



IDENTIFICATION INSTALLSEQ LIGO-E950049-03-B			
TITLE	BEAM TUBE CAN SECTION INSTALLATION SEQUENCE	REFERENCE NO. 930212	SHT 1 OF 11
		OFFICE RCE	REVISION 3
PRODUCT	LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY	MADE BY GLW	CHKD BY KHF
		MADE BY WLR	CHKD BY SDH
		DATE 2/1/94	DATE 4/5/94
		DATE 8/14/95	DATE 10/23/95

1.0 Scope

This procedure outlines the installation sequences to be followed during the installation of the beam tube can sections.

Detail or supporting procedures for welding, cleaning, testing, alignment, etc. are referenced as required. See paragraph 3.0 for listing.

2.0 Installation Sequence

2.1 Deliver beam tube can section to installation site. The sun shield shall cover the beam tube while in temporary storage, transit or installation until permanent covers are installed.

See the "Beam Tube Can Section Fabrication Sequence" procedure (Doc ID "FabSeq") for the specific sequences and procedures that are followed during the fabrication sequence.

The beam tubes are delivered to the installation site in a tested and internally cleaned condition with sealed end caps installed on both ends. The expansion bellows are restrained and blind flanges are installed on pump port nozzles.

Limit contamination of the Beam Tube Module inner surfaces during installation

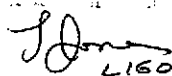

Reference

See

"Contamination Control for Construction
Activities During Beam Tube Installation"

Doc ID "CCP-1"

Additionally, the previously installed beam tube can sections are maintained under a positive clean air flow.

APPROVED
 11/10/95
 11/10/95



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Reference

See

"Positive Blower/Dryer/Filtration System
Installation & Maintenance"

Doc ID "BDF1"

*Follow Cleaning Sequences detailed in
LIGO Procedure CCP-1.*

- 2.2 Move or roll clean room and associated equipment forward allowing sufficient room to position weld shelter and set beam tube can section into position.
- 2.3 Position the Weld Shelter beyond the end of the completed beam tube section.
- 2.4 Following preparation and checkout of the Weld Shelter per Step 1 of CCP-1, move the Weld Shelter over the end of the existing beam tube section, so the end projects into the Ante Room of the Weld Shelter.
- 2.5 Following preparation of the existing beam tube end per Step 2 of CCP-1, move the Weld Shelter further over the existing beam tube section until the end is in the Fit-Up Room.
- 2.6 Position the next beam tube section near the Weld Shelter on temporary, adjustable supports located clear of the contract structural support areas.
- 2.7 Following inspection of the new beam tube section end and protective bag, move the beam tube section forward until the end is in the Weld Shelter Ante Room.
- 2.8 After preparation of the beam tube end per Step 5 of CCP-1, move the beam tube further forward until the end is in the Fit-Up Room and approximately 8 inches from the existing beam tube end, allowing sufficient clearance for removal of the end caps.
- 2.9 Remove end caps and seal protection at weld joint to be made and position beam tube can section to existing beam tube can section. Do not remove the internal tube access plug from the previously installed beam tube can section.



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2.10 Start aligning weld joint using special CBI fitup clamp. See drawing ER45 for details of the fitup clamp.

Warning

**Do not perform any welding
or tacking at this time.**

Reference

See

**"Fitting/Purge Procedure for
Circumferential Butt Welds
for LIGO"**

Doc ID "FPCircumferential"

2.11 Align beam tube can section centerline and elevation to the previously installed alignment reference pads.

Reference

See

**"Initial and Final Alignment During
Installation of LIGO Beam
Tube Modules using GPS System"**

Doc ID "ALI-1"

2.12 Remove polyethylene secondary seal from end of beam tube can section at clean room end. This procedure is defined in LIGO procedure CCP-1.

2.13 Move or roll clean room into position at beam tube can section end and make seal connections to beam tube end. This procedure is defined in LIGO procedure CCP-1.



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Reference

See

"Clean Room Transporting,
Storage and Maintenance Procedure"

Doc ID "CRTSM"

for specific safety precautions and
procedures to be adhered to within
the clean room and beam tube.

- 2.14 Remove end cap from end of beam tube can section now inside clean room. Personnel entering the clean room and tube shall meet the conditions and clothing requirements of CRWA-1.
- 2.15 Verify positive air flow exists and verify safe entry is feasible. Complete required checks and records for non permit confined space entry.
- 2.16 Install inflatable purge ring, centered on weld joint, and connect 3/8" diameter stainless steel purge/evacuation lines listed below:
 - a) Annular space evacuation/vent line (weld purge gas and helium test gas).
 - b) Inflatable seal pressure line (nitrogen ring seal gas).
 - c) Annular space pressure/purge line (weld purge gas and helium test gas).
- 2.17 Inflate the inflatable purge ring outer seals by opening valves # V1 & V2 on nitrogen inflatable seal gas supply holding inflatable purge ring in position centered on the beam tube weld joint to be welded. Regulator should be set at 5 psig.
- 2.18 Open evacuation line valve # V4 and annular space pressure line valves #V5 & V7 allowing 100% Argon backing purge gas to purge annular space. Purge until oxygen level is less than 1.0% oxygen. End point to be verified with oxygen analyzer. Upon reaching 1.0% oxygen, establish Argon flow rate at a minimum value (light positive flow) to maintain less than 1.0% oxygen.



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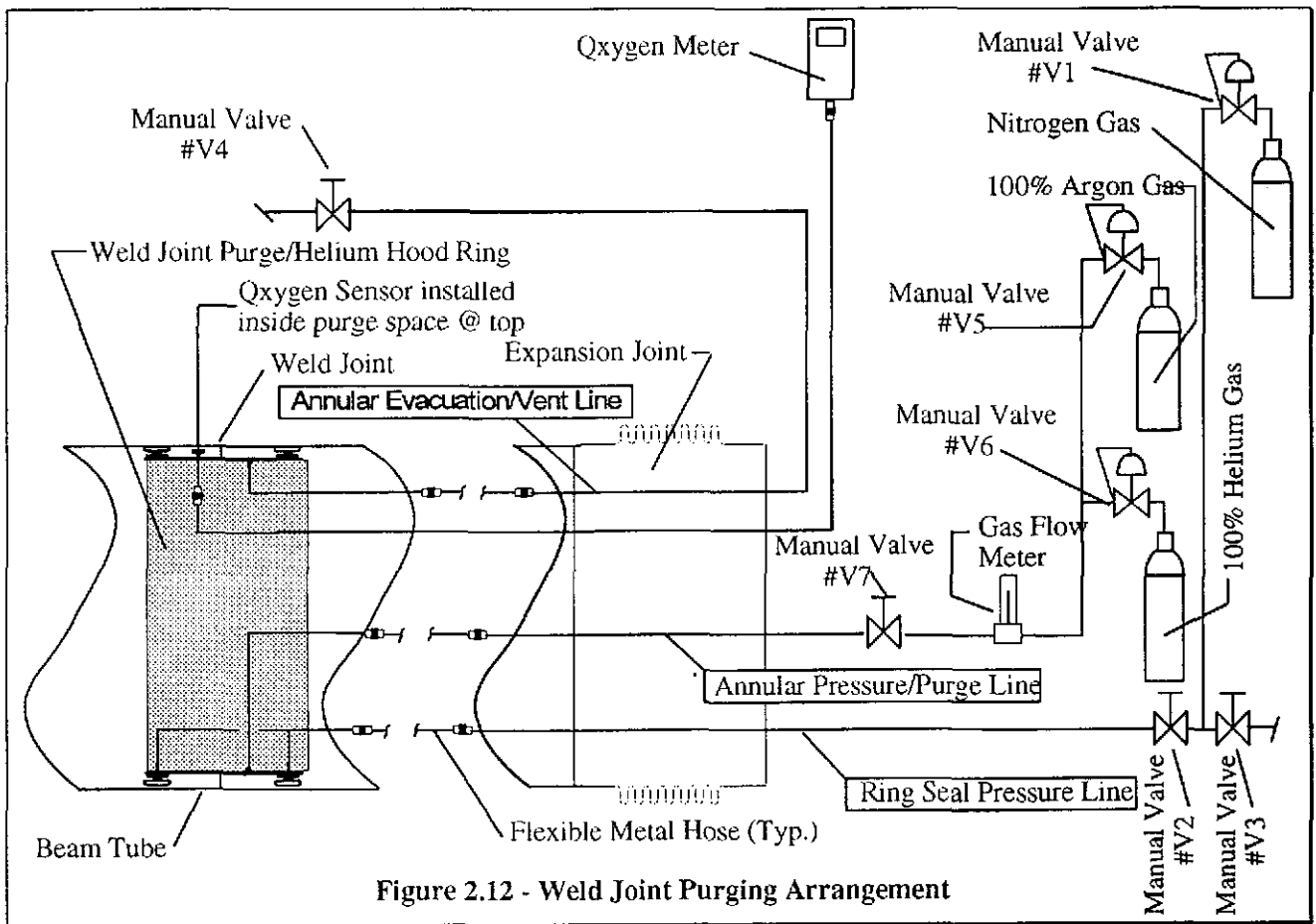


Figure 2.12 - Weld Joint Purging Arrangement

Warning

Welding or tack welding at weld joint to be only performed after completion of the above weld purge.

2.19 Complete fit up of weld joint. Tack welding is allowed at this step.



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Reference

See

"Welding Procedure Specification
for Circumferential Welds"

Doc ID "WPS-ER308L/Circ".

- 2.20 Set up and position automatic weld equipment and complete welding of beam tube weld joint.
- 2.21 Shut valves # V7 & V5 on annular space pressure/purge line from 100% Argon weld purge gas.
- 2.22 Shut valve # V4 on annular space evacuation line.
- 2.23 Close valve # V1 on nitrogen supply regulator. Open inflatable purge ring outer seal vent valve # V3 and deflate purge ring outer seals. Verify positive air flow exists and verify safe entry is feasible. Close both evacuation valves # V2 & V3 associated with purge ring outer seals after venting stops and weld joint purge ring has slackened. Complete required checks and records for non permit confined space entry. Personnel entering the beam tube shall meet the conditions and clothing requirements of LIGO Procedure, CRWA-1. Enter tube and move inflatable purge ring to clear closing weld joint.
- 2.24 Visually inspect closing weld joint.
- 2.25 If visual inspection is acceptable skip step 2.26 and proceed with step 2.27.
- 2.26 If there are to be any welded repairs, use WPS-ER308L/REPAIR. If there are to be any repairs not requiring welding, use repair procedure GR8X. Repairs shall be made under the following conditions to prevent contamination of the tube interior.
 - Any grinding or chipping shall be performed in clean containment glove box.
 - The glove box interior and exposed tube wall shall be vacuumed in place prior to removal from the tube. The vacuum shall vent outside the clean room or must be compatible with the clean room.
 - Grinding shall be done with a portable grinder inside the glove box.



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- Weld repairs shall be made with a portable 110 volt GTAW (TIG) Power source (Maxstar 91 or equal)
- Clean the repair area per procedure CL3N.

2.27 Move inflatable purge ring over closing weld joint. Inflate the inflatable purge ring outer seals by opening valves # V1 & V2 on nitrogen inflatable seal gas supply holding inflatable purge ring in position centered on the beam tube weld joint to be leak tested. Inflatable ring regulator should be set at 5 psig. Refer to Leak testing procedure "HMST2N" for helium flow requirements.

2.28 Install helium mass spectrometer vacuum cover and test beam tube weld joint.

Reference

See

"Helium Mass Spectrometer Hood Testing
of Closing Weld Joints Between Beam
Tube Can Sections"

Doc ID "HMST2N"

2.29 If leak is detected, vent, repair and retest in accordance with the applicable steps of procedure HMST2N.

2.30 Remove helium mass spectrometer vacuum cover from weld joint exterior.

2.31 Shut helium test gas and nitrogen ring seal gas supply valves # V6 & V7.

2.32 Close valve # V1 on the nitrogen supply regulator. Open inflatable purge ring outer seal vent valve # V3.

2.33 Close valves # V2, V3, & V4 associated with annular space evacuation line and purge ring outer seals after venting stops and weld joint purge ring has slackened.

2.34 Disconnect and remove the three (3) stainless steel purge/evacuation lines.



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- 2.35 Remove inflatable purge ring.
- 2.36 Steps 2.37 thru 2.39 are for installation and testing of valve at the pump port. Skip if not applicable to specific beam tube can section.
- 2.37 Locally clean area associated with pump port.
- 2.38 Remove pump port blind flange and install valve with blind flange.

Reference

See

**"Helium Mass Spectrometer Hood Test
of Valve and Blind Flange Seals to Pump Ports"**

Doc ID "HMST3N"

- 2.39 Perform helium mass spectrometer test of installed valve and blind flange.
- 2.40 Remove tube access plug from end of previously installed beam tube.
- 2.41 Inspect and clean beam tube interior as workman "backs out" of beam tube from completed weld joint.

Reference

See

**"Final Cleaning and Inspection of
Beam Tube Module Inner Surfaces "**

Doc ID "CL3N"

- 2.42 Perform initial alignment during construction and installation of beam tube section per procedure ALI-1.
- 2.43 Install tube access plug 8" from clean room end of just installed beam tube immediately upon completion of cleaning, baffle installation and exit from clean room end of beam tube.



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2.44 Install clean room end cap and secure in position with band.

2.45 At this point installation is complete and next beam tube installation may be started.

Note

**Do not move clean room from end
of installed beam tube until just
prior to installation of next beam tube.**

2.46 Install contract structural support on proceeding beam tube section after rolling equipment has been moved forward of structural support point.

2.47 Remove the temporary adjustable supports.

2.48 Remove expansion bellows restraints (if applicable) after contract structural supports have been installed and prior to verification of alignment using the preliminary alignment pads.

2.49 Grout contract structural supports. Grouting can be left until a number of supports can be grouted at one time.

3.0 Referenced Procedures and Specifications

This installation sequence is to be used in conjunction with the following procedures and/or specifications:

3.1 Blower-Dryer Filtration System Operation and Maintenance
Doc ID "BDF1"

3.2 Initial and Final Alignment During Construction and Installation of Beam Tube Modules using GPS System
Doc ID "ALI-1"

3.3 Planned Approach to Leak Testing for LIGO Project
Doc ID "LIGOTP"



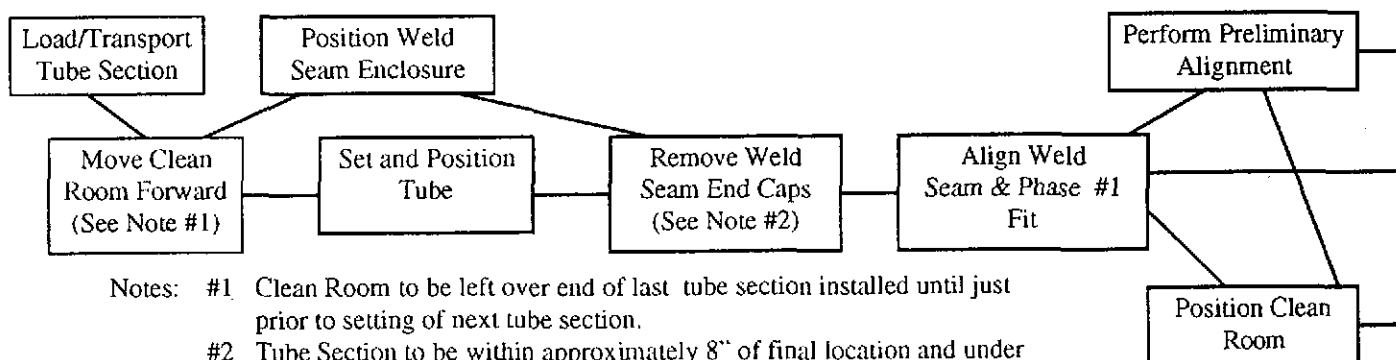
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- 3.4 Helium Mass Spectrometer Hood Test of Closing Weld Joints Between Beam Tube Cans
Doc ID "HMST2N"
- 3.5 Helium Mass Spectrometer Hood Test of Valve and Blind Flange Seals to Pump Ports
Doc ID "HMST3N"
- 3.6 Cleanroom Transporting, Storage and Maintenance Procedure
Doc ID "CR1TSM"
- 3.7 Final Cleaning and Inspection of Internal Surfaces Including Baffles
Doc ID "CL3N"
- 3.8 Fitting/Purge Procedure for Circumferential Butt Welds for LIGO
Doc ID "FPCIRCUMFERENTIAL"
- 3.9 Welding Procedure Specification for Circumferential Welds
Doc ID "WPS-ER308L/CIRC"
- 3.10 Contamination Control for Construction Activities During Beam Tube Installation
Doc ID "CCP-1"

4.0 Beam Tube Can Section Installation Sequence Diagram

See Figures 4.1A through 4.1C for the "Beam Tube Can Section Installation Sequence Diagram".



- Notes: #1 Clean Room to be left over end of last tube section installed until just prior to setting of next tube section.
 #2 Tube Section to be within approximately 8" of final location and under weld seam enclosure prior to removal of end caps.

Figure 4.1A - Beam Tube Can Section Installation Sequence Diagram



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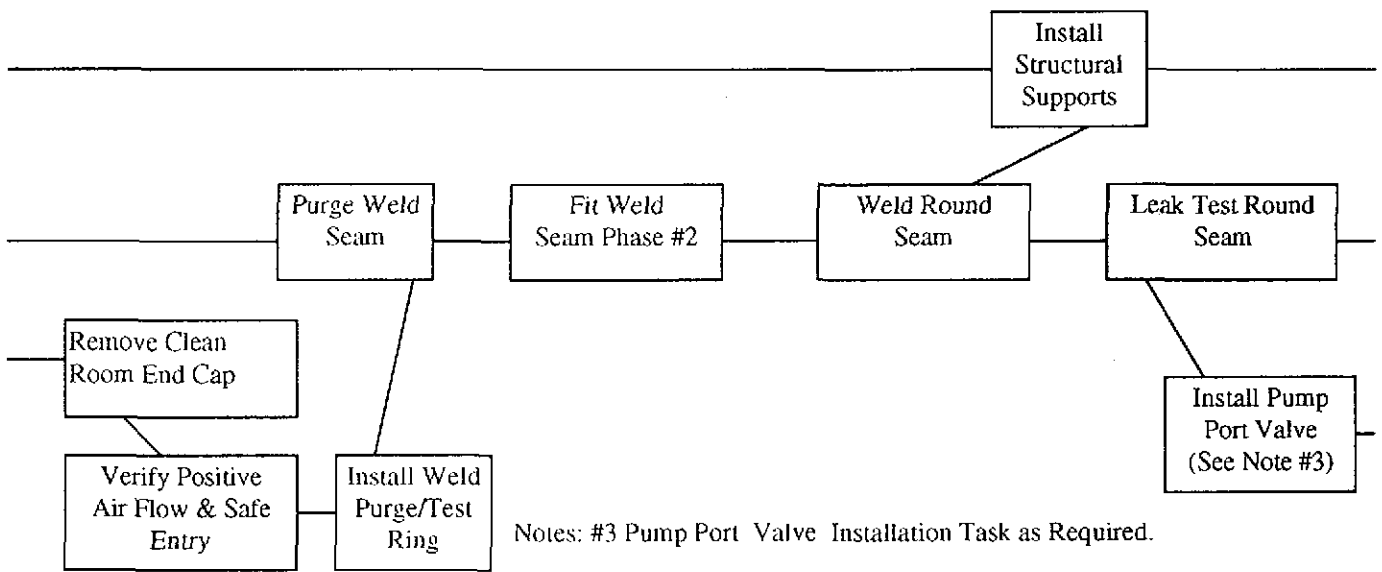


Figure 4.1B - Continuation of the Beam Tube Can Section Installation Sequence Diagram

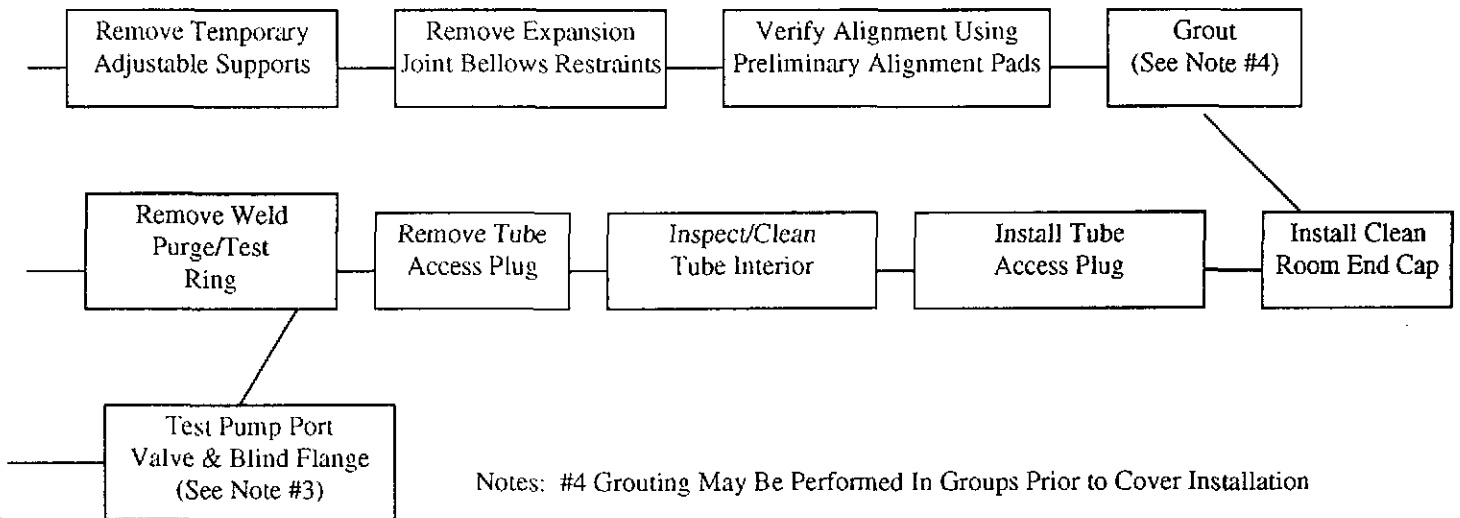


Figure 4.1C - Continuation of the Beam Tube Can Section Installation Sequence