Pipe Cleaning Operating Procedures

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January 24, 1991

D0 Engineering Note 3740.000-EN-277

Approved: _____

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Overview:

This cleaning procedure outlines the steps involved in cleaning the high purity argon lines associated with the D0 calorimeters. The procedure is broken down into 7 cycles: system setup, initial flush, wash, first rinse, second rinse, final rinse and drying. The system setup involves preparing the pump cart, line to be cleaned, distilled water, and interconnecting hoses and fittings. The initial flush is an off-line flush of the pump cart and its plumbing in order to preclude contaminating the line. The wash cycle circulates the detergent solution (Micro) at 180 degrees Fahrenheit through the line to be cleaned. The first rinse is then intended to rid the line of the majority of detergent and only needs to run for 30 minutes and at ambient temperature. The second rinse (if necessary) should eliminate the remaining soap residue. The final rinse is then intended to be a check that there is no remaining soap or other foreign particles in the line, particularly metal "chips." The final rinse should be run at 180 degrees Fahrenheit for at least 90 minutes. The filters should be changed after each cycle, paying particular attention to the wash cycle and the final rinse cycle return filters. These filters, which should be bagged and labeled, prove that the pipeline is clean. Only distilled water should be used for all cycles, especially rinsing. The level in the tank need not be excessive, merely enough to cover the heater float switch. The final rinse, however, may require a full 50 gallons. Note that most of the details of the procedure are included in the initial flush description. This section should be referred to if problems arise in the wash or rinse cycles.

Materials Needed:

- cleaning cart
- 480 volt extension cord
- 3/4" id hose
- spare filter cartridges
- wet/dry vac
- quick ties
- plastic zip-lock bags
- gas heater
- pipe and hose fittings (corks, hose clamps, hose barbs, etc.)
- tools (nut driver, wrenches, pliers, wire cutter, utility knife, etc.)
- barrels of distilled water
- quarts of Micro detergent
- teflon tape
- gloves
- 5 gallon bucket
- broom handle or suitable stick
- copper tubing
- Kimwipes

System Setup:

1. Check to see if the power cord will reach the nearest 480 volt outlet. If not, use a 480 volt extension cord.
2. If necessary, cut a length of 3/4" id hose such that it will reach from the fill/drain connection on the cart to the bottom of a barrel of distilled water. This will be referred to as the fill/drain hose. Use the quick ties to attach the hose to the broom handle such that one end of the hose is 1/2" from the end of the broom handle. This will keep the hose slightly above the bottom of the barrel, while preventing the hose from curling above the water level in the barrel. Connect the other end of the hose to the fill/drain barb on the cart.
3. Check if the fill/drain hose will reach the nearest drain. If not, run a length of hose with a shutoff valve such that the fill/drain hose can be extended to the drain (see schematic - drain hose). This hose does not need to be cleaned, since it will only be used for draining the tank.
4. If necessary, cut two lengths of 3/4" id hose such that they will reach from the supply and return connections to the pipe line. Hose lengths will depend on the position of the pipe line(s) to be cleaned

relative to the cleaning cart. Connect one length of hose to the supply connection. Connect the other length of hose to the return connection. Use the hose clamps to secure the hoses. Connect the two hoses together so that they form a closed circuit not in series with the pipe to be cleaned. This setup will be used to first flush the system to ensure that it is not a source of contamination. Be sure to use teflon tape around pipe threads to prevent leaks.

5. Open a barrel of distilled water by using a wrench or a pair of pliers to twist open one of the caps. Use Kimwipes to clean the outside of the fill/drain hose and broom handle and insert them into the barrel.

Initial Flush:

1. Prime the pump by pouring 2-3 gallons of water (tap water, if necessary) into the tank with the tank drain valve, the fill/drain valve and the pump shutoff valve all open. In general, the pump shutoff valve should always remain open. In some cases, the pump can be primed with distilled water by inserting the fill/drain hose into a full barrel of distilled water. Since the water level in the barrel is higher than that in the tank, gravity will fill the tank with water until the two levels are equal. This process is much slower than using the pump, so turn on the pump as soon as the water in the tank has reached a suitable level. This method of priming the pump is especially useful for the final rinse, when the use of distilled water is most important.

2. Close the tank drain valve, supply valve, and return filter isolation valves. Then check open the pump shutoff valve, the fill/drain valve, the bypass valve, and the supply filter isolation valves. The supply filter housing should be in place without a filter cartridge. This setup will allow water to flow from the barrel, through the bypass valve, and into the tank.

3. Turn on the main power switch. Fill the tank to 1/4 full by turning the pump on. The bypass switch should also be turned on. This switch allows the pump to operate even if the water level is below the pump float switch. The pump float switch is a safety device which shuts off the pump if the water level drops too low. This is necessary in case there is a problem with the piping and the tank does not refill during cleaning (e.g., if a hose slips off). In this case, the float switch will drop and the pump will shut off, preventing it from burning out. However, when filling the tank, the bypass switch should be turned on until the water level rises above the pump float switch. After this point, the bypass switch should be turned off. The other float switch is the heater float switch, which shuts off the heater if the water level drops below the switch. This is necessary because the heater must be completely immersed in water to operate safely.

4. If the tank does not begin to fill immediately, the pump may be cavitating. Do not let the pump continue, or it may overheat. Turn the pump off and open the tank drain valve to allow air bubbles to surface. Then close the tank drain valve and turn the pump back on. Repeat this procedure until the pump draws water. If problems continue, check to see if the barrel of distilled water is almost empty. Note that the pump cannot completely empty a barrel of water because it begins to draw air when the water level is low. If this is the case, remove the fill/drain line, empty the remaining distilled water into the tank, and insert the fill/drain line into another barrel. Be sure to clean the fill/drain line before inserting it.

5. Once the tank is 1/4 full, turn the pump off, close the fill/drain valve, and open the tank drain valve.

6. Replace the return filter housing WITH a filter cartridge. The supply filter housing does not need a filter cartridge, because the return filter will suffice for the initial flush. Close the bypass valve. Open the return filter isolation valves and the supply valve, and check open the supply filter isolation valves.

7. Flush out the isolated system by turning the pump on and circulating through the interconnected hoses for 10 to 15 minutes. The pressure indicator should read below 20 psi (about 11 psi). If it does not, there is either a problem with the valve setup, or there is an obstruction in the line and the pump is "dead heading". If this is the case, turn the pump off and correct the problem as necessary.

8. After about 15 minutes, turn the pump off. Gravity drain the tank by first extending the fill/drain hose to the drain and then opening the fill/drain valve and any other valves along the drain line. Drain the tank completely.

9. While the tank is draining, close the return filter isolation valves, and remove and discard the return filter cartridge. Use the bucket underneath when removing the filter housing, and be careful not to lose the O-ring when emptying the filter housing into the bucket. Also empty the supply filter housing. Open the bypass valve and drain the cleaning cart pipes by opening the isolation valves with the bucket underneath the supply and return filter housings.

10. Disconnect the supply and return hoses and drain them into the bucket. Walk the fill/drain line from the cart to the drain to completely drain it.

Wash:

1. Wipe the outer surface of the fill/drain hose and insert it into a barrel of distilled water.

2. Connect the supply hose and the return hose to the pipe line to be cleaned using the appropriate pipe fittings. Use the teflon tape to seal pipe threads. In some cases, there will be several openings to the pipe line, or several pipe lines to be cleaned. In this case, connect some of the openings together with lengths of hose so that there is only one inlet and one outlet. If there is an odd number of openings, use a T-section to connect two openings to a third, or use

the auxiliary supply valve connection. With this setup, water can flow through all of the openings.

3. Place new filter cartridges in each of the filter housings and tighten.

4. Prime the pump by pouring 2-3 gallons of water into the tank with the tank drain valve, the fill/drain valve, and the pump shutoff valve all open.

5. Check open the bypass valve, supply filter isolation valves, fill/drain valve, and pump shutoff valve. Close the return filter isolation valves, the supply valve, and the tank drain valve.

6. Turn on the pump (bypass switch on) and fill the tank 3/5 full, or just above the heater float switch. As in the initial flush, check for cavitation and repair as required.

7. When the tank is 3/5 full, turn the pump off and close the fill/drain valve. Open the tank drain valve.

8. Add one quart of detergent solution (Micro) to the tank. Use care when handling the detergent solution.

9. Check that the bypass switch is off. Turn on the heater switch and set the thermostat to 180 degrees Fahrenheit.

10. Close the bypass valve. Check closed the auxiliary supply valve, and the fill/drain valve. Open all other valves.

11. Begin circulating through the pipe line by turning on the pump. Again, the pressure indicator should read below 20 psi. If not, turn the pump off and repair as required.

12. Check for leaks and repair by tightening pipe fittings or adding teflon tape. If a small leak exists that cannot be repaired, wrap the leaking area with Kimwipes and quick ties to absorb the leak.

13. Circulate the detergent solution for at least 1-1/2 hours at 180 degrees Fahrenheit.

14. After 1-1/2 hours, turn the pump and heater off. Extend the fill/drain hose to the drain and open the fill/drain valve to drain the tank. Drain the tank completely.

15. While the tank is draining, disconnect the supply and return hoses if possible in order to drain the water remaining in the pipe line. There may be pressure from the water in the pipe line, so use the bucket to drain the hoses and the pipe line. Remember to wear protective gloves when draining the hoses or the filter housings. Reconnect the hoses.

16. Place the bucket beneath the filter housings and remove the filter housings and filter cartridges. Wear the gloves for protection. Be careful not to lose the O-ring when emptying the filter housings. Also drain the cleaning cart pipes the same way as in the initial flush. Discard the supply filter. Bag and label the return filter "[pipe line] [date] wash cycle return filter xx minutes @ yyy degrees." Wipe the filter housings with Kimwipes, replace the filter cartridges with new ones and tighten. Remember that new filter cartridges must be used for each cycle.

17. Use the wet/dry vac to suck the suds and remaining water from the bottom of the tank. Wipe the tank dry with Kimwipes.

First Rinse/Second Rinse:

1. Clean the fill/drain hose and insert it into a barrel of distilled water.

2. Prime the pump with 2-3 gallons of water.

3. Fill the tank 3/5 full.

4. Circulate the first rinse for 20-30 minutes. You may energize the heaters during the rinse but the temperature will rise only a few degrees.
5. After 20-30 minutes, turn the pump off and drain the tank. Also, drain the pipe line if possible.
6. Remove the filters and discard after examining the return filter for "chips".
7. Replace the filter cartridges with new ones and tighten.
8. Repeat the rinsing cycle if there appears to be a significant amount of soap in the solution.

Final Rinse:

1. Insert the fill/drain hose into a barrel of distilled water and fill the tank as full as possible. Do not fill the tank past the pipe at the top of the tank that fills the tank, because it will leak.
2. Energize the heaters and set the thermostat to control the temperature at 180 degree Fahrenheit.
3. Circulate the final rinse for 1-1/2 hours at 180 degrees Fahrenheit.
4. After 1-1/2 hours, turn the pump and heater off. Drain the tank and the pipe line.
5. Remove the filter housings. Discard the supply filter. Bag and label the return filter "[pipe line] [date] final rinse cycle return filter xx minutes @ yyy degrees." Drain the filter housings and the cleaning cart pipes.
6. Check that all of the switches are off, and turn off the main power switch. Disconnect all lines and pack up the cleaning cart. Leave the

filter housings off so that they can dry. Wrap the power cord around the hook at the front of the cart, and wrap the fill/drain line around the handle at the back of the cart.

Drying:

1. Dry the lines with a heated gaseous nitrogen purge or a controlled air purge. Use copper tubing to connect between the pipe line and the heater, and keep the copper tubing with the cart when finished. Note that one end of the pipe line should be connected to the heater, while the other end should remain open to the air.
2. The gas source should have a valve that connects directly onto the inlet of the heater. There may also be another valve at the source of the gas that needs to be opened. The source valve should be opened halfway, and the end valve that connects into the heater should be opened slightly (about 1/4 open). This will restrict the gas flow so that the heater can heat the gas as it enters the pipe line. Set the thermostat of the heater at approximately 325 degrees. Be sure to use quick ties to tie the heater onto something secure so that it can stand upright.
3. Monitor the gas coming out of the pipe with a hygrometer if possible.
4. Continue drying until the gas coming out feels dry or until the change in dew point is insignificant over a 30 minute period.
5. Pump the line completely dry with a power loss protected vacuum pump.
6. Cork the pipe ends and wrap them in plastic to prevent contamination.

PIPE CLEANING: SCHEMATIC

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