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TRANSPORTABLE DEWAR FILL FROM 10,000 LITER HELIUM DEWAR AT THE MAGNET TEST FACILITY

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For

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DEWAR FILL

MAGNET TEST FACILITY 10,000 LITER LHe DEWAR

Liquid withdrawal from the 10,000 liter LHe dewar at the Magnet Test Facility is possible through the bayonet which was to have been used as part of a cold quench scheme. By addition of a valved transfer line to this port, liquid can be transferred to a 500 liter or 1000 gallon dewar. The transfer time for the 500 liter dewar fill has been designed. A simple adapter can be added to allow filling of a 1000 gallon Gardner trailer.

As originally agreed upon, this filling was to have taken place inside Industrial Bldg. #1. It now appears that this is not desirable. Modification of the line to allow this filling to take place elsewhere is a simple matter.

More important than the location of this fill facility is a procedure for filling which will, at one time, minimize the interference with normal plant operation, and require as little manpower as possible.

In the following pages I will propose a scheme for this fill operation which will accomplish both goals. At the same time I will present flow schematics and a procedure.

Input Parameters (Goals)

1. Fill one, 500 liter dewar per shift.
2. Minimize use of 1500 watt personnel.
3. Prevent upset of 1500 watt plant.
4. Provide safe, trouble-free fill with appropriate interlocks.

Fig. 1 shows the flow schematic for a dewar fill station. To fill the dewar liquid available from the 10,000 liter LHe dewar is transferred to the receiving dewar with the cold displaced gas being returned to compressor suction through heater Q_4.

Fill Procedure (2 men required)

1. Move 500 liter dewar into position.

1a. Log all data listed under Dewar Disconnect Step 10.

2. Check with 1500 watt operator and receive permission to proceed with fill.
3. Pilot Light 10 is a plant interlock indicator. It indicates plant condition and should be attached to the JT. Dewar fill should not take place during plant shutdown, warmup or cooldown.
4. Attach flex gas line to dewar (valve 4) loosely.
5. Crack V3, allowing a small amount of gas to purge line.
6. Crack V4, allowing a small amount of gas to purge line.

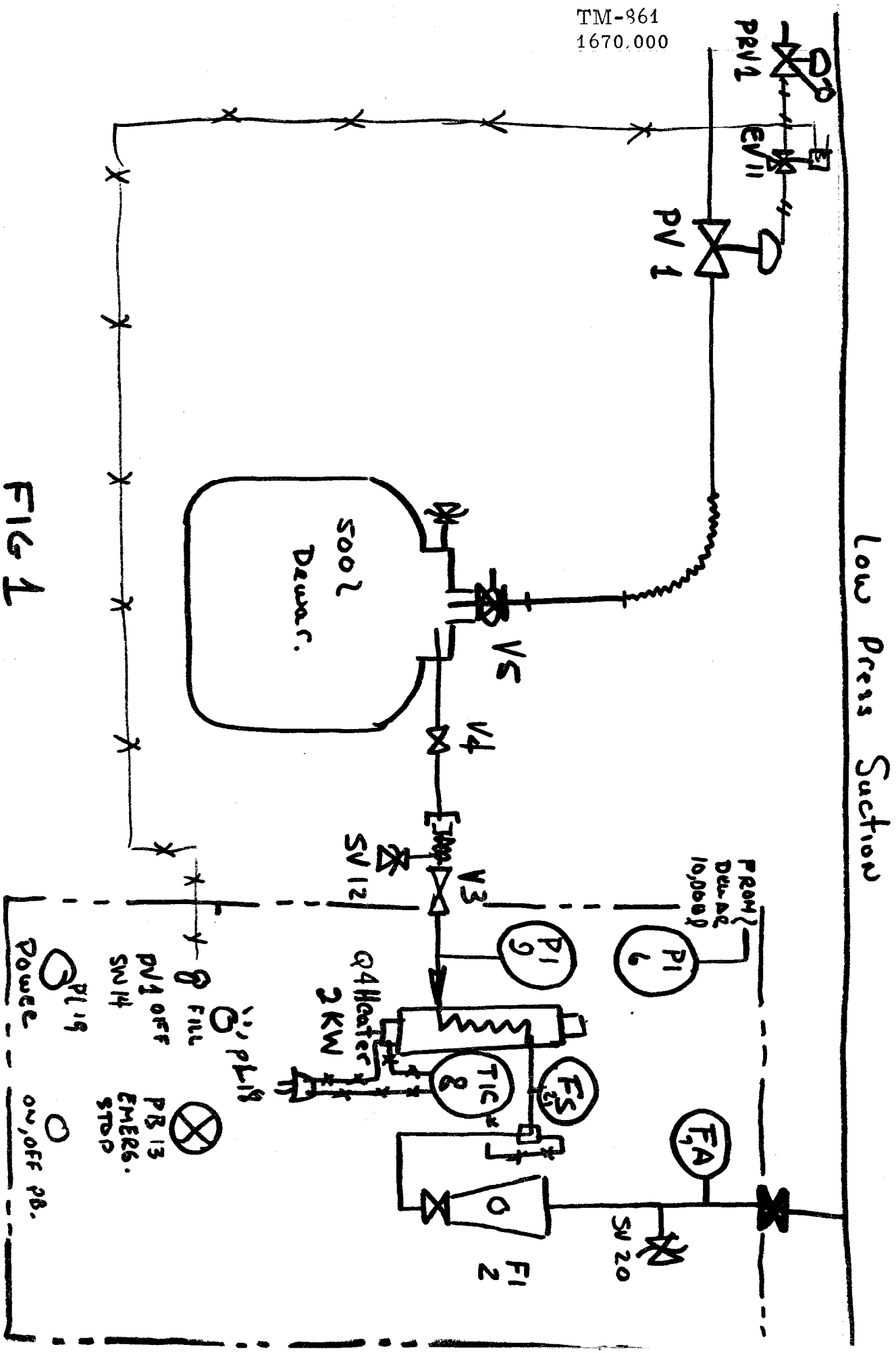
PRV 1
EV 11
PV 1
500 l
Dewar.
V5
V4
SV 12
V3
PRESS
DEWAR
10,000 p
P1
6
P1
9
Q4 Heater
2 KW
TIC
8
FS
21
F.A
SV 20
F1
2
Low Press Suction
PB 13
EMERG.
STOP
ON, OFF PB.
PL 19
POWER
PV 1 OFF
SW 14
FILL

FIG 1

7. Tighten coupling, check for leakage and tighten further if necessary.
8. Open V3 fully.
9. Close V4.
10. Grasp transfer line bayonet, move and point line to the side.
11. Check that PRV1 is set at 15 psig. Switch on valve PV1 - allow gas to flow until cold and pulsating.
12. Close valve PV1, open V5 immediately and insert bayonet into 500 liter dewar.
13. Tighten Goddard (bayonet) nut, check for leaks.
14. Open valve 4.
15. Open PV1.
16. Turn on TIC8, set at 70°F.
17. Adjust valve on F12 to 5.3 scfm.

Monitor PI9 and 500 liter dewar reliefs. If pressure rises above 5 psi or relief settings (whichever is lower) PV1 will have to be throttled by reducing pressure on PRV1.

Check dewar level at 30 minute intervals, to insure transfer losses are not excessive. If dewar does not fill at ~40ℓ/interval increase flow by opening valve on flow meter. If flow does not increase, PV1 must be opened by increasing pressure on PRV1.

A tabulation of dewar pressure vs. PRV setting will be established during initial fills so that the appropriate rates can be maintained with a minimum of operation interaction.

FA7 (Flow Alarm 7) should be set at 7 scfm. The device will alarm at both the Control Panel near the dewar and at the Control Console in the 1500 watt Control Room.

Emergency Fill Stop can be initiated from either location by closing PV1, using EVII from either location.

Dewar Disconnect

When dewar is filled, as evidenced by surging in vent line liquid level indication, begin the following procedure:

1. Close PV1, using SW1.
2. Allow vent lines to warm up naturally or by application of heat.
3. Monitor F12. When flow ceases and line is warm, close V4.
4. Check to see Dewar Road Vent is open and on line.
5. Close V4, immediately remove flex line to compressor suction.
6. Check 500 liter dewar pressure. If 5 psi or less, remove Goddard nut from transfer line.
7. Remove transfer line bayonet until ball valve 5 can be closed. Close V5.

8. Return transfer line to its uppermost position.
9. Remove dewar.
10. Log the following:

    a. Level _____

    b. Pressure _____

    c. Shield flow _____

    d. Dewar condition _____

    _____

    e. Serial # _____

    f. Date _____

    g. Time _____

    h. Operator's name _____

APPENDIX

DEWAR FILL - MAGNET TEST FACILITY 10,000 LITER LHe DEWAR

Calculations

Component Functions

Elect. Schematic

CALCULATIONS

Dewar Fill

Fill 500 liter dewar in six hours (two hours for tie-in).

Flow rate required: $83.3\ell/hr \times 120.8g/\ell = \frac{10066.6g/hr}{3600g/hr}$ 2.79 g/sec.

Size Heater

2.79g/sec liquid displaces 23.2cc GHe at saturation. This gas must be warmed to room temperature - $23.2cc/sec \times .02053g/cc = .477g/sec$
$\Delta H - 1543J/g \times .4778g/sec = 737.3J/sec$ + watts.

Use 2000 watt heater to allow rapid dewar fill (i.e., 3 hr) for emergency. Temperature control should be by Triac. Proportional Control.

Size Flow Meter

$83.3\ell/hr$ liquid flow - equivalent cold gas displaced $\frac{83.3\ell/hr}{60} = 1.38\ell/min$.

$1.38\ell/min \times 20.53g/\ell = 28.5g/min$

28.5g/min at 70°F =>28.5g/hr $5.128\ell/g = 146.1\ell/min$

$146.1\ell/min \quad \frac{1}{28\ell/ft^3} = 5.219ft^3/min = 5.25cfm.$

COMPONENT FUNCTION SHEET

COMPONENT	DESCRIPTION	FUNCTION
PRV1	Press. Red Valve (Regulator)	Control flow through PV1 - Controls % open of PV1.
PV1	Pneumatic Valve	Pneumatic valve ext. stem. Vac. Jac. LHe flow.
GV11	Electric (Solenoid) Valve	On-Off Control of signal to PV1, 3-way solenoid.
FI2	Flow Meter Rotometer Type	Control rate of dewar fill by limiting gas discharge to compressor suction.
V3, V4	Valve, Shutoff	Isolation valve for dewar, compressor suction line.
SV12, 20	Valve Safety	Thermal relief.
V5	Bayonet Isolation Valve	Provide for volume shutoff and transfer line insertion.
PI6	Pressure Gauge	10,000ℓ dewar pressure.
FA7	Flow Alarm	Alarm on excess flow - fill runaway.
FS21	Flow Switch	Heater protection - no flow, no power to heater.
TIC8	Temperature Control	Triac control for 2kW gas circulating heater.
PI9	Press. Gauge	500ℓ dewar and suction line pressure.
SW14	On/Off Switch	On/Off control for PV1 through EV11.
PL18	Pilot Light	Fill pilot light.
PB13	Push Button	Emergency fill stop, 2 units, one also in 1500 watt Control Room.
PL19	Pilot Light	Power on, Control Panel.
SW22	Switch	Power on switch.
IL23	Interlock Switch	Interlock switch controlled by 1500 watt JT valve - no flow-no fill.
Q4	2kW Heater	Return gas warmup.

ELECT. SCHEMATIC