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| Traveler Title | LCLS HE Cryomodule Prep and Shipping to SLAC- WS6 | | | |
| Traveler Abstract | This traveler outlines the necessary assembly steps and in-process quality control inspections for the L2HE Cryomodule preparation and shipping to SLAC. It begins with a tested ready to ship Cryomodule and ends with the unit leaving the Test Lab. Work shall be performed by trained Technical Staff.  Linked documents within the Traveler are for Reference Only, user to verify work is done to the latest revisions. | | | |
| Traveler ID | L2HE-CMA-CM-SHIP | | | |
| Traveler Revision | R2 | | | |
| Traveler Author | J FISCHER | | | |
| Traveler Date | 23-May-25 | | | |
| NCR Informative Emails | HANNESV,AREILLY,ADAMG,ASHLEYA | | | |
| NCR Dispositioners | FISCHER,JJCAMP,JARED,CHENG | | | |
| D3 Emails | HANNESV,AREILLY,ADAMG,ASHLEYA,FISCHER,JJCAMP,JARED,CHENG | | | |
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| Approval Dates |  |  |  |  |
| Approval Title | Author/Group Lead | Project Engineer | SRF Dept Head | Project Rep |

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| References | List and Hyperlink all documents related to this traveler. This includes, but is not limited to: safety (THAs, SOPs, etc), drawings, procedures, and facility related documents. | | | |
| [F10127855\_B- LCLS HE Cryomodule Assy dwg](https://misportal.jlab.org/jlabDocs/documents/versions/184612/download) | [L2HE-PR-CMA-CM-SLBUP-R1](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-274627/L2HE-PR-CMA-CM-SLBUP-R1.pdf) | [L2HE-PR-CMA-DWNSTRM-BL-R1](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280501/L2HE-PR-CMA-DWNSTRM-BL-R1.pdf) | [L2HE-PR-CMA-EDCP-INST-R2 Downstream End Cap Installation Procedure](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-290246/L2HE-PR-CMA-EDCP-INST-R2.pdf) | [L2HE-PR-CMA-FDCP-INST-R2 Upstream Feed Cap Installation Procedure](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-290247/L2HE-PR-CMA-FDCP-INST-R2.pdf) |
| [16000lb Spreader Bar Lift Plan](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280748/16000lb%20spreader%20bar%20lift%20plan.pdf) | [Shipping Frame Lift Plan](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280749/shipping%20frame%20lift%20plan.pdf) | [L2HE-PR-CMA-UPSTRM-BL-R1](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280500/L2HE-PR-CMA-UPSTRM-BL-R1.pdf) | [L2HE-PR-CMA-CM-SHIP-R2 Shipping Procedure for LCLS Cryomodules](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-290245/L2HE-PR-CMA-CM-SHIP-R2.pdf) | [Shipping Authorization Form](https://misportal.jlab.org/railsForms/shipping_authorizations) |
| [Upstream Shipping Configuration- Part 1](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280500/L2HE-PR-CMA-UPSTRM-BL-R1.pdf) | [Downstream Shipping Configuration- Part 2](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280501/L2HE-PR-CMA-DWNSTRM-BL-R1.pdf) | [11141S0029 Vacuum Leak Test Internal Evacuation - HIGH SENSITIVITY](https://misportal.jlab.org/jlabDocs/documents/versions/192249/download) | [Restraint Installation procedure](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280752/CP-L2PRD-ASSY-BLW-RST-R2.pdf) | [FNAL sensor installation procedure](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280753/Slam%20Stick%20X%20Functionality%20Verification%20and%20Installation%20Procedure.docx) |

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| Revision Note |  |
| R1 | Initial release of this Traveler. |
| R2 | Updated Reference Links |

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| Step No. | Instructions | Data Input |
| 1 | Record the Cryomodule and Vacuum Vessel serial number | [[CMSN]] <<CMSN>>  [[SNRecTech]] <<SRF>>  [[SNRecDate]] <<TIMESTAMP>>  [[SNRecComm]] <<COMMENT>> |
| 2 | Is the Cryomodule Testing Traveler, L2PRD-CM-ACTS been completed and the unit is to be prepared for shipping to SLAC. Note any issues or variations in the attached comment box. | [[ResponsibleAuthority]] <<SRF>>  [[VerifyDate]] <<TIMESTAMP>>  [[ReadyToShip]] <<YESNO>>  [[ReadyShipComment]] <<COMMENT>> |
| 3 | Verify the Cryomodule is ready to be removed from the LERF.   * U-tubes, Vacuum Pumps, and Instrumentation has been removed. * Wheel Assemblies have been installed. * Crane, truck, and trailer have been scheduled | [[ReadyLERFTech]] <<SRF>>  [[ReadyLERFDate]] <<TIMESTAMP>>  [[ReadyLERFComment]] <<COMMENT>> |
| 4 | Remove the Cryomodule from the LERF, transport it to the Test Lab, then using the OHC, position it on the pre-staged concrete blocks at the identified work station. [16000lb Lift Plan](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280748/16000lb%20spreader%20bar%20lift%20plan.pdf) | [[RemoveTech]] <<SRF>>  [[RemoveDate]] <<TIMESTAMP>>  [[RemoveComment]] <<COMMENT>> |
| 5 | Record the Cavity serial numbers. | [[RecordSNTech]] <<SRF>>  [[RecordSNDate]] <<TIMESTAMP>>  [[RecordSNComment]] <<COMMENT>>  [[CAVSN1]] <<CAVSN>>  [[CAVSN2]] <<CAVSN>>  [[CAVSN3]] <<CAVSN>>  [[CAVSN4]] <<CAVSN>>  [[CAVSN5]] <<CAVSN>>  [[CAVSN6]] <<CAVSN>>  [[CAVSN7]] <<CAVSN>>  [[CAVSN8]] <<CAVSN>> |
| 6 | Record the Beam line and MC line vacuum levels. | [[BeamlineTech]] <<SRF>>  [[BeamlineVac]] <<SCINOT>>  [[MClineVac]] <<SCINOT>>  [[BeamlineDate]] <<TIMESTAMP>>  [[BeamlineComment]] <<COMMENT>> |

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| Step No. | Instructions | Data Input |
| 7 | Prepare the Upstream Beamline using the Upstream Shipping Configuration Procedure. [Upstream Shipping Configuration- Part 1](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280500/L2HE-PR-CMA-UPSTRM-BL-R1.pdf)   * Record the Beam Line pressures before and after the work is completed. * Upload the leak check of the final beam line connection. | [[UpstreamPrepTech]] <<SRFCMP>>  [[UpstreamPrepDate]] <<TIMESTAMP>>  [[UpstreamPrepComment]] <<COMMENT>>  [[BLVacPrior1]] <<SCINOT>>  [[LeakCheckGuageAssy]] <<FILEUPLOAD>>  [[BLVacPost1]] <<SCINOT>> |
| 8 | Remove the Downstream testing assemblies using the Downstream Shipping Configuration Procedure. [Downstream Shipping Configuration- Part 2](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280501/L2HE-PR-CMA-DWNSTRM-BL-R1.pdf)   * Record the Beam Line pressure before the work is done. * Upload the leak check of the final beam line connection of the gauge manifold. | [[DownstreamTech]] <<SRFCMP>>  [[DownstreamDate]] <<TIMESTAMP>>  [[DownstreamComment]] <<COMMENT>>  [[BLVacPrior2]] <<SCINOT>>  [[LeakCheckGuageManifold]] <<FILEUPLOAD>>  [[BLVacPost2]] <<SCINOT>> |

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| Step No. | Instructions | Data Input |
| 9 | Leak check the beam line using, [JLAB Leak Check Procedure](https://misportal.jlab.org/jlabDocs/documents/versions/192249/download)   * Cover all of the open areas of the vacuum vessel, then backfill the interior with He. Notify the Responsible Authority to review the chart. Record findings.   This step is not required but is done on an as need basis. | [[LeakCheckTech]] <<SRFCMP>>  [[ResponsibleAuthority2]] <<SRF>>  [[LeakCheckDate]] <<TIMESTAMP>>  [[LeakCheckComment]] <<COMMENT>>  [[LeakCheckResults]] <<FILEUPLOAD>> |
| 10 | Review any outstanding NCR's or D3's. Perform any required rework and upload the results. | [[RevNCR\_D3Tech]] <<SRF>>  [[RevNCR\_D3Date]] <<TIMESTAMP>>  [[RevNCR\_D3Comment]] <<COMMENT>>  [[ReworkListUpload]] <<FILEUPLOAD>> |
| 11 | Install the bearing assy locking plates. | [[InstallLockPlateTech]] <<SRF>>  [[InstallLockPlateDate]] <<TIMESTAMP>>  [[InstallLockPlateComment]] <<COMMENT>> |

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| Step No. | Instructions | Data Input |
| 12 | Close and torque the US Cavity String Gate Valve to 177 in/lbs. | [[TorqueTech]] <<SRFCMP>>  [[TorqueDate]] <<TIMESTAMP>>  [[TorqueComment]] <<COMMENT>> |
| 13 | Complete the shipping alignment, including the gate valves and pipe locations. Upload findings. | [[AlignmentTech]] <<SRF>>  [[AlignmentDate]] <<TIMESTAMP>>  [[AlignmentComment]] <<COMMENT>>  [[AlignmentData]] <<FILEUPLOAD>> |
| 14 | Cover the ends of the Cryogenic pipes to protect them during transit. | [[EndCoverTech]] <<SRFCMP>>  [[EndCoverDate]] <<TIMESTAMP>>  [[EndCoverComment]] <<COMMENT>> |
| 15 | Record the beam line vacuum and guage assembly serial numbers. | [[BLVGaugeTech]] <<SRF>>  [[BLVGaugeDate]] <<TIMESTAMP>>  [[BLVGaugeComment]] <<COMMENT>>  [[PTRSN1]] <<PTRSN>>  [[PTRSN2]] <<PTRSN>>  [[Gauge1]] <<SCINOT>>  [[Gauge2]] <<SCINOT>> |
| 16 | Install the Cold coupler bellows restraints according to [Restraint Installation procedure](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280752/CP-L2PRD-ASSY-BLW-RST-R2.pdf) . Scan and upload the procedure checklist for bellows restraints. Upload a picture of each cavity's completed bellows restraint. | [[BlwRstTech]] <<SRF>>  [[BlwRstInstall]] <<TIMESTAMP>>  [[BlwRstComment]] <<COMMENT>>  [[BlwRstChklist]] <<FILEUPLOAD>>  [[CavityPictures]]  <<FILEUPLOAD>> |
| 17 | Check by hand that the upper and lower piezos on each tuner are fully in contact with the cavity.  If not, use the tuner motor control box to drive the tuner until the piezo is firmly in contact with the split ring and mounting ball on the tuner arm; the piezo may still spin, but it should not be possible to shift it longitudinally. | [[PiezotTech]] <<SRF>>  [[PiezoInstall]] <<TIMESTAMP>>  [[PiezoComment]] <<COMMENT>> |
| 18 | Install shipping sensors according to the [FNAL sensor installation procedure](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280753/Slam%20Stick%20X%20Functionality%20Verification%20and%20Installation%20Procedure.docx). | [[SensorTech]] <<SRF>>  [[SensorInstall]] <<TIMESTAMP>>  [[SensortComment]] <<COMMENT>>  [[SensorsComplete]] {{rlegg,powen,lking,fischer}} <<HOLDPOINT>> |
| 19 | Install the shipping caps using the Installation Procedures.  [Shipping Cap Installation Procedures](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280745/Shipping%20Procedure%20for%20LCLS%20Cryomodules.docx),  [Upstream](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280746/Upstream%20Feed%20Cap%20Installation%20Procedure.docx),  [Downstream](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280747/Downstream%20End%20Cap%20Installation%20Procedure.docx)  M:\asd\asddata\CryomoduleAssembly\pictures\LCLS\Shipping Frame and Caps\DSC_0175.JPGM:\asd\asddata\CryomoduleAssembly\pictures\LCLS\Shipping Frame and Caps\DSC_0406.JPG | [[ShipCapTech]] <<SRF>>  [[ShipCapDate]] <<TIMESTAMP>>  [[ShipCapSOTRVerify]] <<SRF>>  [[ShipCapComment]] <<COMMENT>> |

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| Step No. | Instructions | Data Input |
| 20 | Evacuate, then backfill the Insulating vacuum space with N2. Monitor the endcap gauge, stop flow once you reach 0.5 psig. | [[BackfillTech]] <<SRF>>  [[BackFillDate]] <<TIMESTAMP>>  [[BackFillComment]] <<COMMENT>> |
| 21 | Measure and record the Qext FPC Warm for each cavity. | [[QextCavTech]] <<SRF>>  [[QextCavDate]] <<TIMESTAMP>>  [[QextCavComm]] <<COMMENT>>  [[QextCav1]] <<SCINOT>>  [[QextCav2]] <<SCINOT>>  [[QextCav3]] <<SCINOT>>  [[QextCav4]] <<SCINOT>>  [[QextCav5]] <<SCINOT>>  [[QextCav6]] <<SCINOT>>  [[QextCav7]] <<SCINOT>>  [[QextCav8]] <<SCINOT>> |
| 22 | Measure and record the Field Probe Qext Warm for each cavity. | [[QextFPTech]] <<SRF>>  [[QextFPDate]] <<TIMESTAMP>>  [[QextFPComm]] <<COMMENT>>  [[QextFP1]] <<SCINOT>>  [[QextFP2]] <<SCINOT>>  [[QextFP3]] <<SCINOT>>  [[QextFP4]] <<SCINOT>>  [[QextFP5]] <<SCINOT>>  [[QextFP6]] <<SCINOT>>  [[QextFP7]] <<SCINOT>>  [[QextFP8]] <<SCINOT>> |
| 23 | Measure the passband information for each cavity while they are warm and with the vacuum vessel slightly pressureized for shipping.  Upload file of passband information. | [[PassbandTech]] <<SRF>>  [[PassbandDate]] <<TIMESTAMP>>  [[PassbandComm]] <<COMMENT>>  [[PassbandDataWarm]] <<FILEUPLOAD>> |
| 24 | Measure the HOM notch locations for the probe (pu) and coupler (c) HOMs on each cavity.  Record the notch frequency for each HOM to the nearest 0.1 MHz. | [[HOMTech]] <<SRF>>  [[HOMDate]] <<TIMESTAMP>>  [[HOMComm]] <<COMMENT>>  [[Cav1HOMpu]] <<SCINOT>>  [[Cav1HOMc]] <<SCINOT>>  [[Cav2HOMpu]] <<SCINOT>>  [[Cav2HOMc]] <<SCINOT>>  [[Cav3HOMpu]] <<SCINOT>>  [[Cav3HOMc]] <<SCINOT>>  [[Cav4HOMpu]] <<SCINOT>>  [[Cav4HOMc]] <<SCINOT>>  [[Cav5HOMpu]] <<SCINOT>>  [[Cav5HOMc]] <<SCINOT>>  [[Cav6HOMpu]] <<SCINOT>>  [[Cav6HOMc]] <<SCINOT>>  [[Cav7HOMpu]] <<SCINOT>>  [[Cav7HOMc]] <<SCINOT>>  [[Cav8HOMpu]] <<SCINOT>>  [[Cav8HOMc]] <<SCINOT>> |
| 25 | Measure the BPM coupling coefficients with a network analyzer. Upload the values in a file. | [[BPMSRFStaff]] <<SRF>>  [[BPMDate]] <<TIMESTAMP>>  [[BPMComment]] <<COMMENT>>  [[BPMData]] <<FILEUPLOAD>> |
| 26 | Measure the Pi mode resonant frequency on each cavity.  Record the pi mode frequency for each cavity to the nearest 0.1 MHz | [[PiModeTech]] <<SRF>>  [[PiModeDate]] <<TIMESTAMP>>  [[PiModeComm]] <<COMMENT>>  [[Cav1Pi]] <<SCINOT>>  [[Cav2Pi]] <<SCINOT>>  [[Cav3Pi]] <<SCINOT>>  [[Cav4Pi]] <<SCINOT>>  [[Cav5Pi]] <<SCINOT>>  [[Cav6Pi]] <<SCINOT>>  [[Cav7Pi]] <<SCINOT>>  [[Cav8Pi]] <<SCINOT>> |

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| Step No. | Instructions | Data Input |
| 27 | Perform the final instrumentation checks, including the SPQA, LLP's, Heaters, Stepper Motors, Piezo's, and RTD sensors. | [[ElectricalTechnician]] <<SRF>>  [[ElectricalDate]] <<TIMESTAMP>>  [[ElectricalComment]] <<COMMENT>>  [[ElectricalData]] <<FILEUPLOAD>> |
| 29 | 1. Create shipping authorization form <https://misportal.jlab.org/railsForms/shipping_authorizations>  2. Request in the shipping authorization that RADCON is to do a Cryomodule Survey , with reports to go to Shipping (in shipping authorization) - providing a copy of the report to Shipping per Jlab Policies & Procedures  3.SRF Shipping Requestor download a copy of the survey from the shipping authorization form and save as PDF. Then upload a copy of RADCON survey to this traveler. | [[ShipAuthTech]] <<SRF>>  [[ShipAuthDate]] <<TIMESTAMP>>  [[ShipAuthRequest]] <<CHECKBOX>>  [[ShipAuthFormNum]] <<SN>>  [[RADCONTech]] <<SRF>>  [[RADCONDate]] <<TIMESTAMP>>  [[RADCONReport]] <<FILEUPLOAD>>  [[RADCONComments]] <<COMMENT>> |
| 30 | Verify all steps to this point have been completed and that the Cryomodule is ready to be loaded into the shipping frame. | [[CMALead]] <<SRF>>  [[VerifyShipSOTR]] <<SRFCMP>>  [[VerifyShipDate]] <<TIMESTAMP>>  [[VerifyShipComment]] <<COMMENT>> |
| 31 | Using [LCLSII Cryomodule Shipping Procedure](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-290245/L2HE-PR-CMA-CM-SHIP-R2.pdf), load the Cryomodule into the shipping frame. Then onto the truck. Note any anamolies.  Lift plans involved in this activity: [Lift Plan for the 16000lb spreader bar](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280748/16000lb%20spreader%20bar%20lift%20plan.pdf), [Shipping Frame Lift Plan](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-280749/shipping%20frame%20lift%20plan.pdf) | [[LoadTech]] <<SRF>>  [[LoadDate]] <<TIMESTAMP>>  [[LoadComment]] <<COMMENT>> |
| 32 | Verify all steps have been completed and the Cryomodule is ready to leave to dock. Note any changes.  Examples of changes may include Vibration Measurement, Shock Recorders, and Beam Line Vacuum Monitoring. | [[CMASupervisor]] <<SRF>>  [[FinalShipSOTR]] <<SRF>>  [[FinalShipDate]] <<TIMESTAMP>>  [[FinalShipComment]] <<COMMENT>>  [[AdditionalFiles]] <<FILEUPLOAD>> |