



**NPL Polarized Source Group  
Technical Note # 90-2A**

**How to Charge the  $\text{NF}_3$  Leak Valve on the  
Illinois/CEBAF Polarized Electron Source**

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# How to Charge the $\text{NF}_3$ Leak Valve on the Illinois/CEBAF Polarized Electron Source

This note details the procedure followed to charge the  $\text{NF}_3$  leak valve in the revised version of the Illinois/CEBAF polarized electron source in which the  $\text{NF}_3$  is loaded into a "reusable" storage system consisting of a short length of tubing followed by a Nupro valve (see drawing # 2709-126). It is based on the original procedure, documented in Technical Note #90-2, in which the  $\text{NF}_3$  was "stored" in a short length of "pinched-off" copper tube. In addition, this note documents separately the procedures used for both single and dual-port leak valves.

## Charging a Dual-port $\text{NF}_3$ Leak Valve

### Materials

1. Copper gaskets for 1/4" VCR fittings.
2. The "plumbing" shown in drawing 2772-3A, attached.

### Procedure

1. Take an RGA spectrum to document the quality of the vacuum if one is not already available from earlier work on the source.
2. Connect (see note 4) a clean, flexible hose (Cajon part # 321-4-X- 6FMR) between the VCR fitting on the Nupro valve coming from one side of the Balzers leak valve (3) and the 4-way cross attached to the sorption pump valve (1) using 1/4" VCR gaskets. [Numbers here and in the following steps refer to points identified in the figure attached.]
3. Connect (see note 4) a second clean, flexible hose (Cajon part # 321-4-X-6FMR) between the VCR fitting on the Nupro valve on the other side of the Balzers leak valve (3) and the tee (4) which connects to the  $\text{NF}_3$  tank (5) and its regulator to the nitrogen heater and its valve (6).
4. Close the valve (9) isolating the  $\text{NF}_3$  tank and open the nitrogen input valve (6), the up-to-air valve (7) on the 4-way cross by the sorption pump, and the two Nupro valves (10 and 11) on either side of the leak valve. Flow nitrogen through the system

and turn on the nitrogen heater. Place a thermocouple at the location shown (8) on the SS tube between the sorption pump the Nupro valve, and heat to 140 C; you will have to wrap the tubing with fiberfrax.

5. Bake out the tubing for 2-3 hours using the flowing hot nitrogen as the heat source.
6. Turn off the nitrogen heater, and continue to flow nitrogen through the system until it cools to room temperature.
7. While the system is cooling, check that the right angle valve (see point 1 in the attached figure) above the  $\text{NF}_3$  sorption pump (2) is closed and cool the sorption pump down for about one hour.
8. Close the Nupro valves on the nitrogen heater and the up-to-air valve, and begin to evacuate the system by opening the valve (1) to the sorption pump. Monitor the pressure with the convectron gauge. If the pressure does not fall to a few millitorr quickly, one of the VCR fittings is probably leaking. If a leak is observed, tighten each fitting gently until the pressure falls to a few millitorr. Then, as a check, close the valve to the sorption pump and verify that the pressure does not rise quickly. If it does, you still have a leak; try tightening the fittings a bit more and repeating this step. If not, you are ok and can move on to the next step.
9. Close the valve on the pump (1) and open the Nupro valve (9) on the  $\text{NF}_3$  bottle and backfill the system with 2-3 psi of  $\text{NF}_3$ .
10. Repeat evacuation and backfill (steps 8 and 9) two or three times.
11. Charge system to 2-3 psi of  $\text{NF}_3$ .
12. Close the Nupro valve on each side of the leak valve, and then detach the VCR fittings and remove the pump and  $\text{NF}_3$  bottle.
13. Insert a VCR "blank" plug in each of the fittings on the air side of the Nupro valves that are attached to the leak valve. Carefully blow out the fittings with dry nitrogen prior to blanking them off.
14. After sorption pump has reached room temperature, purge it by running nitrogen through the up-to-air valve at a pressure of 7 to 8 psi. After the pressure relief valve pops, let the nitrogen run for an hour to flush out the  $\text{NF}_3$  prior to baking the pump for future use.
15. Prepare the "plumbing" for the charging system for storage by blanking off the VCR fittings and covering other open fittings with lint-free paper followed by clean Aluminum foil. Then store the system out of harm's way for future use.
16. Check that the  $\text{NF}_3$  leak valve tubes have been properly charged and sealed by taking an RGA spectrum in the gun with the leak valve opened to the position for normal operation during cathode fabrication. Open the leak valve until the pressure in the gun rises to the point where the main ion pump current has stabilized at about 1.0  $\mu\text{A}$ .

Then take a second RGA spectrum. Typical spectra showing what you should expect to see before and after the leak valve is opened are attached.

# Charging a Single-port $\text{NF}_3$ Leak Valve

## Materials

1. Copper gaskets for 1/4" VCR fittings.
2. The "plumbing" shown in drawing 2772-3B, attached.

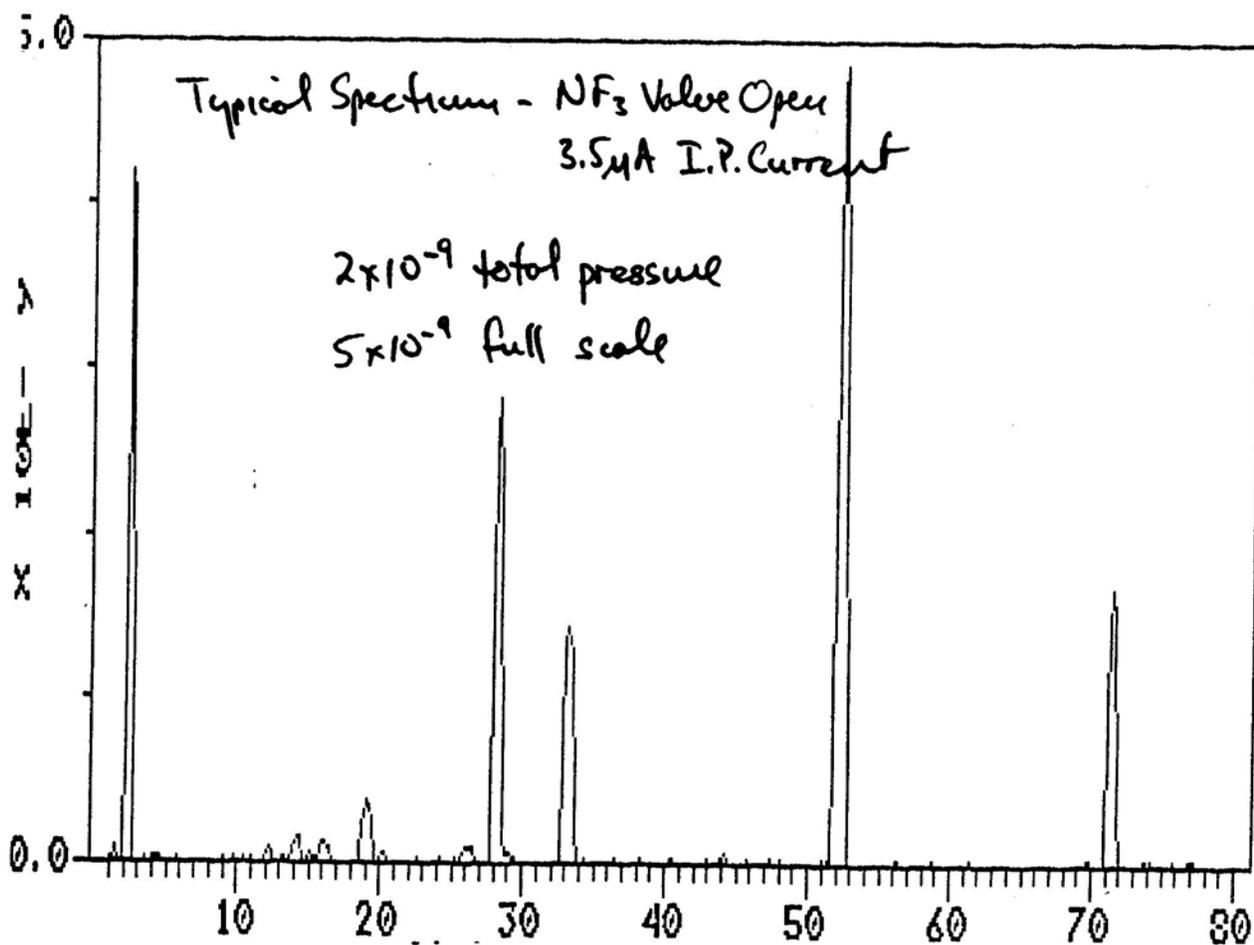
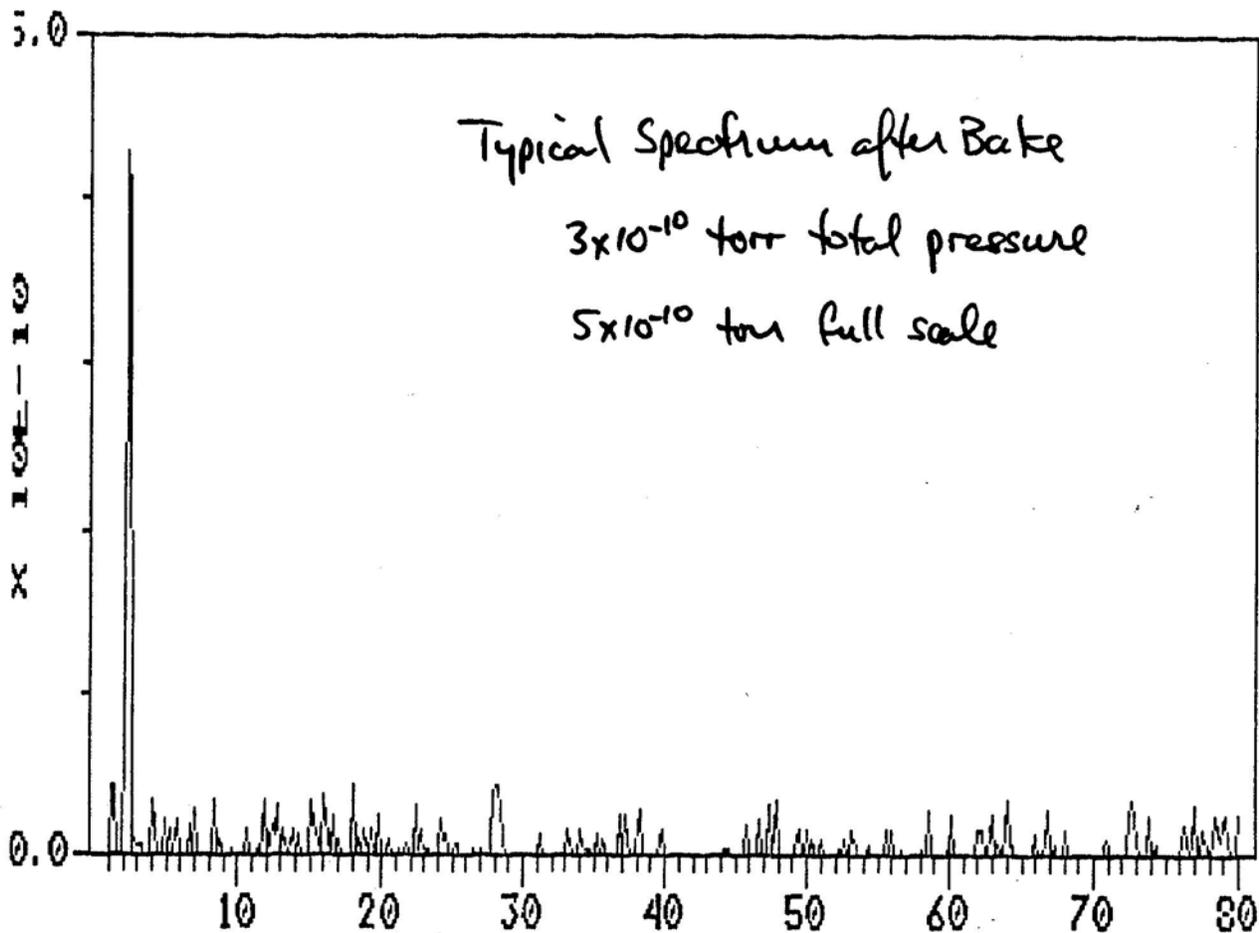
## Procedure

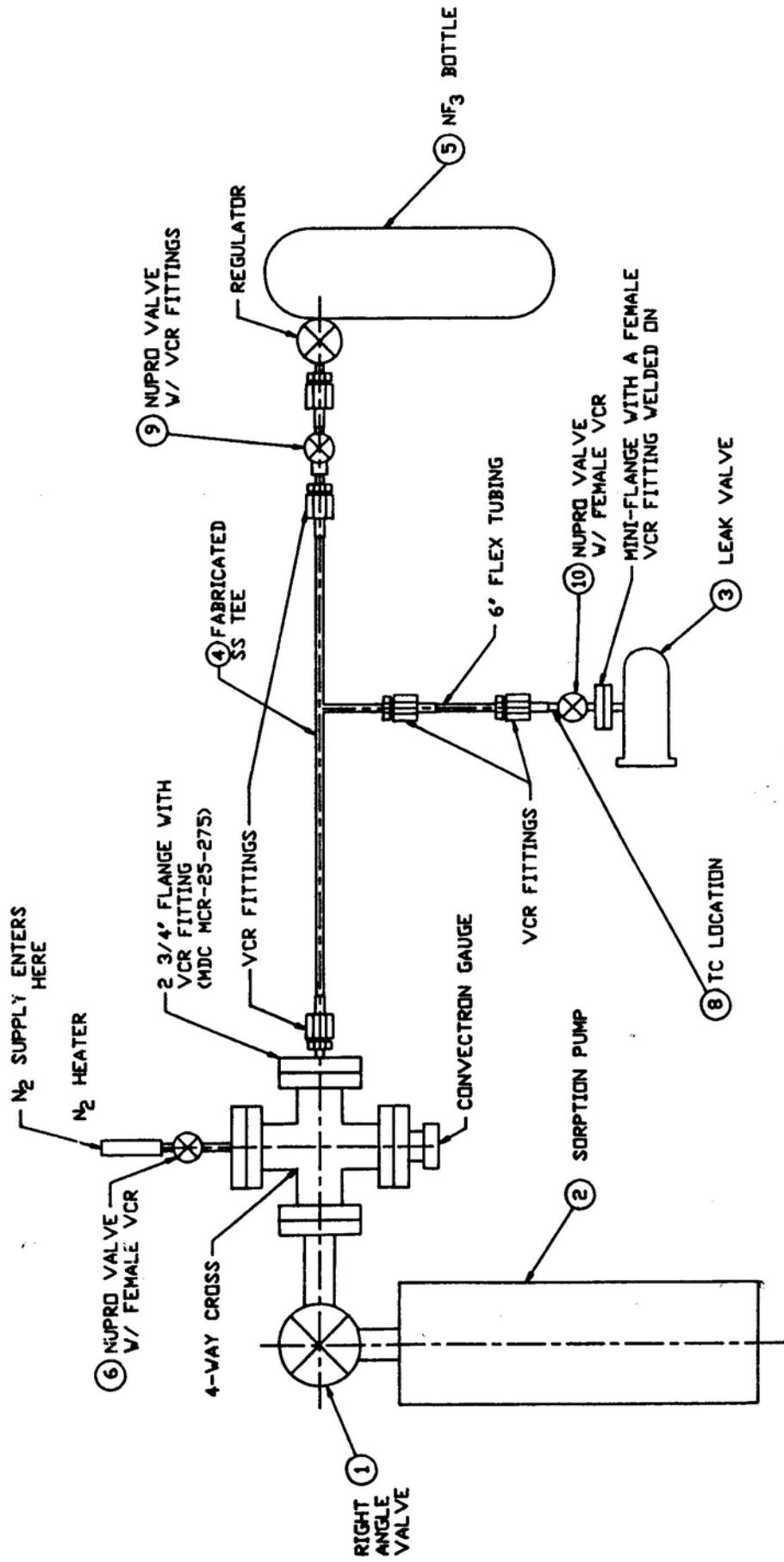
1. Take an RGA spectrum to document the quality of the vacuum if one is not already available from earlier work on the source.
2. Attach the  $\text{NF}_3$  storage system (a Nupro valve (10) between a VCR fitting and a mini-conflat, as shown in drawing 2709-126) to the port on the leak valve (3), but do not tighten the screws - leave them finger-tight. If the storage system is already in place from a previous use of the gun, remove it, replace the conflat gasket, and re-install it, leaving the screws on the mini-conflat only finger-tight. [Numbers here and in the following steps refer to points identified in the figure attached.]
3. Connect (see note 4) a clean, flexible hose (Cajon part # 321-4-X- 6FMR) between the VCR fitting on the Nupro valve attached to the Balzers leak valve (3) and the VCR fitting on the "tee" (4) made from SS tubing that connects the 4-way cross attached to the sorption pump valve (1) and the Nupro valve (9) attached to the regulator on the  $\text{NF}_3$  bottle (5); use 1/4" VCR gaskets.
4. Close the valve (9) isolating the  $\text{NF}_3$  tank and open the nitrogen input valve (6) and the Nupro valve (10) on the leak valve. Flow nitrogen through the system and turn on the nitrogen heater. Place a thermocouple at the location shown (8) on the valve stem of the Nupro valve (10), and heat to 140 C; you will have to wrap the valve, the large "tee," and the flex hose with fiberfrax.
5. Bake out the system for 2-3 hours using the flowing hot nitrogen as the heat source.
6. Turn off the nitrogen heater, and continue to flow nitrogen through the system until it cools to room temperature.
7. While the system is cooling, check that the right angle valve (see point 1 in the attached figure) above the  $\text{NF}_3$  sorption pump (2) is closed and cool the sorption pump down for about one hour.

8. Tighten the mini-conflat attaching the Nupro valve (10) to the leak valve while the hot gas is still running. Then close the Nupro valve on the nitrogen heater and begin to evacuate the system by opening the valve (1) to the sorption pump. Monitor the pressure with the convectron gauge. If the pressure does not fall to a few millitorr quickly, one of the VCR fittings is probably leaking. If a leak is observed, tighten each fitting gently until the pressure falls to a few millitorr. Then, as a check, close the valve to the sorption pump and verify that the pressure does not rise quickly. If it does, you still have a leak; try tightening the fittings a bit more and repeating this step. If not, you are ok and can move on to the next step.
9. Close the valve on the pump (1) and open the Nupro valve (9) on the  $\text{NF}_3$  bottle and backfill the system with 2-3 psi of  $\text{NF}_3$ .
10. Repeat evacuation and backfill (steps 8 and 9) two or three times.
11. Charge system to 2-3 psi of  $\text{NF}_3$ .
12. Close the Nupro valve on the leak valve, and then detach the VCR fittings and remove the pump and  $\text{NF}_3$  bottle.
13. Insert a VCR "blank" plug in the fitting on the air side of the Nupro valve attached to the leak valve. Carefully blow out the fitting with dry nitrogen prior to blanking it off.
14. After sorption pump has reached room temperature, purge it by running nitrogen through the up-to-air valve at a pressure of 7 to 8 psi. After the pressure relief valve pops, let the nitrogen run for an hour to flush out the  $\text{NF}_3$  prior to baking the pump for future use.
15. Prepare the "plumbing" for the charging system for storage by blanking off the VCR fittings and covering other open fittings with lint-free paper followed by clean Aluminum foil. Then store the system out of harm's way for future use.
16. Check that the  $\text{NF}_3$  leak valve tubes have been properly charged and sealed by taking an RGA spectrum in the gun with the leak valve opened to the position for normal operation during cathode fabrication. Open the leak valve until the pressure in the gun rises to the point where the main ion pump current has stabilized at about  $1.0 \mu\text{A}$ . Then take a second RGA spectrum. Typical spectra showing what you should expect to see before and after the leak valve is opened are attached.

## Notes

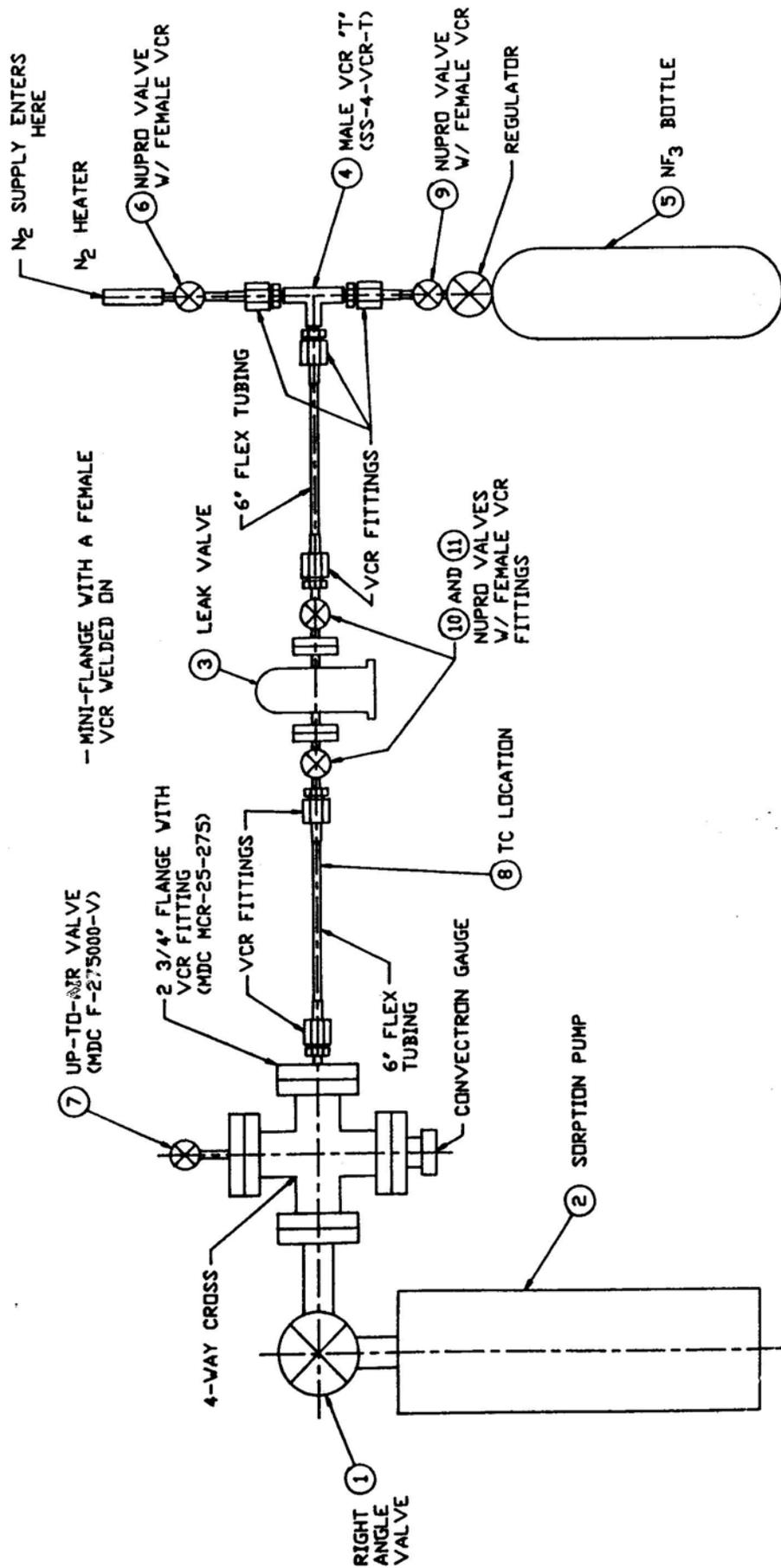
1.  $\text{NF}_3$  is noncorrosive to common metals below 70 C. Provide adequate ventilation when handling - inhalation of large quantities of gas can cause suffocation.
2. Always be sure to purge the  $\text{NF}_3$  from the leak valve prior to a system bakeout.
3. The small sorption pump used for charging the  $\text{NF}_3$  system must be reserved for this purpose only.
4. To tighten the VCR fittings, first tighten them by hand (ie, "finger-tight"). Then turn them 1/4 turn past this point. Do NOT overtighten these fittings as you may damage them.
5.  $\text{NF}_3$  is purchased from Air Products - Specialty Gas, their item # J05-Y-40032. The regulator is their part # E11-TC334A.





NF<sub>3</sub> LOADING PROCEDURE - SINGLE PORT LEAK VALVE

NPL 2772-3B



NF<sub>3</sub> LOADING PROCEDURE - DUAL-PORT LEAK VALVE

NPL 2772-3A