Fermilab

TM-864
1640.000

CCI Report No. 390-106

10,000 Liter LHe Dewar Repair Magnet Test Facility

Prepared Under Fermilab Subcontract No. 94199
By Cryogenic Consultants, Inc.
Allentown, Pa.

For

Fermi National Accelerator Laboratory, Batavia, Illinois

February 14, 1979

10,000 LITER LHe DEWAR REPAIR
MAGNET TEST FACILITY

The 10,000 liter LHe dewar at the Magnet Test Facility developed a vacuum leak causing loss of insulating vacuum. This loss of vacuum resulted in increased heat load to the liquid helium due to condensing air. Complete helium inventory of approximately 4,000 liquid liters vented safely through the standard relief system provided for that purpose. No evidence of excessive pressure or danger to the facility resulted. The pressure in the vessel was relieved through a 3/8 in. relief valve at approximately 25 psig. At no time did pressure reach the design pressure of 50 psig. A rupture disc on the vessel did not relieve. The total inventory was vented with no knowledge of the building inhabitants, all of which attests to the safety of the vessel and system.

A LN_2 line feeding the shield of the LHe vessel suffered a broken seal and allowed liquid to drip onto the carbon steel vessel. Enough liquid spilled to crack a weld at the root of the bayonet thermal break. The dewar insulating vacuum was subsequently lost after a period of time. We estimate that 70 or so pounds of water were drawn into the vessel along with the cryopumped air.

The first step in the repair of the vessel was to isolate this leak. By pressurization of the shield and annular space with nitrogen gas to approximately 7 psi, the leak was found with soap bubble solution. The leak was a crack in a weld as shown in Figure 1. The crack was $\approx$ 2 in. in length and easily detected. Next the surrounding area of about 1 ft^2 was stripped of paint and retested to make certain no other cracks existed or were masked. The area of the crack and $\approx$ 1 in. to each side of the cracked weld was ground away prior to rewelding. The weld was repaired with care being taken to weld well into either side of the crack to insure that no pinholes or micro cracks went unrepaired.

The tank was repressurized and retested. No detectable leak was evident. At this point, "rain gutters" were added to the thermal break of both the LN_2 inlet and outlet lines to channel cold fluids off and away from the carbon steel shield in the future. To reestablish vacuum in the vessel, all cryopumped water had to be removed. Early evacuation stages showed clear indications of the presence of water. Repeated evacuation and backfilling of the annulus with dry nitrogen gas over a period of four days, along with heating of the inner vessel to approximately 170°F, dried the annulus completely. The hot gas also served to reactivate the getter located on the inner vessel.

When the vessel was on the mass spectrometer leak detector alone, the entire vessel was leak tested. The following steps were taken to insure that no leaks were possible:

1. The inner vessel was pressurized to 10 psi during the complete process. Any leak in the inner vessel would preclude any test with the mass spectrometer. Mass spectrometer background was at an acceptable level. Conclusion: No leak in inner vessel.

2. The annulus relief device was sprayed with helium. Conclusion: No leak.

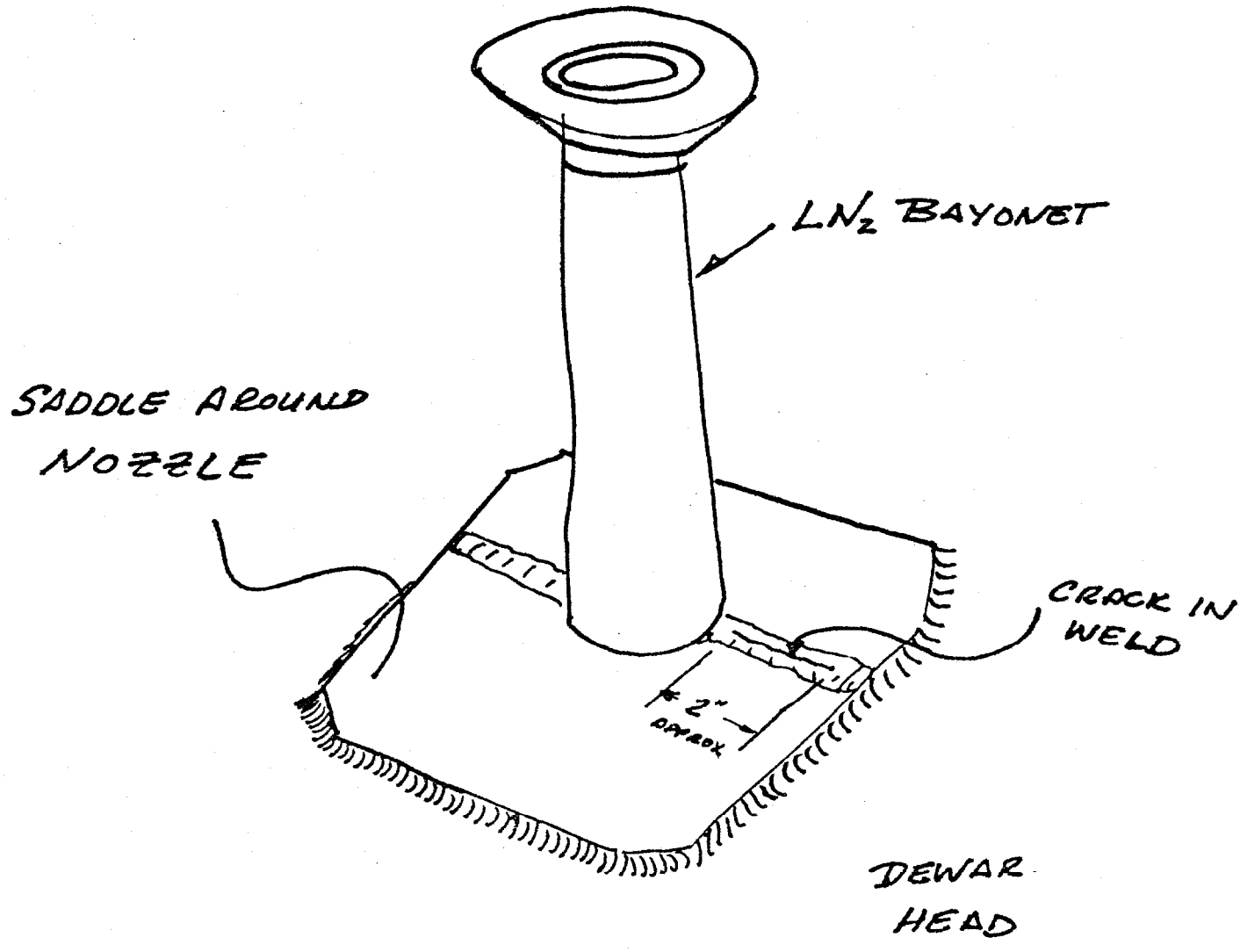
3. The region in and about the repair zone was at first slowly and selectively sprayed with helium. No leak. The entire area was flooded with helium. No leak. Conclusion: No leak in nozzle area.

4. The LN_2 shield was then pressurized to 10 psig with helium gas. No leak indication.

5. New vacuum readout devices were added to the area at the pumpout valve. This region was leak tested. No leak. Conclusion: Vessel is tight and ready for service.

An additional "rate of rise" test showed less than a 2μ rise in pressure in a 1/2 hr. period. At this point, the LN_2 line was reinstalled and equipped with a T.F.E. nose seal and T.F.E. O-ring. (Note: Apparently, no nose seal was installed during the original tie-in of the line.) The N_2 shield was pressurized to 25 psig and the bayonet was tested for leaks. No leak was evident. The vacuum was at 5 μ when sealed off. This was a lower reading than when the vessel arrived originally.

The vessel is considered tight and the decision was made to put the dewar back into service.



CCI REPORT
390-106

FIG 1