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Operational Safety Procedure Review and Approval Form # 104764
(See [ES&H Manual Chapter 3310 Appendix T1 Operational Safety Procedure \(OSP\) and Temporary OSP Procedure](#) for Instructions)

Type:	LOSP Click for OSP/TOSP Procedure Form Click for LOSP Procedure Form Click for LTT-Individual Information Click for LTT-Group Information					
Serial Number:	(Assigned after final approval)					
Issue Date:	(Assigned after final approval)					
Expiration Date:	< <i>Approximately 7/23/2023</i> >					
Title:	LOSP for LAD detector calibration system					
Location: (where work is being performed) Building Floor Plans	90 - Experimental Equipment Lab (EEL) 96 - Experimental Hall C	Location Detail: (specifics about where in the selected location(s) the work is being performed)	EEL for installation of laser fiber on LAD, operation in Hall C on SHMS beam left side			
Risk Classification: (See ES&H Manual Chapter 3210 Appendix T3 Risk Code Assignment)	Without mitigation measures (3 or 4):	3				
	With mitigation measures in place (N, 1, or 2):	1				
Reason:	This document is written to mitigate hazard issues that are : Determined to have an unmitigated Risk code of 3 or 4					
Owning Organization:	PHALLC					
Document Owner(s):	Szumila-Vance, Holly (hszumila@jlab.org) Primary					
Supplemental Technical Validations <input type="checkbox"/>						
Lasers Class 3B or 4 (Ultraviolet, Infrared, and Visible Light) (Jennifer Williams, Paul Collins) ESH&Q Liasion (Bert Manzlak)						
Document History <input type="checkbox"/>						
<table border="1"><thead><tr><th>Revision <input type="checkbox"/></th><th>Reason for revision or update <input type="checkbox"/></th><th>Serial number of superseded document <input type="checkbox"/></th></tr></thead></table>				Revision <input type="checkbox"/>	Reason for revision or update <input type="checkbox"/>	Serial number of superseded document <input type="checkbox"/>
Revision <input type="checkbox"/>	Reason for revision or update <input type="checkbox"/>	Serial number of superseded document <input type="checkbox"/>				
Lessons Learned	Lessons Learned relating to the hazard issues noted above have been reviewed.					
Comments for reviewers/approvers: <input type="checkbox"/>						
Attachments <input type="checkbox"/>						

Procedure: [LOSP_for_LAD.pdf](#)

THA: [LOSP_THAform.pdf](#)

Additional Files:

Review Signatures

This form entry has not been submitted for signatures.

Approval Signatures

This form entry has not been submitted for signatures.

NOT APPROVED

Laser Operational Safety Procedure (LOSP) Form
 (See [ES&H Manual Chapter 6410 Appendix T1](#)
[Laser Operational Safety Procedure](#))

Serial Number: _____

(Assigned by [ESH&Q Document Control](#) x7277)

*** Attach the Task Hazard Analysis (THA) related to this procedure**

Issue Date:	_____	Expiration Date:	_____
Title:	LOSP for LAD detector calibration system		
Location:	Hall C beam left upstream of target		
Description of Project	Class 3B laser is used as source of fiber distribution system for detector calibration purposes of LAD detector		
Document Owner(s):	Florian Hauenstein / Holly Szumila-Vance	Date:	07/17/20

Laser Inventory

Laser Serial #	Laser Class	Wavelength(s)	Maximum Power/Energy
1. GR1800568	3B	355nm	51uJ, max. 2kHz repetition rate
2. _____	_____	_____	_____
3. _____	_____	_____	_____
4. _____	_____	_____	_____

Approval Signatures:	Print	Signature	Date:
Laser System Supervisor:	Dave Gaskell?	_____	_____
Laser Safety Officer:	Paul Collins	_____	_____
Division Safety Officer	Ed Folts?	_____	_____
Department or Group Head:	Cynthia Keppel	_____	_____
Other Approval(s):	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

Document History:

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

Distribution: ESH&Q Document Control (x7277, MS6B); affected area(s); Document Owner; Division Safety Officer

Introduction – In areas containing more than one laser, define operational sequence or parameters.

This Laser Operational Safety Procedure Form describes the necessary controls and procedures during the work with and maintenance of the Laser Calibration System for the LAD detector in Hall C. The system is in an enclosed box and uses only optical fibers between components to ensure that no user is exposed to laser-related hazards during all phases of operation. This allow for classification as a Class 1 system, since the laser light can not escape the fiber.

The box contains a one class 3B picosecond diode laser (STV-01E-140) with 355nm wavelength, 0.3ns pulse width (FWHM), 51μJ pulse energy at 2kHz triggering which can be triggered externally by 10Hz – 2kHz. The output of the laser is directly coupled to a fiber through a mode scrambler which converts the single-mode output of the laser to multi-mode. Afterwards the signal is feed through a 90-10 splitter which 10% output is connected to a photodiode for monitoring while the 90% output is feed through an adjustable attenuator ($1 \cdot 10^{-4}$). The attenuator output is connected via multi-mode fiber to the fiber distribution system. Each fiber of this system is connected via a patch panel to each scintillator bar of the LAD detector.

Jefferson Lab has developed engineering and administrative controls to control the hazard issues associated with the use of lasers. Please refer to Jefferson Lab's ES&H manual chapter 6410 for more information on the laser safety program and regulations.

The principal contacts:

1. Florian Hauenstein – laser setup operator
2. Tyler Kutz – laser setup operator
3. Dave Gaskell? – Hall C Laser System Supervisor (LSS)
4. Paul Collins – JLab Laser Safety Officer (LSO)

Personnel

Only those authorized by the LSS are permitted to enter the location noted on the cover sheet of this document.

List:

- Training and qualification requirements (including refresher training).
- Medical requirements.
- Spectator protection requirements.

The laser system may only be maintained by personnel who have completed the following:

- The laser safety course SAF1140
- The laser-specific training course SAFxxx
- Read the ES&H Manual Chapter 6410 Laser Safety Program
- Read LOSP Form (this document)
- Signed the list of authorized laser personnel

Laser

Define:

- Laser system specifications.
- Define laser system components.
- Copy of laser operating manuals or reference the location of the manual(s).

The main component of the system is the picosecond diode laser STV-01E-140 (Serial Number: GR1800568) which is classified as a class 3B laser product during all procedures of operation. It emits light with a wavelength of 355nm.

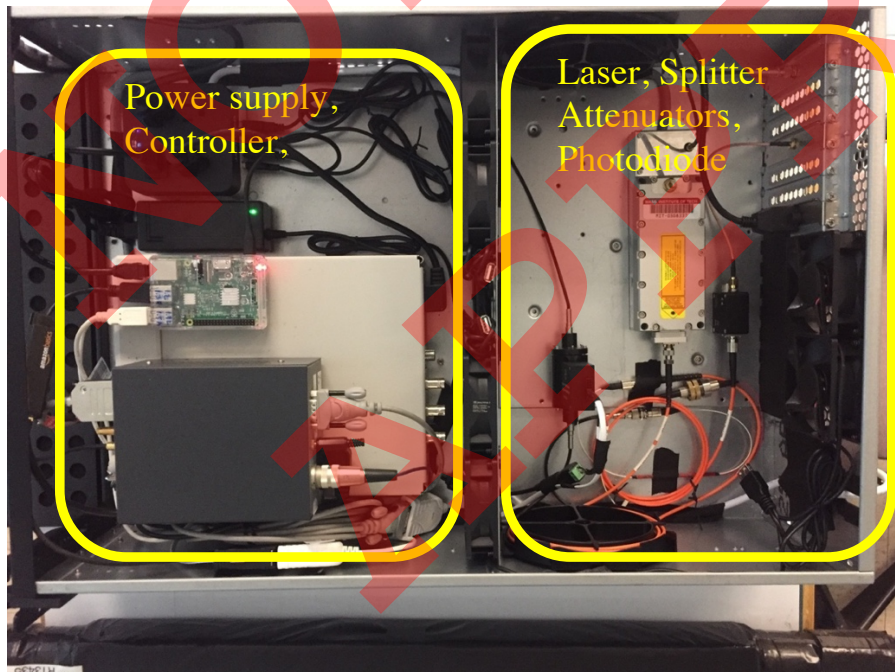
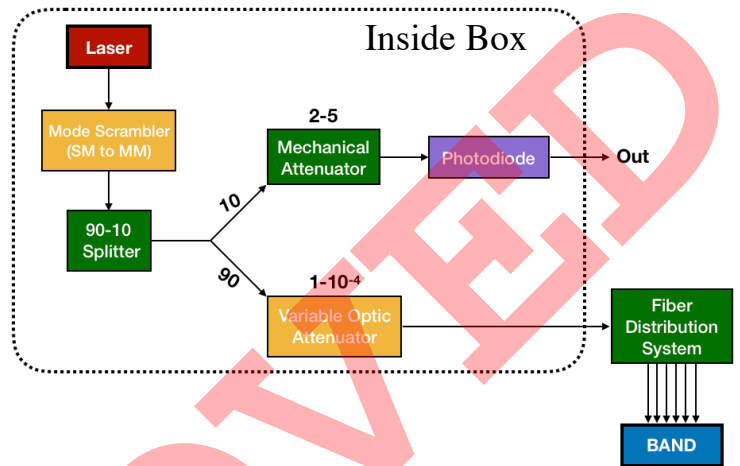
Each pulse has 51μJ energy and 0.3ns width (FWHM) at 2kHz triggering. The laser can be triggered externally between 10Hz – 2kHz.

Further components of the system are a mode scrambler, a 90-10 splitter which outputs connected to a mechanical attenuator and variable optic attenuator. The output of the mechanical attenuator is connected to the reference photo diode while the output of the variable optic attenuator (DD-100-MD) is connected to the fiber distribution system for LAD.

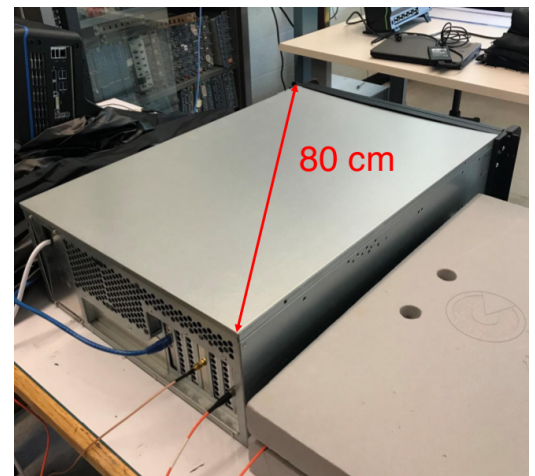
All connections between the different components are done by fibers with no free optical path. A schematic view of the full system is shown to the right.

The full system inside its closed box is shown below.

The laser, splitter, attenuators and diode are sitting to the right in the box. On the left side the power supply, raspberry pi, temperature monitor, variable attenuator controller, laser driver and signal generator are located.



Closed box with laser system components



The Fiber distribution system itself is shown below. It is a compact unit which splits the input into 400 fibers with connectors. The box containing the system is installed at the LAD side. It is connected to fiber patch panels on the LAD side. From the patch panel a fiber is glued to every LAD scintillator bar. Each glue joint is covered so that no light can come out or stray light can come in.



Hazards and Mitigation

Define:

- Laser-specific hazards.
- Occupational exposure hazards beyond laser light (e.g. fumes, noise, etc.).
- Credible non-beam hazards (e.g. environmental hazards).
- Describe all required [personal protective equipment ES&H Manual Chapter 6410 Appendix T2 Laser Personal Protective Equipment \(PPE\)](#) (include: clothing requirements (e.g.: no reflective jewelry, etc.).

Laser Beam Hazards:

The close box is considered to be a Class 1 condition since the direct laser light can not leave the enclosure. All light is transported by fibers only. Specifically designed interlock automatically turns the laser off when the box is opened.

Non-Beam Hazards:

Electric Shock: Before switching on the instrument, ensure that it has been properly grounded through the supplied AC power cable to a socket outlet with a protective earth contact. Electrostatic Discharge (ESD) on or near the connectors can damage electronic devices inside the instrument. Personnel should touch the metal frame of the box for a second before touching any connectors or instrumentation in the box.

Laser Environment

System designs, including interlocks, require hazard evaluation review by SME.

Define:

- Layout of the laser controlled area and/or table. (Show beam location in relation to user (waist height preferable).)
- Interlock schematic (or similar) (including smoke detector interlocks).
- Room lighting conditions during laser use and alignment procedure(s).
- Targets.
- Primary and all likely beam paths (open or enclosed).

The enclosed box with the main laser and controllers is mounted in the SHMS hut. From there one multimode fiber connects the laser output after splitter and variable attenuator to the fiber distribution system next to LAD. The output of the distribution system is connected to a patch panel. From there a fiber is glued to each scintillator bar.

The enclosed box with the laser is interlocked such that the box can not be opened without having the laser on. All pathway of laser light is within fibers. There is no free pathway and there is no alignment necessary. The box with the laser has some holes for airflow to cool the electronics inside. These holes are covered by light-tight, black tedlar foil which is also used for light-tight wrapping of scintillators bars. Therefore, no hole is visible from the outside. There will be warning signs installed on the outside of the foil.

**Written Procedure
 for Use
 and
 Alignment**

Provide:

- All process steps – including unattended operation controls.
- All process steps for detailed alignment – Include manufacturer’s protocols for alignment.
- Maintenance and service.
- Off-normal and emergency procedures (e.g. beam loss, fire).

There is no alignment necessary. The operation of the system is only performed by authorized and trained personnel with the control software via the raspberry pi (see figure below). In case the system is not used it is powered off.

For maintenance or service, the system is powered off and disconnected from the power supply. Only full components of the system are exchanged if repairs are necessary. For complicated maintenance guidance from the Laser Safety Officer is requested.

Laser		Generator		Attenuator	
Times Supply Time: 3689:1 [H:M] Emitting: 3688:52 [H:M]		Pulsing Status: ON Turn ON Turn OFF		Select Channel Channel 1 Channel 2 Channel 1 selected	
Temperatures Diode: 34.00 [°C] Crystal: 28.01 [°C] Electronic Sink: 44.00 [°C] Heat Sink: 23.00 [°C]		Channel 1 Parameters Wave: PULSE Amplitude: 5 [V] Offset: 2.5 [V] Frequency: 1000 [Hz] Duty: 10 [%] Pulse Width: 0.0001 [S] Rise: 2.68e-08 [S] Fall: 1.68e-08 [S]		Handling by dB Current dB: 0.00 [dB] Set dB: -0.1[dB] +0.1[dB] -1[dB] +1[dB]	
Temperature Control Control TEC 1: ON Control TEC 2: ON		Output OFF Get Current Load Default Set Parameters Turn ON Turn OFF		Handling by Transference (OUT/IN)% Current Transference %: 100.0 [%] Set %: -1[%] +1[%] -10[%] +10[%]	
Errors and Informations Error 1: 0 Error 2: 0 Error 2: 0 Info 1: 12 Info 2: 133 Info 3: 47				Handling by Step Current Position Step: 2640 [Step] Set Position: -1 +1 -10 +10	
				Last Command: DB Update	

Laser Controls

- Describe all [controls](#) ([administrative](#) and [engineering](#)). (If a different control is recommended the rationale for not using a typical/recommended control.)

- The laser control area will be posted with a warning sign indicating the laser class.
- Only trained, authorized personnel are permitted to operate the laser equipment
- The interlock, installed by JLab's electronics group, is connected to the door sensor to prevent laser operation with an open box.

Required Calculations

- [Maximum permissible exposure](#).
- Optical density.
- [Nominal hazard zone](#).

OD, MPE and NHZ calculations are not required since the setup is always under Class 1 condition.

Labeling/Posting

(See ES&H Manual Chapter 6410 Appendix T5 Laser Labeling/Posting Requirements)

- Equipment/area labeling/posting requirements.
- Area signs.

The laser system components will have posting attached to it. Furthermore, there will be signs about the laser at the crate where the laser system is installed.

Authorized/Trained Individuals

Print Name/Signature	Date

Authorized/Trained Individuals

Print Name/Signature	Date

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Task Hazard Analysis (THA) Worksheet

(See [ES&H Manual Chapter 3210 Appendix T1](#)
[Work Planning, Control, and Authorization Procedure](#))

Click
For Word

Author: Florian Hauenstein	Date: July 23, 2020	Task #: If applicable	
Complete all information. Use as many sheets as necessary			
Task Title: Installation, Maintenance and Usage of Laser Calibration System for LAD	Task Location: Hall C		
Division: Physics	Department: Hall C	Frequency of use:	continuously
Lead Worker:			
Mitigation already in place: Standard Protecting Measures Work Control Documents		All workers on the Laser system for LAD in the hall complete SAF1112 (Hall C safety training), Laser system OSP (xx),	

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation)
1	Laser calibration system, invisible light 355nm, output max per pulse 51μJ	M	M	3	Service work on fiber and system requires laser system powered off and locked. All laser light is guided in fibers. Enclosed box with the laser system is interlocked at all times.	All service work on the Laser system needs laser training and laser-specific training of the system	1

Highest Risk Code before Mitigation:	3	Highest Risk Code after Mitigation:	1
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When completed, if the analysis indicates that the [Risk Code](#) before mitigation for any steps is “medium” or higher (RC≥3), then a formal [Work Control Document](#) (WCD) is developed for the task. Attach this completed Task Hazard Analysis Worksheet. Have the package reviewed and approved prior to beginning work. (See [ES&H Manual Chapter 3310 Operational Safety Procedure Program](#).)

Task Hazard Analysis (THA) Worksheet

(See [ES&H Manual Chapter 3210 Appendix T1](#)
[Work Planning, Control, and Authorization Procedure](#))

Form Revision Summary

Periodic Review – 08/13/15 – No changes per TPOC

Revision 0.1 – 06/19/12 - Triennial Review. Update to format.

Revision 0.0 – 10/05/09 – Written to document current laboratory operational procedure.

ISSUING AUTHORITY	TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW DATE	REV.
ESH&Q Division	Harry Fanning	08/13/15	08/13/18	0.1

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For questions or comments regarding this form contact the Technical Point-of-Contact [Harry Fanning](#)

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