

MUON CRYOSYSTEM DESIGN NOTE 28

SUBSYSTEM: CCM CVM Cryoplant

TITLE: Boil-off Measurements - Helium Storage Dewar

AUTHORS: *R. W. Fast* & *Q. S. Shu*
R.W. Fast & Q.S. Shu

DATE: June 15, 1986

OBJECTIVE OF NOTE

To describe the boil-off test performed on the 400-L helium dewar to be used on the Muon cryoplant and to document the test results.

DESCRIPTION OF TEST

The storage dewar was fabricated by CDM Machining and Fabrication Co., Commerce City, Colorado. It has an inner vessel Code stamped to 100 psid (85 psig with external vacuum). Design Note 13 archives the CDM-supplied documentation and Design Note 25 is the pressure vessel engineering note. The inner vessel has a liquid capacity of 410 L, exclusive of the neck. The dewar has a liquid nitrogen cooled radiation shield and neck intercept.

The dewar was set up in Lab 8, the insulating vacuum space evacuated and a foam plug inserted into the neck. A flow of LIN was started through the shield and the inner vessel purged with GHe. No LIN was put into the inner vessel. After two hours the transfer of LHe was begun; the dewar was full about 7 hours later; about 800 L was used for cooldown and fill. The helium depth was measured with the Dwyer differential pressure gauge: 4 inches of water corresponded to 410 L. The boil-off flow rate was measured with a Dwyer rotameter (5 to 50 SCFH).

TEST RESULTS

Table 1 gives the data taken over the 3-day test period.

Table 1. Test Results

Date	Time	Boil-off flow rate (ft ³ /hr)	Temperature of gas	LHe depth (inches of water)	Inner vessel pressure (psig)
6/2/86	1620	>50	20°C	3.9	0.5
6/2/86	2200	>50	20°C	3.6	0.5
6/3/86	1000	33	20°C	3.4	0.5
6/3/86	1600	25	20°C	3.3	0.5
6/4/86	0700	14	20°C	3.2	0.5
6/4/86	1730	12	20°C	3.15	0.5
6/5/86	0700	12	20°C	3.1	0.5

ANALYSIS OF RESULTS

One litre of saturated liquid helium at one atmosphere-absolute becomes 26.6 ft³ of gas at 293 K and 1 ata. The observed steady-state flow rate (12 ft³/hr) corresponds to a liquid boil-off rate of 0.45 L/h or 10.82 L/d. This is 2.6% of the net capacity per day.

CONCLUSION

The contract specification is for a maximum acceptable evaporation rate of 4% per day; the dewar therefore meets the specification.

REVIEWED BY

M. E. Stone _____ 6/11/86 _____
Name Date