ACCELERATOR DIVISION DEPARTMENT PROCEDURE

IOTA/FAST DEPARTMENT

ADDP-FF-3006

IOTA PROTON INJECTOR SOURCE CLEANING

RESPONSIBLE DEPARTMENT: IOTA/FAST Department

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1.0 PURPOSE AND SCOPE

The purpose of this procedure is to outline and detail the conduct of personnel qualified to perform activities related to cleaning of the IOTA Proton Injector duoplasmatron ion source. It serves as the basis for Hazard Analysis (HA) Form 1924.

2.0 PREPARATION ACTIVITIES

This procedure should be reviewed by all employees involved before this procedure is performed and referred to throughout performing any part of the cathode preparation process.

3.0 AUTHORIZED PERSONNEL

Accelerator Division personnel are authorized to perform this procedure if he/she has the necessary knowledge and all current training relevant to the hazards represented.

4.0 NECESSITY OF A WRITTEN PROCEEDURE

Cleaning the IOTA Proton Injector duoplasmatron ion source is a multi-day process, involving removal of limited quantities of potentially toxic components that require special consideration in their use, handling, and transportation. These components are included in a pre-mixed compound referred to as Radio Mixture No 3, produced by J.T Baker Chemical Co (currently Avantor Inc) used to activate source filaments, and a set of resultant oxides following an activation process (ADDP-FF-3004).

A complete list of these components is in 4.1 and the specific hazards are codified in 4.2.

The duoplasmatron is a complex and delicate assembly, and requires attention to safely prepare, transport, clean, and return to service. Primary components are shown and described in 5.2.

4.1 TABLE OF COMPONENTS

Component	Hazard	MSDS CAS Number
Radio Mixture No. 3		
Barium Carbonate	Toxic	513-77-9
Calcium Carbonate	None	471-34-1
Strontium Carbonate	None	1633-05-2
Acetone	Irritant/Flammable	67-64-1
Activated Filament		
Barium Oxide	Toxic/Irritant	1304-28-5
Strontium Oxide	Irritant	1314-11-0

4.2 LIST OF SPECIFIC HAZARDS

Component	Hazard
Radio Mixture No. 3	H302 – Harmful if swallowed.
Acetone	H225 – Highly flammable liquid and vapor. H319 – Causes serious eye irritation. H336 – May cause drowsiness or dizziness.
Activated Filament	H302 - Harmful if swallowed. H331 - Toxic if inhaled H315 – Causes skin irritation. H319 – Causes serious eye irritation. H335 – May cause respiratory irritation.

5.0 PREPARATION FOR SOURCE CLEANING

Before initiating the cleaning procedure outlined in section 6.0, personnel involved in the cleaning shall perform the following steps unless otherwise stated:

- A hardcopy of this procedure and associated HA shall be made available for review and reference throughout.
- Chemical Hygiene Safety training shall be given by a responsible ESH&Q representative to all new personnel performing this procedure. Contact the current Division Safety Officer (DSO) for delegation.
- The hazard and associated precautions of handling Barium Carbonate (in the Radio Mixture No 3 compound), and the associated Oxides (from the activated filament) shall be reviewed.
- Proton Source personnel shall be contacted to verify availability of the source cleaning station & personnel.

5.1 MATERIAL LIST

Prior to initializing the cleaning procedure, availability of cleaning materials shall be verified. These should include two (2) **cleanroom bags** large enough for the plasma cup assembly, a **padded container** suitable for transportation of the plasma cup assembly and accelerating column, a small (< 12 oz) squirt-bottle of **acetone**, a package of **kimwipes** or similar, and PPE: 3M M95 dust **mask**, purple **nitrile gloves**, and **chemical splash goggles**.

5.2 PICTURES OF THE DUOPLASMATRON SOURCE COMPONENTS

Presented here are images of the various components of the source along with an engineering schematic of the source and LEBT for reference.

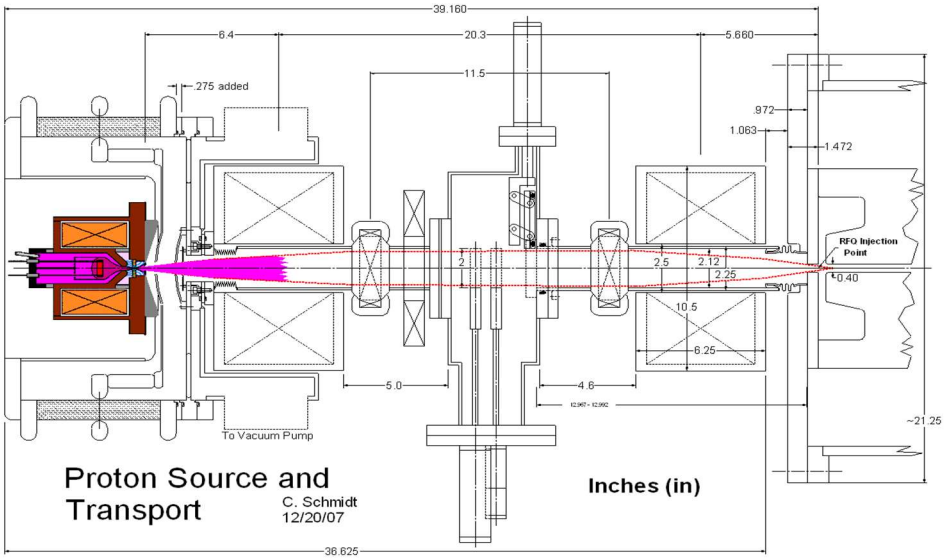

Fig 1 - Source & LEBT Schematic. The source itself is to the far left.

Fig 2 – Plasma Cup Assembly (6.0.2.a)

Fig 3 – First Electrode(6.0.2.b)

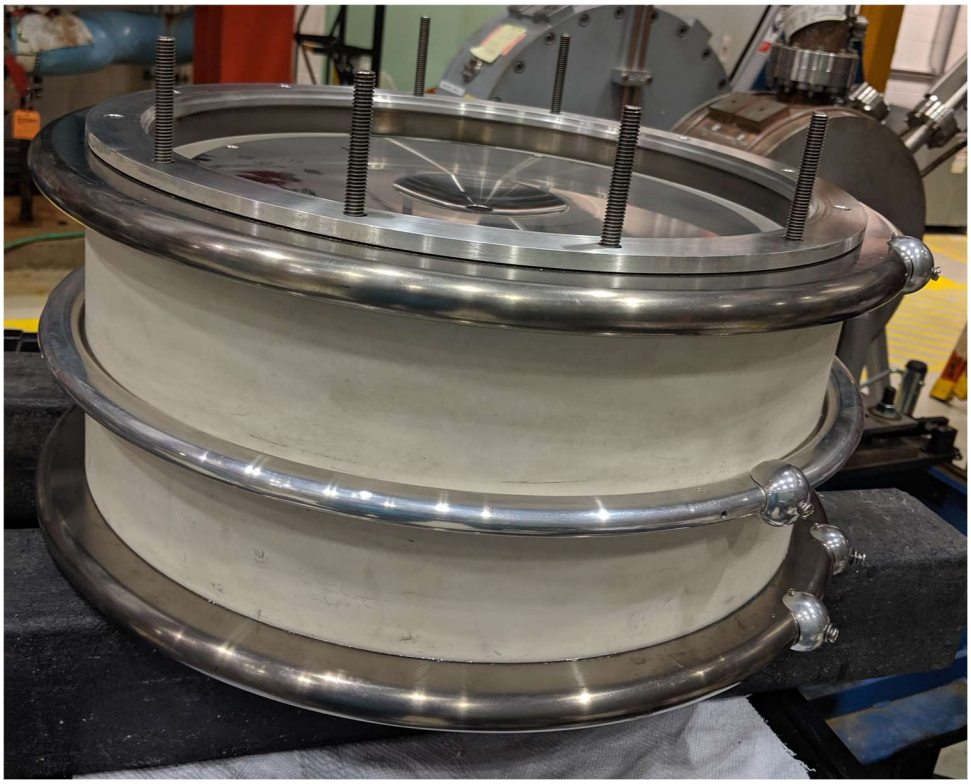

Fig 4 – Accelerating Column (6.0.2.c)

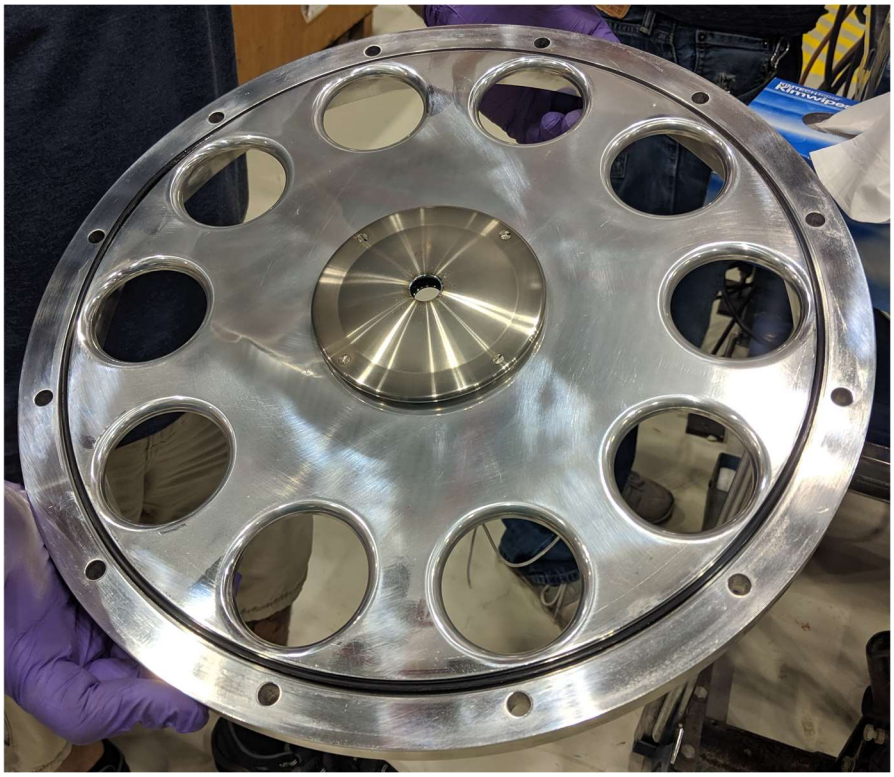

Fig 5 – Intermediate (Electron Suppression) Electrode (6.0.2.d)

6.0 DUOPLASMATRON CLEANING PROCEDURE

The cleaning procedure is a multi-day process and shall be executed as follows:

1. The filament shall be removed and stored in an N_2 gas-purged transport cylinder unless otherwise prescribed and documented, all notes throughout this procedure understood to be made in the FAST electronic logbook under the IOTA Proton Injector category for future reference. The rear port of the plasma cup assembly should be capped with a blank. The state of the removed filament shall be documented.

2. Personnel shall don PPE specified in 5.0 and the source shall be detached from the FAST Proton Injector LEBT upstream flange into a set of four easily transported components as shown in 5.2:
    a. Plasma cup assembly
    b. First electrode
    c. Accelerating column
    d. Intermediate electrode

3. The plasma cup assembly shall be bagged. At least the plasma cup assembly and accelerating column shall be packed in a designated protective container for transportation. All components shall be transported in a laboratory vehicle to the source cleaning station in the Linac Annex.

4. Personal shall don PPE specified in 5.0, and begin with disassembly of the plasma cup assembly, noting the deposition of carbonite build-up at all stages along with signs of arcing, and other wear throughout this process. Components shall be cleaned thoroughly with small amounts (~100 ml) of acetone and wiped clean with a kimwipe.

5. The cone aperture at the downstream end of the filament cup shall be replaced with a fresh cone, with pinhole aperture of 500 µm, unless prescribed and documented otherwise.

6. Once clean and wiped dry, the plasma cup assembly shall be reassembled, capped with the blank, and bagged before proceeding with cleaning of the other components.

7. All other components from the list in 6.0.2 shall be cleaned thoroughly with small amounts (~100 ml anticipated) acetone and wiped dry with (~10 anticipated) kimwipes, personnel performing this step careful to document any signs of carbonite deposition, arcing, or other wear. Upon completion, these components shall be bagged.

8. Used wipes of evaporated solvent and the residual carbonate and dust deposition shall be collected and disposed of appropriately as prescribed by the proton source group waste generator.

9. At least the plasma cup assembly and accelerating column shall be re-packed in the designated protective container for transportation, and all components returned to NML in a laboratory vehicle for reassembly such that the source be returned to the same state as found in 6.0.1. This may include a freshly coated/activated cathode. The final state of the source including the state of the installed filament shall be documented.

7.0 PROCEDURE TRAINING REQUIREMENTS

The procedure shall be reviewed and understood in its entirety prior to each execution. It shall be followed explicitly throughout.

8.0 PROCEDURE DISTRIBUTION

An electronic copy of this procedure shall be made available through the FAST Web Page (http://fast.fnal.gov/). A signed hard copy of the latest revision shall be maintained in the NML control room.