

Brookhaven National Laboratory National Synchrotron Light Source		Number: LS-ATF-0017	Revision: 1
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Subject: ATF CO ₂ LASER SYSTEM PITER I MAINTENANCE PROCEDURES			
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ATF CO₂ LASER SYSTEM PITER I MAINTENANCE PROCEDURES

Perform these procedures at the following intervals:

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| 1. Deionized water in the sharpening capacitor tank cleaning or refill | 1 thousand shots |
| 2. Spark gaps cleaning or replacement | 1 million shots |
| 3. Cleaning or refill of transformer oil in transmission line | 10 thousand shots |
| 4. Vacuum pump servicing | every 2 years |
| 5. Amplifier vessel inspection | every 1/2 years |
| 6. SF6 gas cleaning | 1 thousand shots |
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1. Deionized water in the sharpening capacitor tank cleaning or refill procedures
 - 1a. Deionized water cleaning can be performed on line while the CO₂ amplifier is in operation by turning on a pump that circulates water through the built-in deionizer.
 - 1b. Deionized water refill

Attention: This procedure requires initial red-tagging of the amplifier AC power supply panel

 - 1b.1 after every 1000 shots of the amplifier take sample of the water from the PFN tank
 - 1b.2 measure resistivity of the sample water – normally shall be above 50 Mohm mm²/cm
 - 1b.3 at a low resistivity, circulate the PFN water through the built-in deionizer
 - 1b.4 if circulation through the deonizer does not restore the resistivity, proceed to refilling
 - 1b.5 attach water pump and exhaust tubing to the valve at the bottom of the PFN water tank
 - 1b.6 open the valve, turn the pump on and empty the tank outside the building, close the valve when done
 - 1b.7 fill the tank with fresh water from drums (the same water pump can be used after cleaning)
 2. Spark gaps cleaning or replacement
 - 2a. Preamplifier spark gaps cleaning or replacement

Attention: This procedure requires initial red-tagging of the preamplifier AC power supply panel located in room C2

 - 2a.1 stop air circulation, close air cylinder and regulator, relieve air pressure in the line down to 1 atm

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- 2a.2 open the preamplifier PFN enclosure top lead, use grounding pole to make sure that no residual electrical potential exists on the exposed high voltage contacts
- 2a.3 using an oil pump and empty transformer oil from the PFN into clean plastic canisters below the spark gap level
- 2a.4 use grounding pole to make sure that no residual electrical potential exists on the exposed high voltage contacts, disconnect spark gaps from electrical leads and air lines, mark all disconnected wires and terminals to restore the connections upon assembly, ground high voltage terminals
- 2a.5 remove spark gaps from the PFN and entirely clean the oil from the surface
- 2a.6 disassemble and open each spark gap and examine for a possible damage by discharge or pressure and contamination by oil, discharge products, or other debris
- 2a.7 clean internal surfaces of spark gaps using conventional cleaning solvents (alcohol, acetone, etc.) and by sending the metal surfaces if necessary
- 2a.8 assemble spark gaps (or use new), restore connections, fill PFN with oil
- 2a.9 open air cylinder and regulators, bring the air pressure in spark gaps to the required level, visually inspect for bubbles
- 2a.10 restore electrical connections, restore PFN enclosure
- 2a.11 remove red tag from the preamplifier AC power supply panel
- 2a.12 before turning on high voltage, check that the PFN enclosure interlocks work properly
- 2a.13 test PFN functioning at the nominal voltages

2b Amplifier spark gaps cleaning or replacement (10 spark gaps inside the Marx generator, 1 spark gap inside the preionizer PFN)

Attention: This procedure requires initial red-tagging of the amplifier AC power supply panel located in room C1

- 2b.1 vent SF6 outside through a scrubber, purge system with compressed nitrogen or air
- 2b.2 similar to 2a.2
- 2b.3 similar to 2a.3
- 2b.4 similar to 2a.4
- 2b.5 similar to 2a.5
- 2b.6 put on gaggles and face mask, disassemble and open each spark gap, blow out residual sulfur powder using a compressed air gun, examine for a possible damage by discharge or pressure and contamination by oil, discharge products, or other debris
- 2b.7 similar to 2a.7
- 2b.8 similar to 2a.8
- 2b.9 pressurize the entire SF6 circulation circuit (including spark gaps) to 2-3 atm absolute with compressed nitrogen or air, visually inspect for bubbles
- 2b.10 using vacuum pump, pump out air from the entire SF6 circulation circuit
- 2b.11 fill system with SF6 gas at the required pressure
- 2b.12 similar to 2a.10
- 2b.13 similar to 2a.11
- 2b.14 similar to 2a.12
- 2b.15 similar to 2a.13

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3. Cleaning or refill of transformer oil in transmission line between Marx generator and water capacitor
 - 3a. When the amplifier is in operation, use a pump to circulate the oil in the transmission line after every 100 shots or once a day (whatever comes first).
 - 3b. Change the oil in the transmission line when the oil changes color or after 10 thousand shots (whatever comes first). Procedure for oil change is as follows:
 - 3b.1 connect container with fresh oil (5 liters or more) to expansion cylinder; make sure that there are no trapped air bubbles in the expansion cylinder and connecting tube left.
 - 3b.2 disconnect the oil pump return line from the expansion cylinder before the valve; put the end of the return line into the container for spent oil
 - 3b.3 start oil pump; continue pumping oil from the fresh oil container through the transmission line watching that no air bubbles are introduced
 - 3b.4 stop pumping the oil when the required amount is flashed and the oil running from the return pipe is transparent
 - 3b.5 disconnect the fresh oil container from the expansion cylinder
 - 3b.6 connect the return line to the expansion cylinder; turn oil pump intermittently several times until air bubbles stop to appear

4. Vacuum pumps servicing
 - 4a. Periodically check the oil level and color in vacuum pumps
 - 4b. When necessary, or once in two years send pumps for servicing to NSLS vacuum group

5. Amplifier vessel inspection
 - 5a. Inspect the internal welds in the amplifier vessel every time when the vessel is open or at least semiannually.
 - 5b. Arrange for liquid dye penetration test if the visual inspection or change in the vacuum condition indicate a possibility of a crack or other defect developed.

6. SF6 gas cleaning
 - 6a. When the amplifier is in operation, use a pump to circulate SF6 through the spark gaps of the amplifier Marx generator and x-ray tube PFN after every 1000 shots or once a week (whatever comes first).
 - 6b. Vent the SF6 through the scrubber and replace with a fresh gas once a year.

7. Check laser protective eyewear for cleanliness and surface damage (once a month)