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Jefferson Lab
Thomas Jefferson National Accelerator Facility

Operational Safety Procedure Form

(See ES&H Manual Chapter 3310 Appendix T1 Operational Safety Procedure (OSP) and Temporary OSP Procedure for instructions.)

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DEFINE THE SCOPE OF WORK

Title:	Acceptance test for SHMS Magnets		
Location:	Hall C - SHMS	**Type:**	☐ **OSP** ☒ **TOSP**
Risk Classification (per Task Hazard Analysis attached) (See *ESH&Q Manual Chapter 3210 Appendix T3 Risk Code Assignment*.)		**Highest Risk Code Before Mitigation (3 or 4):**	3
		Highest Risk Code after Mitigation (N, 1, or 2):	1
Owning Organization:	Physics	**Date:**	Nov, 19,2014
Document Owner(s):	Steven Lassiter		

Document History (Optional)

Revision:	Reason for revision or update:	Serial number of superseded document

ANALYZE THE HAZARDS

1. Purpose of the Procedure – Describe in detail the reason for the procedure (what is being done and why).

The new SHMS Magnets require installation unto the SHMS and acceptance testing at JLAB. This TOSP provides instructions for preforming these tests in a safe reliable manner. The following tasks are require for each magnet:

1. Pressure check of the Helium circuit, N2 shields and insulating vacuum systems.
2. Hi-potting of the DC circuit.
3. Connect the magnet to the cryogenic lines via Bayonet installation.
4. DC power connections and power testing the magnets.

The magnets will arrive throughout the 2105 year, with Q1 expected to arrive first followed closely by the HB and then the Dipole, Q2, and Q3 magnet later.

2. Scope – include all operations, people, and/or areas that the procedure will affect.

SHMS HB, Q1, Q2, Q3 and Dipole magnets, DC power supplies, cryogenics involving connecting the magnet via U-tubes to the SHMS transfer line and HX. Testing will be done by JLAB's Hall C engineers, JLAB techs and magnet vendor's personal.

3. Description of the Facility – include floor plans and layout of a typical experiment or operation.

Hall C and SHMS.

4. Authority and Responsibility:

4.1 Who has authority to implement/terminate

Test Leader: Paul Brindza (or his designee) is responsible for implementation/termination of this procedure

4.2 Who is responsible for key tasks

Paul Brindza, Steven Lassiter, Eric Sun: DA's responsible for analyzing the potential hazards,

verifying that the correct testing equipment is used and coordination with cryo-group. They shall schedule, supervise and witness the test and ensure that all documentation of testing is recorded and stored.

Test technicians shall setup the test hardware, preform the tests or installation under the direct supervision of the DA, preform the posttest examinations and maintain the test worksheets. They shall also maintain the calibrated testing equipment such as gauges, relief valves, regulators, hi-pot equipment and other equipment used in the test.

Quality Assurance Inspector (or a representative appointed by the inspector) shall witness the pressure tests for pressure piping and certify that the pressure systems satisfactorily passed the pressure testing.

4.3 Who analyzes the special or unusual hazards (See ES&H Manual Chapter 3210 Appendix T1 Work Planning, Control, and Authorization Procedure)

The design Authority(DA), or his designee, will analyze the hazards involved in this work and will prescribe any necessary mitigation measures.

4.4 What are the Training Requirements (See http://www.jlab.org/div_dept/train/poc.pdf)

In addition to reading this TOSP, the following training is required for all participating with the testing.
Rad Worker 1, ODH, Electrical worker, Hall C Orientation, LOTO, Fall Protection, SAF100c for contractor personnel.
Pressure/Leak testing personal: SAF130A
Design Authority: SAF 130B

5. Personal and Environmental Hazard Controls Including:

5.1 Shielding

None

5.2 Interlocks

None

5.3 Monitoring systems

None

5.4 Ventilation

None

5.5 Other (Electrical, ODH, Trip, Ladder) (Attach related Temporary Work Permits or Safety Reviews as appropriate.)

The DA, or his designee will analyze the hazards involved in this work.

1. Pressure test of Helium vessels, N2 shields and Insulating vacuum spaces.

The primary hazards associated with pressure tests are sudden leakage or rupture where loose projectiles can be emitted, pressurized lines can move suddenly, unexpected load noise can damage hearing or startle nearby workers. Each pressure test is to be conducted one at a time according to the parameters given in Section 2 and the procedures given on section 4.
Any JT valve stems not anchored by a motor actuator shall be secured by retainer nut.

The approximate stored energy for pressure test is calculated according to the method of ENG-11-008-OSP. The stored energies, using GN2 as the gas source for all test are given below:

System	Test Pressure [psig]	Internal Volume [L]	Stored Energy [kJ]	Min reg standoff distance [ft]
HX warm Transfer lines	50	10	3.4	6
Magnet LN2 piping	95	110	71	17
Magnet He space	95	185	120	20

The hazard due to internal energy is mitigated to RC=1 since:

- Each test is to be conducted one at a time.
- The piping and vessels are restrained.
- The pressure components are ductile at the test temperature.
- Hearing protection and safety glasses shall be worn.
- Personnel exposure shall be minimized around the test system during testing.
- For the Magnets, the majority of the of the test circuit is contained within the magnet's outer vacuum shells, with only the penetrations located on the top plate of the cryo-can reservoir being exposed.

Oxygen Deficiency Hazard:

Each pressure test will be conducted one at a time according to the parameters given in Section 2 and the procedures given in Section 4. A worst case for determining ODH risks is to assume that the test article fully releases its contents into Hall C, with no ventilation. The volume of Hall C, below the dome, is approximately 707,000 cu ft.
Oxygen concentration as calculated by using the method of ENG-11-008-OSP will not be lower than 20.998%. There is no risk of developing an ODH condition.

2. Hi-pot testing

Hi-potting of the magnet will occur only when the magnet's coils have been isolated from all other connections. A low current Hi-pot testing device will be used:
The hazard is mitigated to RC=1 since:

- The voltages and current levels do not surpass the electrical risk thresholds of 3kV and 3 mA.
- Controlled ramp up steps to detect early indications of breakdown voltage.
- Hearing protection and safety glasses shall be worn.
- Personnel exposure shall be minimized around the test system during testing.

3. Cryogenic Bayonet Operations:

The U-tube insertion will follow the OSP ENP-14-33322-OSP for Physics Division Cryogenic Bayonet Operations.
The hazards associated with this task include: Lifting/moving objects, Pressurized containers, and vacuum vessels, Fall Protection, Ladders, Gas, ODH, Cryogenic fluids and Helium contamination.

4. DC power test:

Each magnet will be connected to a low voltage, high current power supply:
7V, 4000 Amps for Q1,Q2,Q3 and Dipole
7V, 5000Amps for the HB magnet.

6. List of Safety Equipment:

6.1 List of Safety Equipment:

- All personnel shall wear proper PPE, minimally including:
  Eye Protection (safety glasses with side shields)
- Hearing protection
- Proper work Clothes
- Fall protection when required.

Entrance(s) to area shall be posted with the PPE requirements.

6.2 Special Tools:

N/A

DEVELOP THE PROCEDURE

1. Associated Administrative Controls

The following written procedures will be used to reduce risk:

- Appropriate training as per section 4.4
- Posted signs and watch personnel to minimize personnel exposure to the work area by preventing entry of non-test personnel at all entryways according to the procedures given in Section4.
- Watch personnel shall enforce standoff distance for non-test personnel.

2. Operating Guidelines

Pressure Test:

System	Test Gas	Design Pressure [Atm]	Test Pressure [psig]	Max Relief Pressure [psig]
Warm 300K He Gas	N2	3	50	55
Magnet He vessel	N2	5	95	105
Magnet LN2 shield	N2	5	95	105

Hi-Pot test:

Maximum test voltage 1,000 V
Maximum current 0.1mA
DC power test:
maximum ramp voltage 7 V.
Maximum output current 4,000A for Q2,Q2,Q3 and Dipole, 5,000A for HB.

3. Notification of Affected Personnel (who, how, and when)

The Design Authority (DA) (or his Designee) shall brief affected personnel, including the area Safety Warden and CHL chief cryogenic engineer (pertaining to Bayonet installation/removal), prior to the planned work. The DA, or Designee, shall maintain communication with affected personnel throughout the duration of the work.

4. List the Steps Required to Execute the Procedure: from start to finish.

See Attachments.

5. Back Out Procedure(s) i.e. steps necessary to restore the equipment/area to a safe level.

Halt test and Immediately start De-pressurizing the test articles if there is ANY indication of a failure; i.e., notification to terminate from any of the test personnel, pressure gauge (once isolated from pressure source) indicating a steady drop in pressure, sound of releasing pressure, motion of line (due to releasing pressure).
Once test article is depressurized, find and repair leaks as required. The pressure test procedures must be re-started once leaks have been repaired.

6. Special environmental control requirements:

6.1 Environmental impacts (See EMP-04 Project/Activity/Experiment Environmental Review)

NA

6.2 Abatement steps (secondary containment or special packaging requirements)

NA

7. Unusual/Emergency Procedures (e.g., loss of power, spills, fire, etc.)

In the event of injury, call 911 and also notify:

- Guards (x5822)
- Occupational Medicine (x7539)
- Hall C leader (x7367)

8. Instrument Calibration Requirements (e.g., safety system/device recertification, RF probe calibration)

Pressure Gauges and relief valves must be calibrated.
Hi-pot testing equipment must be in calibration.

9. Inspection Schedules

Pressure tests shall be witnessed by QA/CI personnel or their qualified designee.
Hi-pot tests shall be witnessed by Hall C Engineering.
DC power test shall be witnessed by Hall C Engineering.

10. References/Associated Documentation

EHS&Q 6151 T4 Pressure Systems Pressure Testing Program
ASME B31.3 & B&PVC VIII Division 1.
ENP-14-33322-OSP Physics Division Cryogenic Bayonet Operations

11. List of Records Generated (Include Location / Review and Approved procedure)

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Operational Safety Procedure Form

Click
To Submit OSP
for Electronic Signatures

Distribution: Copies to: affected area, authors, Division Safety Officer
Expiration: Forward to ESH&Q Document Control

Form Revision Summary

Revision 1.3 – 11/27/13 – Added "Owning Organization" to more accurately reflect laboratory operations.
Revision 1.2 – 09/15/12 – Update form to conform to electronic review.
Revision 1.1 – 04/03/12 – Risk Code 0 switched to N to be consistent with 3210 T3 Risk Code Assignment.
Revision 1.0 – 12/01/11 – Added reasoning for OSP to aid in appropriate review determination.
Revision 0 – 10/05/09 – Updated to reflect current laboratory operations

ISSUING AUTHORITY	FORM TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW REQUIRED DATE	REV.
ESH&Q Division	Harry Fanning	12/01/11	12/01/14	1.3