn | 1 ea. |
| 10 | 273-0004-2 | Beam Former | 1 ea. |
| 11 | 273-0005-1 | Insulator, Cross | 1 ea. |
| 12 | 273-0006-1 | Insulator, Collar | 2 ea. |
| 13 | 273-0008-1 | Insulator, L | 1 ea. |
| 14 | 273-0010-1 | Insulator, HV | 2 ea. |
| 15 | 273-0031-1 | Cathode Block, Left | 1 ea. |
| 16 | 273-0032-1 | Cathode Block, Right | 1 ea. |
| 17 | 273-0033-1 | Filament Clamp | 2 ea. |
| 18 | 273-0035-1 | Filament Bus Bar, Left | 1 ea. |
| 19 | 273-0036-1 | Filament Bus Bar, Right | 1 ea. |

Coil Assembly

See Figure 5-C

The coil assembly is not intended to be disassembled. With careful handling the stainless steel can be cleaned, taking care not to damage the electrodes.

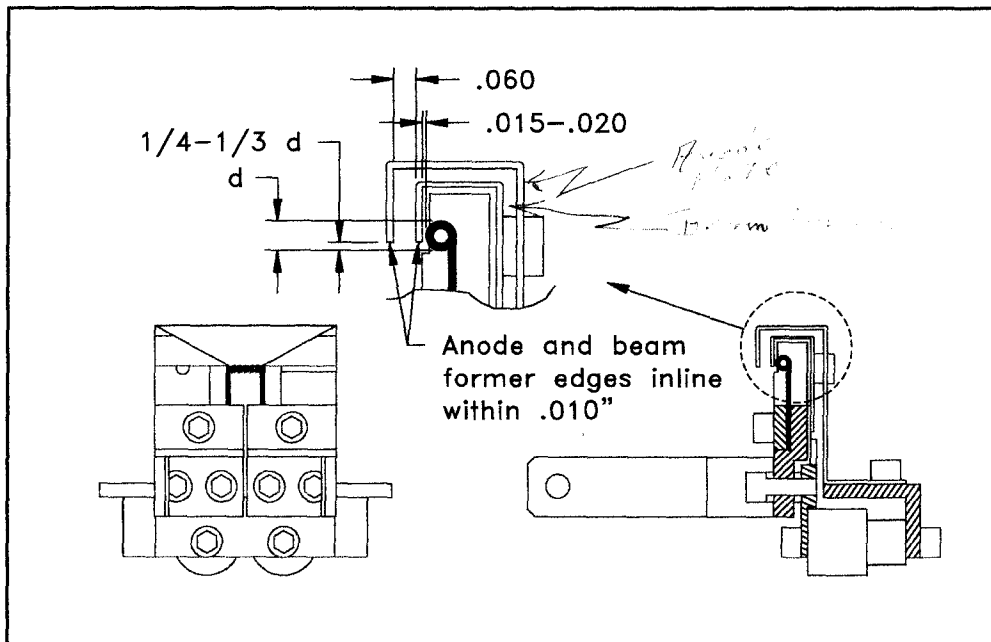


Figure 5-B
Filament
Location

Main Body Reassembly

See Figure 5-C

When completely disassembled, after the components are cleaned, the main body of the source should be reassembled in the following order:

Place on the main block and the bottom plate the right hand magnetic arm. Line up, and tighten the four #6-32 connecting screws.

Carefully lower in magnet, North Pole towards arm and side marked Top away from base. When it snaps in push forward against stop.

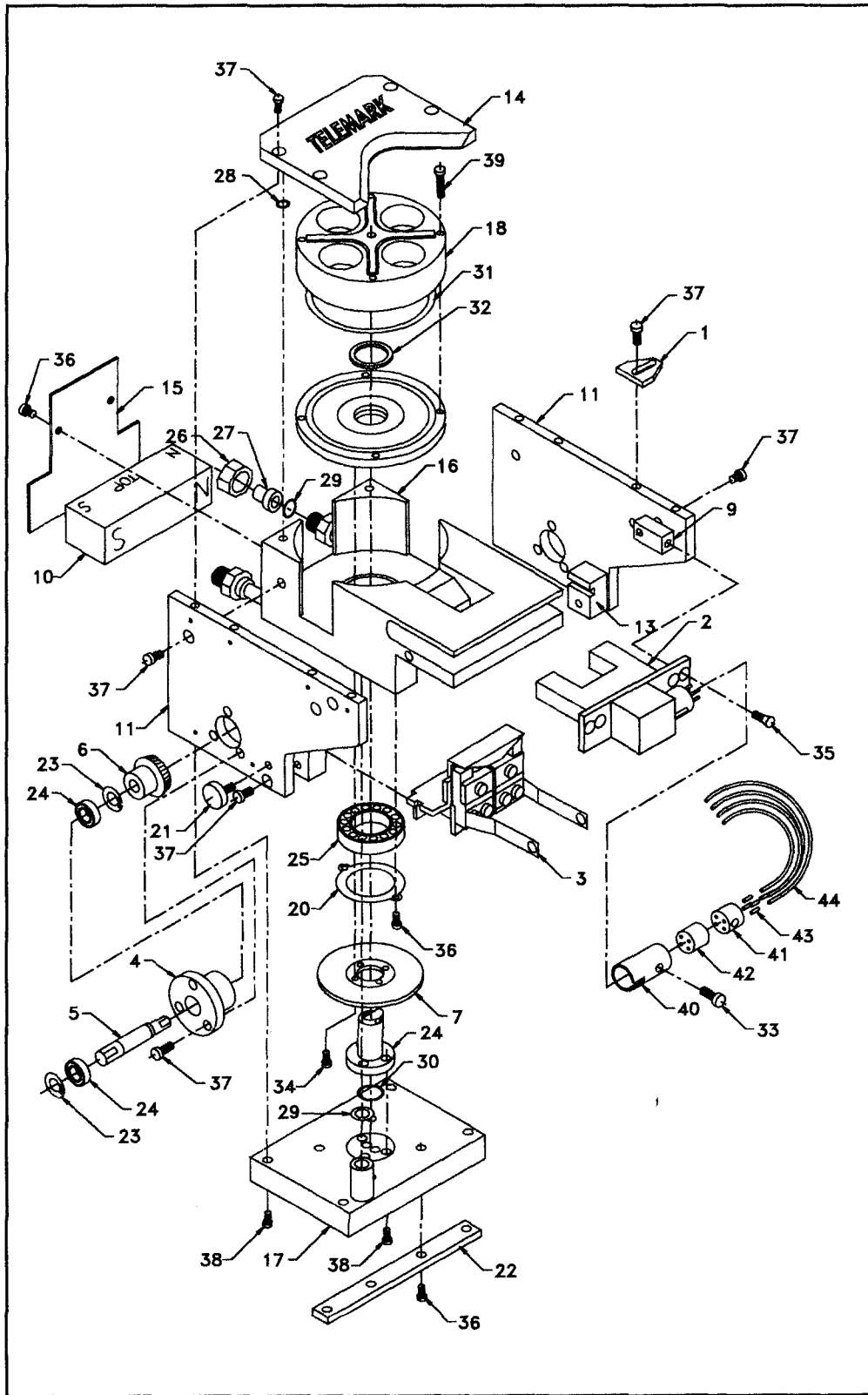
Attach left arm to the main block and the bottom plate with four #6-32 Allen head screws. Insert coil and attach electrode shield to the arms.

Check Bearing for free turning. Insert bearing in base plate.

Put on magnet shield, pole pieces, mounting straps. Insert crucible assembly. Replace emitter assembly. Fasten down crucible cover.

If necessary use check list on page 5-12 which is used on final inspection to make sure everything is in place.

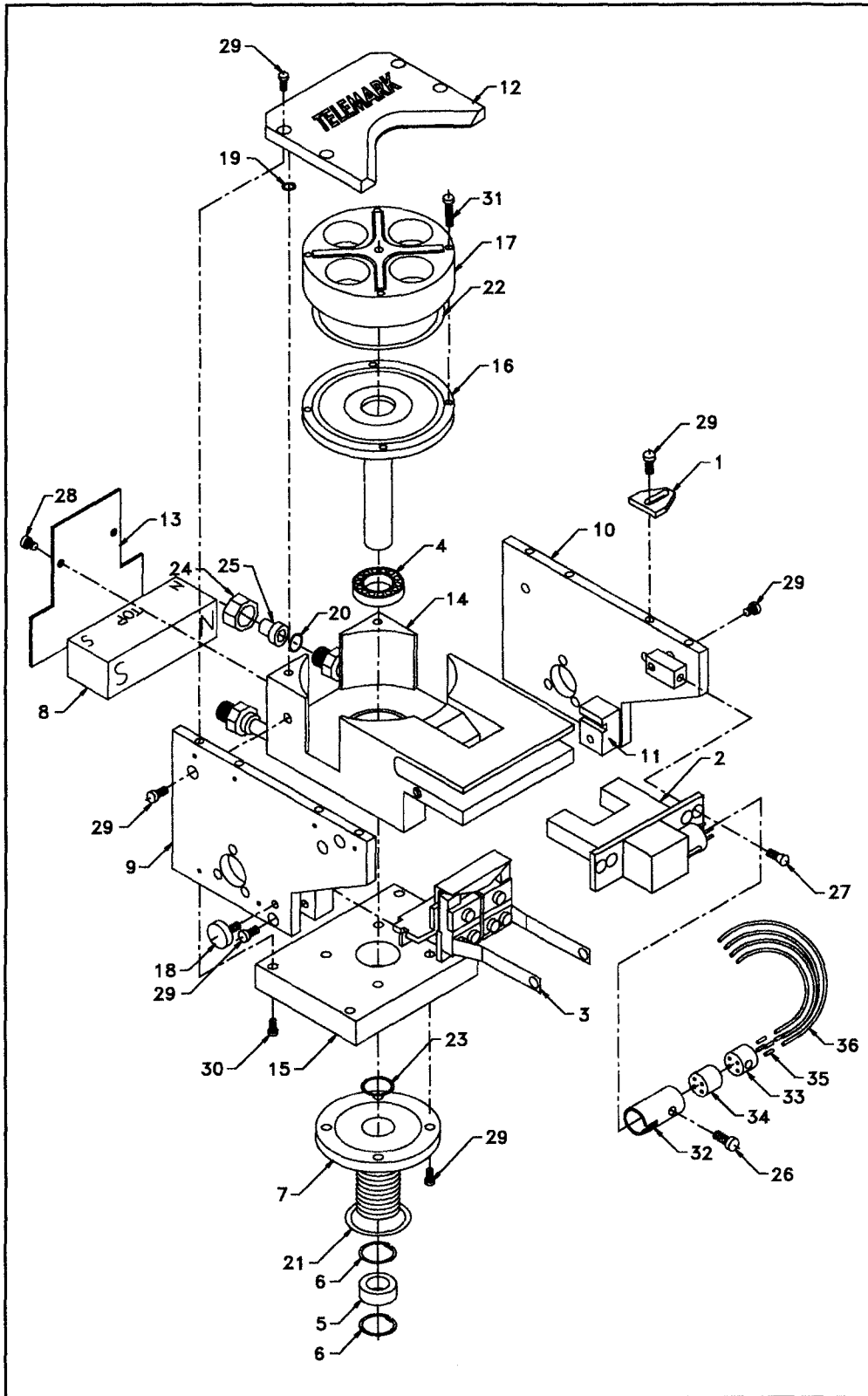
Figure 5-C
241 Main
Assembly



| Ref | Part# | Description | Qty. |
|-----|------------|-----------------------------------|---------|
| 1 | 211-0100-1 | Pole Piece | 2 ea. |
| 2 | 212-0080-1 | Coil Assembly | 1 ea. |
| 3 | 213-0150-1 | Emitter Assembly | 1 ea. |
| 4 | 241-0010-1 | Housing, Side Drive | 1 ea. |
| 5 | 241-0011-1 | Shaft, Side Drive | 1 ea. |
| 6 | 241-0012-1 | Pinion Gear | 1 ea. |
| 7 | 241-0013-1 | Bevel Gear | 1 ea. |
| 8 | 241-0042-1 | Pivot Shaft | 1 ea. |
| 9 | 241-0047-1 | Coil Block | 2 ea. |
| 10 | 241-0055-1 | Permanent Magnet | 1 ea. |
| 11 | 241-0058-1 | Magnet Arm, Left | 1 ea. |
| 12 | 241-0059-1 | Magnet Arm, Right | 1 ea. |
| 13 | 241-0061-1 | Mounting Block | 2 ea. |
| 14 | 241-007x-1 | Crucible Cover | 1 ea. |
| 15 | 241-0084-1 | Rear Shield | 1 ea. |
| 16 | 241-0111-1 | Main Block Assembly | 1 ea. |
| 17 | 241-0112-2 | Base Plate Assembly | 1 ea. |
| 18 | 241-02xx-1 | Crucible | 1 ea. |
| 19 | 241-0442-2 | Crucible Base, Side Drive | 1 ea. |
| 20 | 241-0656-1 | Bearing Strap | 1 ea. |
| 21 | 241-5006-1 | Thumbscrew, Emitter | 2 ea. |
| 22 | 241-0088-1 | Mounting Strap | 2 ea. |
| 23 | 271-0003-1 | Clip Ring, 1/4" | 2 ea. |
| 24 | 261-0152-1 | Bearing, 1/4" | 2 ea. |
| 25 | 271-0035-1 | Bearing, 1" | 1 ea. |
| 26 | 271-0650-2 | Water Fitting, Nut | 2 ea. |
| 27 | 271-0651-2 | Water Fitting, Gland | 2 ea. |
| 28 | 271-2007-1 | O-ring, Cover | 2 ea. |
| 29 | 271-2110-1 | O-ring, Water Line/ Body | 3 ea. |
| 30 | 271-2014-1 | O-ring, Pivot Shaft | 1 ea. |
| 31 | 271-2145-1 | O-ring, Crucible | 1 ea. |
| 32 | 271-4206-1 | Quad Ring | 1 ea. |
| 33 | 271-5998-1 | Round Head Screw, #4-40 X 1/8" | 1 ea. |
| 34 | 271-6000-1 | Round Head Screw, #4-40 X 3/8" | 4 ea. |
| 35 | 271-6010-1 | Flat Head Screw, #6-32 X 1/4" | 2 ea. |
| 36 | 271-6030-1 | Soc. Head Cap Screw, #6-32 X 1/4" | 8 ea. |
| 37 | 271-6050-1 | Soc. Head Cap Screw, #6-32 X 3/8" | 15 ea. |
| 38 | 271-6060-1 | Soc. Head Cap Screw, #6-32 X 1/2" | 7 ea. |
| 39 | 271-6075-1 | Soc. Head Cap Screw, #6-32 X 1" | 4,6 ea. |
| 40 | 272-0101-1 | Coil Connector Shield | 1 ea. |
| 41 | 272-0102-2 | Coil Connector, B | 1 ea. |
| 42 | 272-0102-3 | Coil Connector, A | 1 ea. |
| 43 | 272-0110-1 | Crimp Connector | 4 ea. |
| 44 | 272-0106-1 | Kapton Wire | 4 ea. |

Figure 5-C
241 Main
Assembly

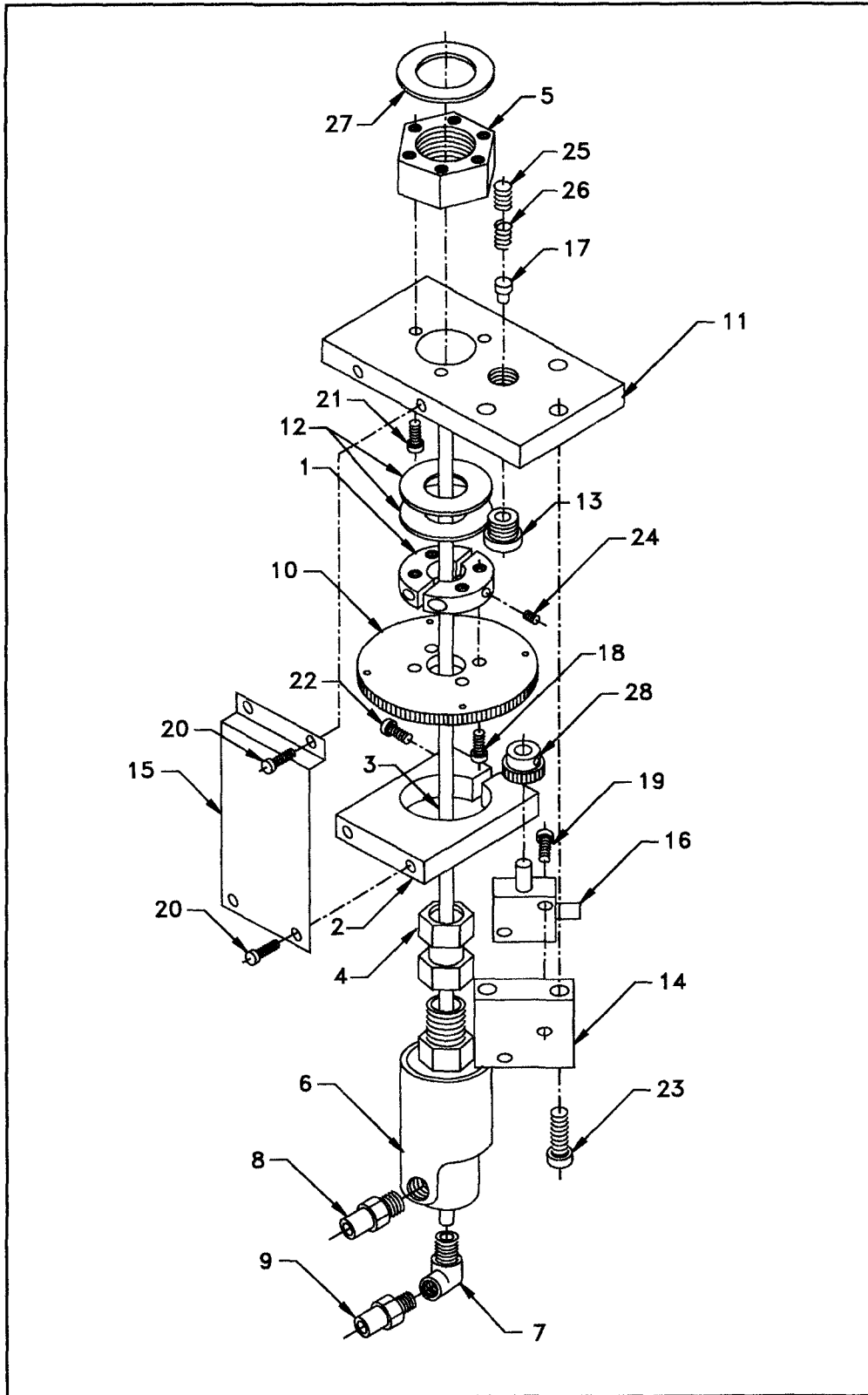
Figure 5-D
247 Main
Assembly



| Ref | Part# | Description | Qty. |
|-----|------------|-----------------------------------|---------|
| 1 | 211-0100-1 | Pole Piece | 2 ea. |
| 2 | 212-0080-1 | Coil Assembly | 1 ea. |
| 3 | 213-0150-1 | Emitter Assembly | 1 ea. |
| 4 | 231-0035-1 | Bearing | 1 ea. |
| 5 | 231-0036-1 | Rotation Bushing | 1 ea. |
| 6 | 231-0460-1 | Retaining Ring | 2 ea. |
| 7 | 231-0470-1 | Feedthrough Assembly | 1 ea. |
| 8 | 247-0055-1 | Permanent Magnet | 1 ea. |
| 9 | 241-0058-1 | Magnet Arm, Left | 1 ea. |
| 10 | 241-0059-1 | Magnet Arm, Right | 1 ea. |
| 11 | 241-0061-1 | Mounting Block | 2 ea. |
| 12 | 241-007x-1 | Crucible Cover | 1 ea. |
| 13 | 241-0084-1 | Rear Shield | 1 ea. |
| 14 | 241-0111-1 | Main Block Assembly | 1 ea. |
| 15 | 241-0112-1 | Base Plate Assembly | 1 ea. |
| 16 | 241-0115-1 | Crucible Base Assembly | 1 ea. |
| 17 | 241-02xx-1 | Crucible | 1 ea. |
| 18 | 241-5006-1 | Thumbscrew, Emitter | 2 ea. |
| 19 | 271-2007-1 | O-ring, Cover | 2 ea. |
| 20 | 271-2110-1 | O-ring, Water Line | 2 ea. |
| 21 | 271-2122-1 | O-ring, Feedthrough | 1 ea. |
| 22 | 271-2145-1 | O-ring, Crucible | 1 ea. |
| 23 | 271-4206-1 | Quad Ring | 1 ea. |
| 24 | 271-0650-2 | Water Fitting, Nut | 2 ea. |
| 25 | 271-0651-2 | Water Fitting, Gland | 2 ea. |
| 26 | 271-5998-1 | Round Head Screw, #4-40 X 1/8 | 1 ea. |
| 27 | 271-6010-1 | Flat Head Screw, #6-32 X 1/4" | 2 ea. |
| 28 | 271-6030-1 | Soc. Head Cap Screw, #6-32 X 1/4" | 2 ea. |
| 29 | 271-6050-1 | Soc. Head Cap Screw, #6-32 X 3/8" | 16 ea. |
| 30 | 271-6060-1 | Soc. Head Cap Screw, #6-32 X 1/2" | 4 ea. |
| 31 | 271-6075-1 | Soc. Head Cap Screw, #6-32 X 1" | 4,6 ea. |
| 32 | 272-0101-1 | Coil Connector Shield | 1 ea. |
| 33 | 272-0102-2 | Coil Connector, B | 1 ea. |
| 34 | 272-0102-3 | Coil Connector, A | 1 ea. |
| 35 | 272-0110-1 | Crimp Connector | 4 ea. |
| 36 | 272-0106-1 | Kapton Wire | 4 ea. |

Figure 5-D
247 Main
Assembly

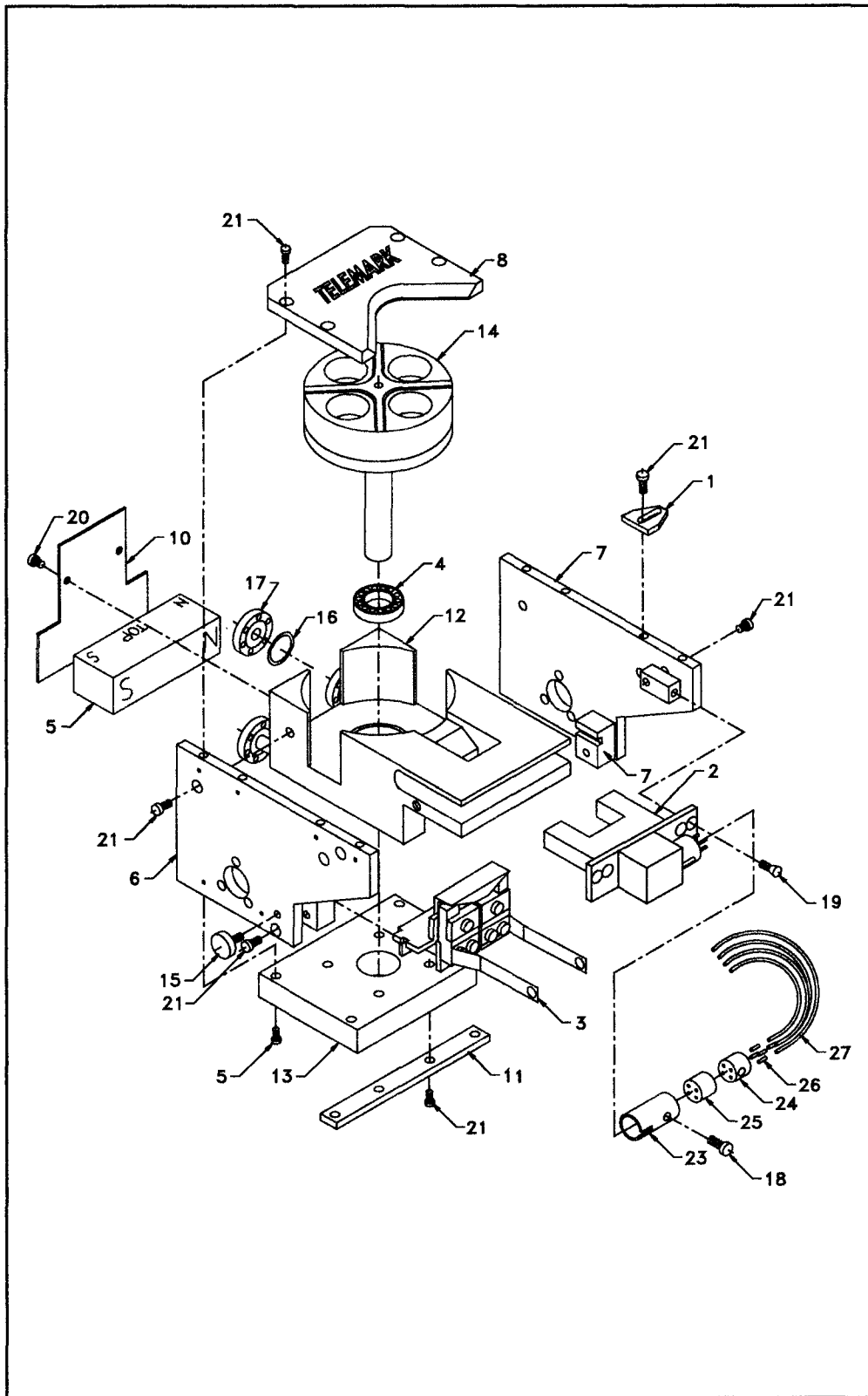
Figure 5-E
247 External
Assembly



| Ref | Part# | Description | Qty. |
|-----|------------|---|-------|
| 1 | 231-0162-1 | Gear Clamp | 1 ea. |
| 2 | 231-0170-1 | Union Clamp | 1 ea. |
| 3 | 231-0455-1 | Water Inlet Tube | 1 ea. |
| 4 | 231-0456-1 | Compression Fitting, 1/2" tube x 3/8" NPT | 1 ea. |
| 5 | 231-0472-1 | Feedthrough Nut | 1 ea. |
| 6 | 231-4020-1 | Water Union | 1 ea. |
| 7 | 231-4022-1 | Elbow, Water Union, 1/4" x 1/4" | 1 ea. |
| 8 | 231-4023-1 | Water Fitting, 3/8" NPT X 3/8" Tube | 1 ea. |
| 9 | 231-4024-1 | Water Fitting, 1/4" NPT X 3/8" Tube | 1 ea. |
| 10 | 267-0149-1 | Gear, 96 Teeth | 1 ea. |
| 11 | 267-0160-1 | Motor Clamp | 1 ea. |
| 12 | 267-0160-6 | Motor Clamp Washer | 2 ea. |
| 13 | 267-0164-1 | Plunger Housing | 1 ea. |
| 14 | 267-0168-1 | Rt. Angle Mount | 1 ea. |
| 15 | 267-0171-1 | Union Strap | 1 ea. |
| 16 | 267-9020-1 | Gear Box | 1 ea. |
| 17 | 271-0077-1 | Nylon Plunger | 1 ea. |
| 18 | 271-6060-1 | Soc. Head Cap Screw, #6-32 X 1/2" | 4 ea. |
| 19 | 271-6129-1 | Soc. Head Cap Screw, #8-32 X 1-1/4" | 2 ea. |
| 20 | 271-6145-1 | Soc. Head Cap Screw, #10-32 X 3/8" | 4 ea. |
| 21 | 271-6150-1 | Soc. Head Cap Screw, #10-32 X 1/2" | 3 ea. |
| 22 | 271-6175-1 | Soc. Head Cap Screw, #10-32 X 1-1/4" | 1 ea. |
| 23 | 271-6178-1 | Soc. Head Cap Screw, #10-32 X 1-3/4" | 2 ea. |
| 24 | 271-6198-1 | Set Screw, #6-32 X 1/4" | 2 ea. |
| 25 | 271-6210-1 | Set Screw, 7/16-14 X 3/8" | 1 ea. |
| 26 | 271-6220-1 | Spring | 1 ea. |
| 27 | 275-0046-1 | Washer, 1" | 1 ea. |
| 28 | 281-0150-1 | Gear, 24 Teeth | 1 ea. |

Figure 5-E
247 External
Assembly

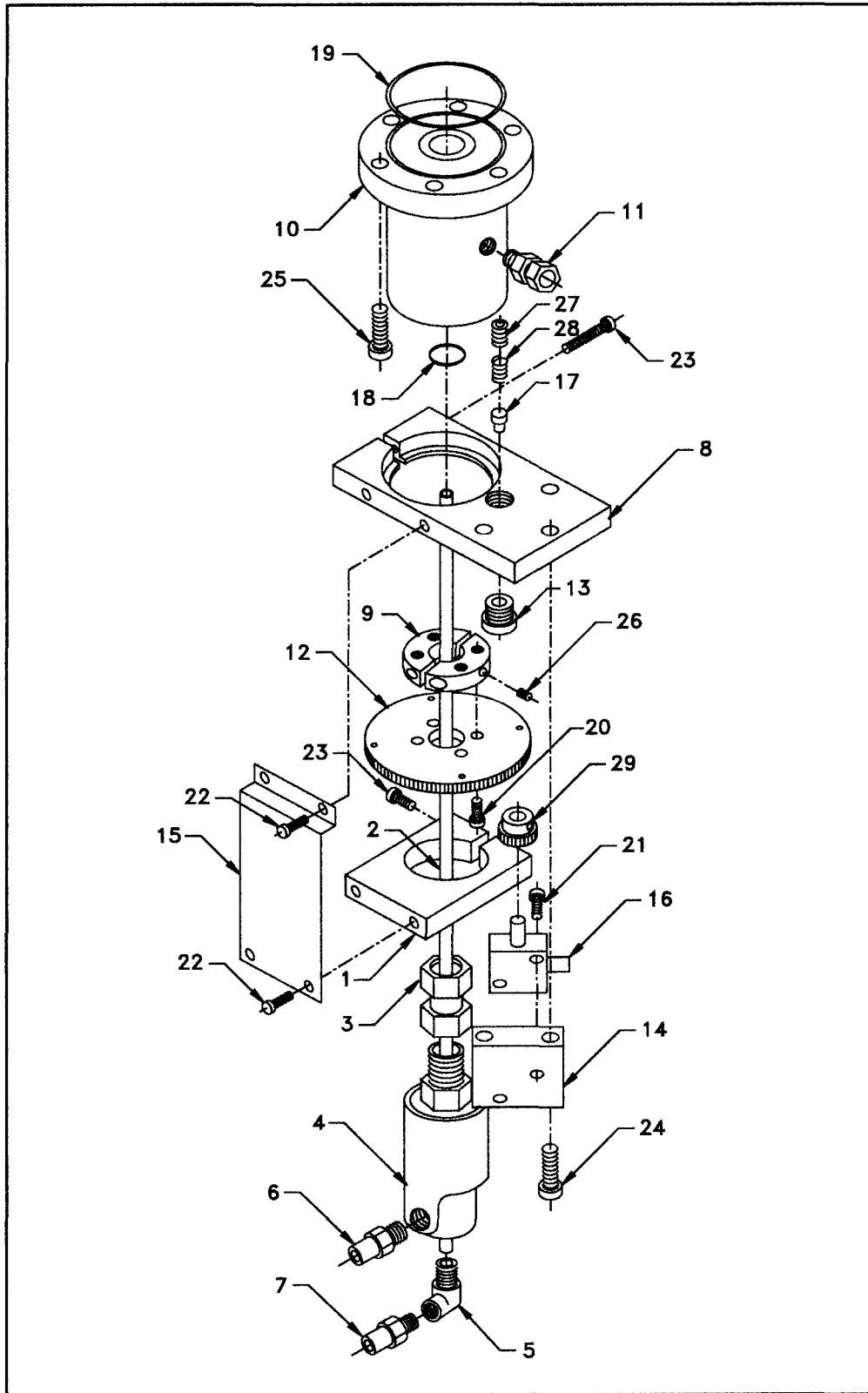
Figure 5-F
248 Main
Assembly



| Ref | Part# | Description | Qty. |
|-----|-----------------------------|--|--------|
| 1 | 241-0100-1 | Pole Piece | 2 ea. |
| 2 | 212-0080-1 | Coil Assembly | 1 ea. |
| 3 | 213-0150-1 | Emitter Assembly | 1 ea. |
| 4 | 231-0035-1 | Bearing | 1 ea. |
| 5 | 247-0055-1 | Permanent Magnet | 1 ea. |
| 6 | 241-0058-1 | Magnet Arm, Left | 1 ea. |
| 7 | 241-0059-1 | Magnet Arm, Right | 1 ea. |
| 8 | 241-0061-1 | Mounting Block | 2 ea. |
| 9 | 248-007x-1 | Crucible Cover | 1 ea. |
| 10 | 241-0084-1 | Rear Shield | 1 ea. |
| 11 | 241-0088-1 | Mounting Strap | 2 ea. |
| 12 | 248-0111-1 | Main Block Assembly | 1 ea. |
| 13 | 241-0112-1 | Base Plate Assembly | 1 ea. |
| 14 | 241-02xx-1 | Crucible | 1 ea. |
| 15 | 241-5006-1 | Thumbscrew, Emitter | 2 ea. |
| 16 | 271-3581-1 or 271-3501-1 | Copper Gasket, Water Line, 1.33 VCR gaskets, 3/8 | 2 ea. |
| 17 | 271-3641-1 or 271-0651-3 | Water Fitting, CCF, 1.33 Water Fitting Gland, VCR | 2 ea. |
| 18 | 271-5998-1 | Round Head Screw, #4-40 X 1/8" | 1 ea. |
| 19 | 271-6010-1 | Flat Head Screw, #6-32 X 1/4" | 2 ea. |
| 20 | 271-6030-1 | Soc. Head Cap Screw, #6-32 X 1/4" | 2 ea. |
| 21 | 271-6050-1 | Soc. Head Cap Screw, #6-32 X 3/8" | 16 ea. |
| 22 | 271-6060-1 | Soc. Head Cap Screw, #6-32 X 1/2" | 4 ea. |
| 23 | 272-0101-1 | Coil Connector Shield | 1 ea. |
| 24 | 272-0102-2 | Coil Connector, B | 1 ea. |
| 25 | 272-0102-3 | Coil Connector, A | 1 ea. |
| 26 | 272-0110-1 | Crimp Connector | 4 ea. |
| 27 | 272-0106-1 | Kapton Wire | 4 ea. |

Figure 5-F
248 Main
Assembly

Figure 5-G
248 External
Assembly



| Ref | Part# | Description | Qty. |
|-----|------------|--------------------------------------|-------|
| 1 | 231-0170-1 | Union Clamp | 1 ea. |
| 2 | 231-0455-1 | Water Inlet Tube | 1 ea. |
| 3 | 231-0456-1 | Compression Fitting | 1 ea. |
| 4 | 231-4020-1 | Water Union | 1 ea. |
| 5 | 231-4022-1 | Elbow, Water Union | 1 ea. |
| 6 | 231-4023-1 | Water Fitting, 3/8" NPT X 3/8" Tube | 1 ea. |
| 7 | 231-4024-1 | Water Fitting, 1/4" NPT X 3/8" Tube | 1 ea. |
| 8 | 238-0160-1 | Motor Clamp | 1 ea. |
| 9 | 238-0162-1 | Gear Clamp | 1 ea. |
| 10 | 238-4010-1 | Magnetic Seal Feedthrough | 1 ea. |
| 11 | 238-4012-1 | Water Fitting, Feedthrough | 2 ea. |
| 12 | 267-0149-1 | Gear, 96 Teeth | 1 ea. |
| 13 | 267-0164-1 | Plunger Housing | 1 ea. |
| 14 | 267-0168-1 | Rt. Angle Mount | 1 ea. |
| 15 | 267-0171-1 | Union Strap | 1 ea. |
| 16 | 267-9020-1 | Gear Box | 1 ea. |
| 17 | 271-0077-1 | Nylon Plunger | 1 ea. |
| 18 | 271-2013-1 | O-ring 2-013 | 1 ea. |
| 19 | 271-3601-1 | Copper Gasket, 2.75" | 1 ea. |
| 20 | 271-6060-1 | Soc. Head Cap Screw, #6-32 X 1/2" | 4 ea. |
| 21 | 271-6129-1 | Soc. Head Cap Screw, #8-32 X 1-1/4" | 2 ea. |
| 22 | 271-6145-1 | Soc. Head Cap Screw, #10-32 X 3/8" | 4 ea. |
| 23 | 271-6175-1 | Soc. Head Cap Screw, #10-32 X 1-1/4" | 2 ea. |
| 24 | 271-6178-1 | Soc. Head Cap Screw, #10-32 X 1-3/4" | 2 ea. |
| 25 | 271-6197-1 | Soc. Head Cap Screw, 1/4-28 X 7/8" | 6 ea. |
| 26 | 271-6198-1 | Set Screw, #6-32 X 1/4" | 2 ea. |
| 27 | 271-6210-1 | Set Screw, 7/16-14 X 3/8" | 1 ea. |
| 28 | 271-6220-1 | Spring | 1 ea. |
| 29 | 281-0150-1 | Gear, 24 Teeth | 1 ea. |

Figure 5-G
248 External
Assembly

External Reassembly

See Fig. 5-D

After inserting a fresh O-ring in the feedthrough, set it in the chamber with a O-Ring. With the source in place and on stand-offs the external parts can be installed.

The water union and tube are inserted.

Finally all the water lines are connected.

Quick Check

| | | | |
|---|--|---|--|
| Emitter Assembly | <u>Filament location</u> | | |
| | Anode, beam former and filament parallel | | |
| | #6-32 screws snugged | | |
| | Resistance check | <u>filament continuity</u> emitter to ground | |
| <u>Fastened to baseplate</u> | | | |
| Tightened firmly to HV leads | | | |
| Main Body Assembly | Screws tightened | #6-32 | 8x magnet arms 2x magnet shield 2x electrode shield 4x crucible cover |
| | | Thumbscrew | 2x emitter |
| | Check magnet orientation! (From rear of source, North on left, Top up) | | |
| Magnetic Field | checked directly above filament: | No current, 1 Amp applied | Longitudinal Lateral |
| Leak check to 2×10^{-10} Std. ccs of helium. | | | |
| Cleanliness | <u>Beadblasting</u> | | |
| | <u>Flakes, dust, coating</u> | | |
| | <u>Fingerprints</u> | | |
| Waterline Fittings | tight | | |

Rebuild Kits**Maintenance Kit, part #241-0702-2****Maintenance Kit, part #247-0702-2****Maintenance Kit, part #248-0702-2**

| Part Number | | | Description | Qty. |
|-------------|------------|------------|-----------------------------------|--------|
| 241 | 247 | 248 | | |
| 241-2000-1 | 247-2000-1 | 248-2000-1 | Gasket Kit | 1 ea. |
| | | 271-6128-1 | Soc. Head Cap Screw, #8-32 x 1/2" | 12 ea. |
| 213-0700-1 | 213-0700-1 | 213-0700-1 | Emitter Rebuild Kit | 1 ea. |

Gasket Kit, part #241-2000-1**Gasket Kit, part #247-2000-1****Gasket Kit, part #248-2000-1**

| Part Number | | | Description | Qty. |
|-------------|------------|-----------------------------|---|-------|
| 241 | 247 | 248 | | |
| 271-2007-1 | 271-2007-1 | | O-ring, Cover | 2 ea. |
| 271-2110-1 | 271-2110-1 | | O-ring, Water Line | 1 ea. |
| 271-2014-1 | | | O-ring, Pivot Shaft | 1 ea. |
| | 271-2122-1 | 271-2013-1 | O-ring, Feedthrough | 2 ea. |
| 271-2145-1 | 271-2145-1 | | O-ring, Crucible | 1 ea. |
| | | 271-3581-1 or 271-3501-1 | Copper Gasket, Water Line, 1.33 VCR gaskets, 3/8 | 2 ea. |
| 271-4206-1 | 271-4206-1 | | Quad Ring | 1 ea. |

Emitter Rebuild Kit, part #213-0700-2

| Part Number | Description | Qty. |
|-------------|------------------------------------|-------|
| 213-0003-3 | Anode Plate | 1 ea. |
| 271-6030-1 | Soc. Head Cap Screw, #6-32 x 1/4" | 3 ea. |
| 271-6040-1 | Soc. Head Cap Screw, #6-32 x 5/16" | 2 ea. |
| 271-6050-1 | Soc. Head Cap Screw, #6-32 x 3/8" | 6 ea. |
| 271-6060-1 | Soc. Head Cap Screw, #6-32 x 1/2" | 2 ea. |
| 273-0002-1 | Filament 5-1/2 Turn | 5 ea. |
| 273-0004-1 | Beam Former | 1 ea. |
| 273-0005-1 | Insulator, Cross | 1 ea. |
| 273-0006-1 | Insulator, Collar | 2 ea. |
| 273-0008-1 | Insulator, L | 1 ea. |
| 273-0010-1 | Insulator, HV | 2 ea. |

NO VOLTAGE

Cause: System or source has high resistance ground

Correction: Check emitter, filament or feedthroughs for shorts

| |
|----------------------|
| Beam Problems |
|----------------------|

NO BEAM VISIBLE IN CRUCIBLE AS CURRENT IS INCREASED

Cause 1: Magnet was reversed on reassembling source (this can have damaging affects on the E-source and chamber walls if emission current is increased too far while searching for beam).

Correction: Close down system and reassemble source with magnet properly oriented.

Cause 2: Sweep output transistor is blown so that there is no coil current. This normally shows up in that only the lateral or longitudinal sweep work, not both.

Correction: Replace transistor.

BEAM CENTERED TO FRONT OF CRUCIBLE, without coil current

Cause 1: Voltage below 10 kV.

Correction: Adjust voltage to 10 kV.

Cause 2: Magnet too strong.

Correction: Place a shunt just behind the cover plate on the magnet arms. This will however cause the beam to be fuzzy or defused.

BEAM CENTERED TO BACK OF CRUCIBLE, without coil current

Cause 1: Voltage above 10 kV.

Correction: Adjust voltage to 10 kV.

Cause 2: Magnet too weak.

Correction: Remove shunts, if still out of position then regauss or replace permanent magnet.

BEAM DOES NOT HAVE DESIRED SHAPE

Cause 1: Filament is warped or misaligned.

Correction: Replace filament.

Cause 2: Pole pieces are either in or out too far.

Correction: Adjust pole pieces.

Cause 3: Voltage set below 10 kV will cause beam to spread out.

Correction: Adjust voltage

ARCING AND BLUE FLUORESCENCE OCCUR WHERE BEAM SHOULD BE

Cause: Pressure is too high. There may be a water leak, bleed valve may be wide open, or chamber seal may be broken.

Correction: Shut off bleed valve, check source or water fittings for leaks, check most recently opened chamber seals (such as door) for clean surfaces. Mentally and if necessary physically leakcheck chamber.

Rotation Problems

LOSS OF VACUUM WHEN CRUCIBLE IS ROTATED

Cause: Water seal is letting water through.

Correction: Install new Quad-ring.

CRUCIBLE DIFFICULT TO ROTATE

Cause: Water seal in need of lubrication.

Correction: Install new Quad-ring.