

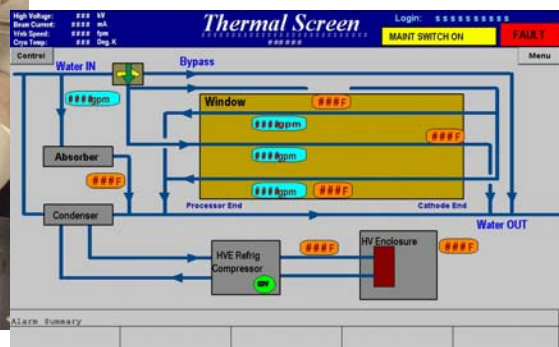
## BroadBeam® Maintenance Services

At BroadBeam® Equipment, we understand how important your E-Beam machine's reliability and performance are to your company's bottom line. Just like an automobile, a machine that runs for many months or years with no maintenance service will suffer a loss in performance. This is usually indicated by lower filament current, poor vacuum levels, frequent foil failures and increase in sparks at higher beam current levels. This may mean that your process line speed is limited, resulting in less product out the door.

In order to help you continue to get the most out of your machine, BroadBeam® Equipment has several maintenance options available. The options are tailored to fit your specific machine and your company's in-house maintenance capabilities. Some customers have several BroadBeam® machines in service and are well equipped with the necessary tools and experienced maintenance personnel. Other customers have smaller production facilities without a dedicated E-Beam maintenance area and staff. In either situation, we can help!

Following is a brief description of each E-Beam maintenance option that is currently available. If you are unsure as to which option would best suit your needs, call our office for a free consultation. By answering a few simple questions and discussing any specific problems you are experiencing, we can help simplify the choices. Pricing is typically available within 24 hours. Onsite service is available with all maintenance options and is strongly recommended for some of them. Any purchased maintenance option that includes our onsite service technicians entitles you to a discount charge for machine calibration while our technician is at your plant.

We want to make sure your BroadBeam® is "tuned-up" and running smoothly!



## **Maintenance Option #1 — Control Board Calibration and System Check**

This option is a preventative maintenance procedure that will maintain the integrity of the E-Beam operation. It is recommended that the Control Calibration and System Check be conducted yearly. During this service, the BroadBeam<sup>®</sup> technician will:

### **Beam Controller:**

- Inspect components on PC control boards
- Check DC power supplies
- Check electrical connections

### **HV Enclosure:**

- Inspect components on PC control boards
- Check HV deck DC power supply
- Check components inside the HV enclosure
- Check SF<sub>6</sub> pressure switches for proper settings and refill with SF<sub>6</sub> gas

### **HVPS:**

- Inspect external electrical connections and components

### **PC Control Board Calibration:**

Check calibration to ensure accuracy of:

- Filament volts and amps
- Screen grid volts and amps
- HV reading

### **Power Cubicle:**

Inspect the following:

- Electrical connections
- Cooling fans
- Filters

### **Vacuum System:**

- Inspect cryogenic pump and compressor
- Check fore line connections
- Change oil and filter in roughing pump (if needed)
- Change absorber in cryogenic compressor (if needed)



**Cooling System:**

Check for proper water flow:

- Through the copper window
- To the cryogenic compressor
- Through the chill roll or beam absorber

**Ozone System (if applicable):**

- Inspect blower and rubber boots on blower
- Inspect duct work on machine

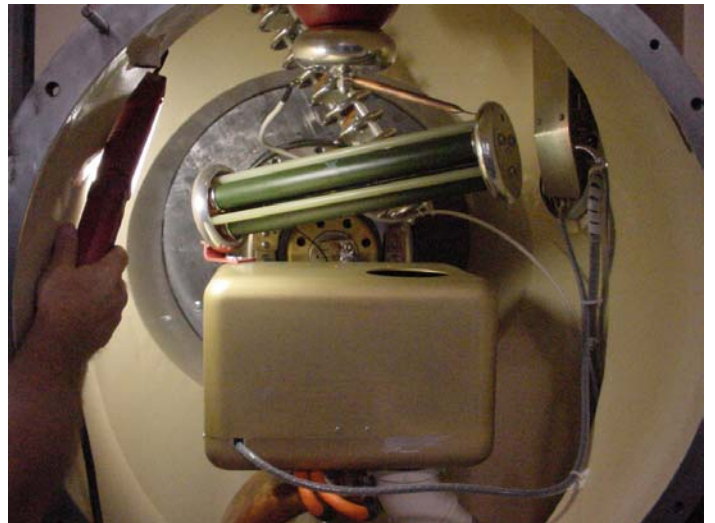
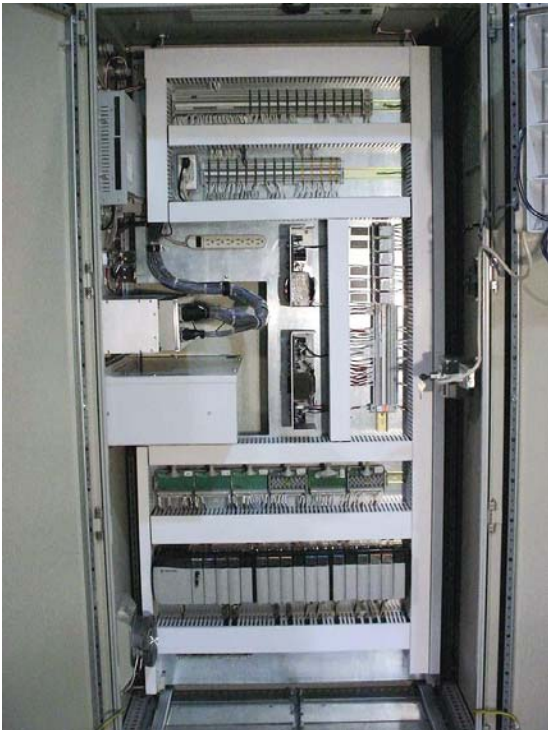
**Inerting System (if applicable):**

- Check for N<sub>2</sub> flow through knife bars
- Check screws for tightness on copper for inerting fixture
- Inspect components for inerting system

**Lead Shielding:**

- Inspect all lead shielding for any damage or deformity

This service can be completed by one BroadBeam<sup>®</sup> technician (with customer assistance) in approximately 8 to 10 hours.



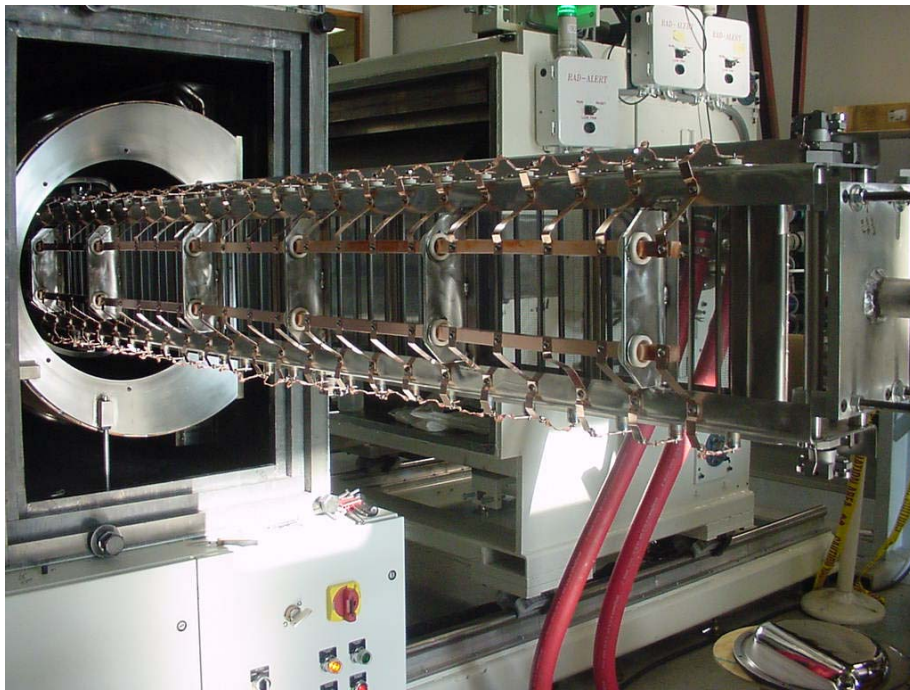
## **Maintenance Option #2 — Filament Replacement**

This is the most commonly used maintenance kit for our machines. As a rule of thumb, our filaments should be changed after 12,000 hours of operation. In most cases, filament replacement can be accomplished within an 8-10 hour shift.

Many of our customers purchase the option from us and install the parts themselves. However, we have service technicians available that can assist with changing, testing and conditioning the filaments, insuring your machine is back in production as quickly as possible. While onsite, our technician will inspect your machine and power supply for any other problem areas that may require attention. You will receive a written copy of our technician's inspection report and any recommendations that may apply.

The Filament Replacement Option includes the following:

- New 12-MIL filaments, springs and insulating ceramics
- New O-Rings for the vacuum chamber door and HV Enclosure Door
- Lint free gloves and wipes
- Aquadag thread lubricant
- Basic instructions for changing and conditioning the filaments
- New foil and foil clamp O-Ring (Optional)
- Field Service Technician for up to two working days (Optional)



### **Maintenance Option #3 – Gun Overhaul**

This option is a step up from Option #1 and is of a more extensive parts replacement of the cathode components. This service is typically required when a cathode has become contaminated over time or as a result of a sudden loss in vacuum (foil implosion). A BroadBeam<sup>®</sup> machine with a contaminated gun typically exhibits deterioration in vacuum level and frequent sparking. During a Gun Overhaul, the cathode is stripped down to the frame and rebuilt with fresh components that are chemically cleaned and ready for vacuum service. Depending on a machine's performance, a Gun Overhaul should be considered every fourth filament change. A Gun Overhaul can typically be accomplished within three to four 8- 10hour shifts. After re-installation of the cathode, the machine will need to be conditioned (run at lower beam levels) for a short period before full production is resumed.

Because of the number of parts involved with a Gun Overhaul, it is more costly than Option #1. In an attempt to reduce the cost to our customers, BroadBeam<sup>®</sup> Equipment offers a credit for return of certain parts that are removed during the overhaul process. Our cost proposal for this option explains in further detail which parts can be returned for credit.

Although more labor intensive than a Filament Change, the Gun Overhaul can be performed by a customer who has experience working on our machines. For customers with limited first hand experience working on our equipment, we recommend a Broad-Beam<sup>®</sup> service technician to assist with this work. By working with our technician, your maintenance personnel will receive hands-on training in rebuilding our gun. Once rebuild of the gun is complete, our service technician will assist with re-conditioning the cathode and vacuum chamber. Again, our technician will perform an onsite inspection and provide you with a report on your machine's condition.

The Gun Overhaul Option includes the following:

- New 12-MIL filaments, springs and insulating ceramics
- Replacement form grids and bushings
- New screen grid, clips, and frame
- New copper braids and bus bar filaments
- Replacement screws, nuts, washers, insulators, all cleaned and ready for vacuum service
- New O-Rings for the vacuum chamber door and HV Enclosure Door
- Lint free gloves and wipes
- Aquadag thread lubricant
- Nylon brush and Scotch-Brite pads for cleaning the frame, bus bars, tapped holes, etc.
- Basic instructions for changing and conditioning the filaments
- New foil and foil clamp O-Ring (Optional)
- Field Service Technician for up to three to four working days (Optional)



## **Maintenance Option #4 – Copper Window Cleaning**

Inspection and cleaning of the copper window is offered a stand alone service or as an additional service to the Gun Overhaul option. A machine outage for a Gun Overhaul is a convenient time to remove the window from the machine and replace the O-Ring between the copper and the face of the vacuum chamber. Because of the intense heat and radiation generated in the vacuum chamber, this O-Ring should be replaced approximately every 35,000 hours of operation (about every 4 years of full time operation).

This option is offered as a parts-only option for customers with extensive experience in working on our machines. For others customers, this option is offered as a full service product, using our tools, fixtures and personnel. In the full service format, the only item the customer is responsible for is a forklift or overhead crane operator to assist in removal of the window.

After the window is removed, it is placed in a holding fixture and cleaned. Both faces of the window must be cleaned, along with all O-Ring grooves and holes. We will then inspect the window for warping (rare) and cracking. Any flaws or defects of this nature will be brought to the customer's attention. Any damaged or corroded mounting holes for the foil frame will be repaired before re-installation on the machine. Once the window and cathode are re-installed, our service technician will assist with re-conditioning the cathode and vacuum chamber. Again, our technician will perform an onsite inspection and provide you with a report on your machine's condition.

The Copper Window Cleaning maintenance option will typically take between two and four 8-10 hour shifts, depending on the size and condition of the window. To reduce overall machine downtime, this work can be performed in conjunction with a Filament Change or Gun Rebuild.

The parts-only Copper Window Cleaning Option includes the following:

- New window O-Rings
- Repair kit for the foil frame mounting holes
- Lint free gloves and wipes
- Aquadag thread lubricant
- Nylon brush and Scotch-Brite pads for cleaning the frame, bus bars, tapped holes, etc.
- New foil and foil clamp O-Ring (Optional)



## **Maintenance Option #5 – Cathode Housing and Gun Frame Cleaning**

After many years of continuous operation or in cases where the vacuum chamber has been repeatedly exposed to contaminated environments (frequent foil changes, implosions, vacuum leaks, etc.), the cathode and cathode housing will become excessively dirty and discolored. In these cases, a chemical cleaning of the cathode is recommended. This service is offered as an upgrade to the Gun Overhaul maintenance option.

To accomplish this level of cleaning, both the gun and cathode housing are removed from the machine. After the gun is stripped, the gun frame, cathode housing and cathode housing end-plate are crated and shipped to our local cleaning facility. The components are electro-polished and chemically cleaned for vacuum service, and then returned to the customer's site for re-installation and alignment in the vacuum chamber.

We can provide the shipping crate for the cathode housing and frame. Typical turnaround time for shipping and cleaning is six business days. Should you require this service, BroadBeam® Equipment will verify the turnaround time with our local cleaning facility prior to shutdown of your machine. This eliminates "surprises" in the length of the production outage required. The overall downtime of the machine is estimated at two to four business days in addition to the cleaning turnaround time.

During the time the cathode and cathode housing are removed from the machine, the vacuum chamber should be wiped clean using lint free cloths and a chemical solution. In rare instances, the inside of the chamber may be so dirty or flawed that it is necessary to abrasively clean the chamber walls. We offer this service as well, and can perform this work at your facility without disturbance to other process lines in your plant

This Cathode Housing and Gun Cleaning option is offered as a cleaning service only option for customers with extensive experience in working on our machines. For others customers, the option is offered as a full service product, using our tools, fixtures and personnel. In the full service format, the only item the customer is responsible for is a forklift or overhead crane operator to assist in removal of the window.

The cleaning service only option includes the following:

- Shipping crate for the cathode housing, end cover and window frame (Optional)
- Cleaning service
- New copper window O-Rings
- Lint free gloves and wipes
- New foil and foil clamp O-Ring (Optional)
- Shipping costs (Optional)

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