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| Traveler Title | ER5C Waveguide Assembly Traveler | | | |
| Traveler Abstract | This traveler outlines the necessary steps and checkpoints to assemble the Waveguide and Tophat assembly for the Linac Cryomodule. It begins with an aligned Helium Vessel inside the Vacuum Vessel and ends with a completed Cryounit. The waveguide installation can be completed in the Cryounit assembly area or on the fixed assembly bench while the Cryomodule is being assembled. All work shall be performed by trained Cryomodule Assembly Technicians only.  ***\*\* Radiological controls are a critical component of the cryomodule rework disassembly and assembly process. Dose rate, as well as contamination surveys (where indium gaskets or seals are present) shall be performed and analyzed, with information communicated to all involved personnel. Results will be recorded at traveler hold points. RW-II training will be required where contamination is identified\*\**** | | | |
| Traveler ID | ER5C-CMACU-WG-ASSY | | | |
| Traveler Revision | R2 | | | |
| Traveler Author | John Fischer | | | |
| Traveler Date | 20-Mar-25 | | | |
| NCR Informative Emails | areilly | | | |
| NCR Dispositioners | fischer,weaksmc | | | |
| D3 Emails | areilly,fischer,weaksmc | | | |
| Approval Names | J. Fischer | J. Campbell | M. Weaks | A. Reilly |
| Approval Signatures |  |  |  |  |
| Approval Dates |  |  |  |  |
| Approval Title | Author/CMA Lead | Technical Reviewer | Project Coodinator | Project Representative |

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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. | | | |
| [11140-0030 Instrumentaion Plate](https://misportal.jlab.org/jlabDocs/documents/versions/7027/download) | [11140-0031 Waveguide Assy](https://misportal.jlab.org/jlabDocs/documents/versions/7028/download) | [JL0064915 Neg Manifold Assy Dwg](https://misportal.jlab.org/jlabDocs/documents/versions/135715/download) | [11141S0033 REVC Large Leak Check Specification](https://misportal.jlab.org/jlabDocs/documents/versions/192250/download) | [11141S0029 REVC-Small Leak Check Specification](https://misportal.jlab.org/jlabDocs/documents/70283/download) |
| [11141-0007 Waveguide Assy](https://misportal.jlab.org/jlabDocs/documents/versions/124299/download) | [11141-0052 Waveguide Instrumentation](https://misportal.jlab.org/jlabDocs/documents/versions/7164/download) | [11141-0075 Waveguide Top View](https://misportal.jlab.org/jlabDocs/documents/versions/7178/download) | [11141-0063 Waveguide Mu Front](https://misportal.jlab.org/jlabDocs/documents/versions/7171/download) | [11141-0049 Waveguide Mu Scallop](https://misportal.jlab.org/jlabDocs/documents/versions/7162/download) |
| [CP-C75-CM-EVAC-NEG-R1](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-239051/CP-C75-CM-EVAC-NEG-R1.pdf) | [CP-C75-CU-RBLD-RTFT](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-239052/CP-C75-CU-RBLD-RTFT-Final.docx) |  |  |  |

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| Revision Note |  |
| R1 | Initial release of this Traveler. |

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| Step No. | Instructions | Data Input |
| 1 | Verify the Vaccum Vessel Traveler is complete. Record the Cryounit serial number. | [[VerifyTech]] <<SRFCMP>>  [[GatherDate]] <<TIMESTAMP>>  [[GatherComment]] <<COMMENT>>  [[CUSN]] <<CUSN>> |
| 2 | Record the waveguide assy serial numbers.  Feedtrhu Flange (INFFSN), Left and Right warm windows (XWINSN), warm window assy's (XWINWSN), and waveguide extensions (XWGDXSN). | [[LeftWGDXSN]] <<WGDXSN>>  [[RightWGDXSN]] <<WGDXSN>>  [[INFFSN]] <<INFFSN>>  [[LeftWINWSN]] <<WINWSN>>  [[RightWINWSN]] <<WINWSN>>  [[LeftWINSN]] <<WINSN>>  [[RightWINSN]] <<WINSN>>  [[SNCMATech]] <<SRF>>  [[SNDate]] <<TIMESTAMP>>  [[SNComment]] <<COMMENT>> |
| 3 | Clean and inspect the feedthrough plate. | [[INSPCMA]] <<SRF>>  [[INSPDate]] <<TIMESTAMP>>  [[INSPComment]] <<COMMENT>> |
| 4 | Install the feedthrough plate onto the assembly fixture. | [[INSTCMA]] <<SRF>>  [[INSTDate]] <<TIMESTAMP>>  [[INSTComment]] <<COMMENT>> |
| 5 | Weld two (2) rotary feedthroughs into the feedthrough plate in accordance with drawing 11140-  D-0030.  Rotary feedthoughs will be reworked using CP-C75-CU-RBLD-RTFT | [[Welder]] <<SRF>>  [[WELDDate]] <<TIMESTAMP>>  [[WELDComment]] <<COMMENT>> |
| 6 | Install helical couplings (Item 29) and telescopic socket (Item 14) onto rotary feedthrough shafts  on helium vessel. Install roll pin (Item 34) as per drawing 11140-E-0031. | [[INSTALLCOUPLINGTech]] <<SRF>>  [[INSTALLCOUPLINGDate]] <<TIMESTAMP>>  [[INSTALLCOUPLINGComment]] <<COMMENT>> |

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| Step No. | Instructions | Data Input |
| 7 | Assemble the Waveguide   1. Visually inspect the components, note any findings. 2. Install pre-tested infrared (IR) detectors onto upper instrumentation ports of warm windows, sapphire windows onto the lower instrumentation ports of warm windows and "N" connectors into 2 ports at center of feedthrough plate.   Electrically check the IR sensors. Fluke meter only  Resistance range to be between >5 K <17 K; outside this range IR should be changed:  \_\_\_\_left IR sensor \_\_\_\_right IR sensor   1. Install the warm window assemblies onto the feedthru plate. Torque fasteners to 70 in/lbs. 2. Install the fundamental waveguides onto the warm window assemblies.    1. Cleanly install indium seals to both ends of the waveguides.    2. Attach the waveguide extension to the rear of the warm window assemblies, be sure to have the waveguide 50k intercept blocks turned outward.   **\*\*\*Note-All indium seals joints require a minimum of 3 torque sequences each at least 8 hours apart.\*\*\***   * 1. Torque to 70 in./lbs. Following the torque pattern.      * 1. Add the C75 Waveguide cooling blocks with indium to each of the Waveguide extensions. Torque to 70 in/lbs a minimum of three times at least 8 hours apart. See below.       Cover all open flanges, pump out ports and waveguide inner flanges with clean aluminum foil. | [[ASSYTech]] <<SRF>>  [[ASSYDate]] <<TIMESTAMP>>  [[ElectricalTech]] <<SRF>>  [[ASSYComment]] <<COMMENT>> |

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| Step No. | Instructions | Data Input |
| 8 | Clean the cavity pair flanges using acetone, isopropyl and lint free wipes.  Install four (4) guide pins in the cavity pair dogleg flange corners. | [[CLEANTech]] <<SRF>>  [[CLEANDate]] <<TIMESTAMP>>  [[CLEANComment]] <<COMMENT>> |
| 9 | Attach the waveguide support fixture to the vacuum vessel top hat flange. | [[SupportTech]] <<SRF>>  [[STComment]] <<COMMENT>> |
| 10 | Install the waveguide assembly onto the cavity pair, utilizing the guide pins for alignment. Bolt  The waveguide to cavity pair by installing 4 belleville spring washers (Item 20) and 1 socket head  Cap screw (SHCS) (Item 21) through the waveguide flange and into the cavity pair flanges.  Belleville washers should be stacked parallel, four per bolt as shown below. | [[WGTech]] <<SRF>>  [[WGDate]] <<TIMESTAMP>>  [[WGComment]] <<COMMENT>> |
| 11 | Remove the four (4) guide pins and install the remaining hardware. Snug bolts in the pattern  Shown then torque bolts to 30 in./lb., 50 in./lb., 70 in./lbs. following the pattern shown above. | [[TorqueTech]] <<SRF>>  [[TTDate]] <<TIMESTAMP>>  [[TTComment]] <<COMMENT>> |
| 12 | Install the waveguide leak-check manifold. Leak-check all connections on waveguide assembly  and dogleg indium joints.  As per Specification #11141S0029.  THIS IS A CRITICAL MEASUREMENT  Use of Critical MTE is required  Record the F-tag (or serial No.) and CAL DUE date of the Critical MTE used:  **Helium Standard Leak Rate** | [[LCTech]] <<SRF>>  [[LCDate]] <<TIMESTAMP>>  [[LCComment]] <<COMMENT>>  [[LCUpload]] <<FILEUPLOAD>>  [[CritLkRateSN]] <<SN>>  [[CritLkRateDueDate]] <<TIMESTAMP>> |

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| Step No. | Instructions | Data Input |
| 13 | Retorque all the waveguide indium seals to 70 in/lbs.  **\*\*\*Note-All indium seals joints require a minimum of 3 torque sequences each at least 8 hours apart.\*\*\*** | [[RTTech]] <<SRF>>  [[RTDate]] <<TIMESTAMP>> |
| 14 | Bolt the copper intercept straps from the 50 K shield to the intercept blocks on the  waveguides, torque to 40 in/lbs, as per drawing 11141-E-0007. | [[StrapTech]] <<SRF>>  [[StrapDate]] <<TIMESTAMP>>  [[StrapComment]] <<COMMENT>> |
| 15 | Connect the helical couplings (Item 29) to the telescopic shafts (Item 31) and to the rotary  feedthroughs on the feedthrough plate with roll pins (Item 34) engaging the telescopic socket  (Item 14) on the helium vessel, as per drawing 11140-C-0031. Ensure that linkages rotate freely. | [[CONNECTCouplingTech]] <<SRF>>  [[CONNECTCouplingDate]] <<TIMESTAMP>>  [[CONNECTCouplingComment]] <<COMMENT>> |
| 16 | Connect the coaxial cables onto the "SMA" type connectors on the He vessel. Connect the  opposite end to the "N" type connectors on the feedthrough plate, as per drawing 11141-D-0052.  Make sure the rubber insert in the coaxial cable is removed. Have an electrical technician perform  T.D.R. test. | [[CAElectricalTech]] <<SRF>>  [[CADate]] <<TIMESTAMP>>  [[CAComment]] <<COMMENT>>  [[CAUpload]] <<FILEUPLOAD>> |
| 17 | Connect the wiring harness and feedthrus from the He vessel to the feedthrough plate as Per  drawing,11141-D-0052. Install the copper instrumentation strap onto the coaxial cables and the  wiring harness. Do not pinch the wires, perform an electrical check on all wiring. \*\*Retain the  plugs in sockets with Kapton tape.\*\* | [[WHElectricalTech]] <<SRF>>  [[WHDate]] <<TIMESTAMP>>  [[WHComment]] <<COMMENT>>  [[WHUpload]] <<FILEUPLOAD>> |
| 18 | Install the waveguide MLI, G10, and Mu metal. As per 11141-C-0076, 11141-D-0075. | [[WGMTech]] <<SRF>>  [[WGMDate]] <<TIMESTAMP>>  [[WGMComment]] <<COMMENT>> |
| 19 | Fit, Weld, then Leak-check the top hat. | [[WGLCTech]] <<SRF>>  [[WGLCDate]] <<TIMESTAMP>>  [[WGLCComment]] <<COMMENT>>  [[WGLCUpload]] <<FILEUPLOAD>> |

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| Step No. | Instructions | Data Input |
| 20 | Perform the final wiring check. | [[FinalElectricalTech]] <<SRF>>  [[FinalDate]] <<TIMESTAMP>>  [[FinalComment]] <<COMMENT>>  [[FinalUpload]] <<FILEUPLOAD>> |
| 21 | Install the Tophat. | [[THTech]] <<SRF>>  [[THDate]] <<TIMESTAMP>>  [[THComment]] <<COMMENT>> |
| 22 | Install the NEG manifold assemblies and leak check using Specification 11141S0029 Rev C.  THIS IS A CRITICAL MEASUREMENT  Use of Critical MTE is required  Record the F-tag (or serial No.) and CAL DUE date of the Critical MTE used:  **Helium Standard Leak Rate** | [[NEGTech]] <<SRF>>  [[NEGDate]] <<TIMESTAMP>>  [[NEGComment]] <<COMMENT>>  [[NEGLCLeftUpload]] <<FILEUPLOAD>>  [[NEGLCRightUpload]] <<FILEUPLOAD>>  [[CritLkRateSN]] <<SN>>  [[CritLkRateDueDate]] <<TIMESTAMP>> |
| 23 | When pressure in the manifold is at 1 x 10^-6 torr, activate the NEG pump, then start the ion  pump. Follow the attached Procedure. [CP-C75-CM-EVAC-NEG-R1](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-239051/CP-C75-CM-EVAC-NEG-R1.pdf) | [[ACTTech]] <<SRF>>  [[ACTDate]] <<TIMESTAMP>>  [[ACTUpload]] <<FILEUPLOAD>> |
| 24 | Upload any Magnetic Hygiene notes or Activity Log information if required. | [[MagHygTech]] <<SRFCMP>>  [[MHDate]] <<TIMESTAMP>>  [[MHComment]] <<COMMENT>>  [[MHUpload]] <<FILEUPLOAD>> |
| 25 | ENSURE THAT ALL STEPS HAVE BEEN COMPLETED.  READY FOR SHIPMENT TO CRYOMODULE AREA. | [[EnsureTech]] <<SRF>>  [[EnsureDate]] <<TIMESTAMP>>  [[EnsureComment]] <<COMMENT>> |
| 26 | Hold-point for supervisor's inspection | [[Supervisor]] <<SRF>>  [[HLDPTDate]] <<TIMESTAMP>>  [[HLDPTComment]] <<COMMENT>> |