



TITLE BEAM TUBE CAN SECTION INSTALLATION SEQUENCE		IDENTIFICATION INSTALLSEQ			
		REFERENCE NO. 930212		SHT 1 OF 10	
PRODUCT LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		OFFICE RCE		REVISION 2	
		MADE BY GLW	CHKD BY KHF	MADE BY SWP	CHKD BY WLR
		DATE 2/1/94	DATE 4/5/94	DATE 5/2/95	DATE

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.

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.

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

Reference

See

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

Doc ID "BDF1"

- 2.2 Move or roll clean room and associated equipment forward allowing sufficient room to set beam tube can section into position.
- 2.3 Set beam tube can section on temporary adjustable supports located clear of the contract structural support areas. Position beam tube can section approximately eight (8) inches from end of previously installed beam tube can section allowing sufficient end clearance to remove the two adjoining end caps.



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- 2.4 Move or roll weld enclosure over open joint.
- 2.5 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.
- 2.6 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"

- 2.7 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"

- 2.8 Remove polyethylene secondary seal from end of beam tube can section at clean room end.



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2.9 Move or roll clean room into position at beam tube can section end and make seal connections to beam tube end.

Reference

See

"Clean Room Transporting,
Storage and Maintenance Instructions"
Doc ID "CRITSM"

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

- 2.10 Remove end cap from end of beam tube can section now inside clean room.
- 2.11 Verify positive air flow exists and verify safe entry is feasible. Complete required checks and records for non permit confined space entry.
- 2.12 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).

See sketch 1, "Weld Joint Purging Arrangement", in this installation sequence.

- 2.13 Inflate the inflatable purge ring outer seals by opening valve 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.



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2.14 Open evacuation line valve and annular space pressure line valve 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.

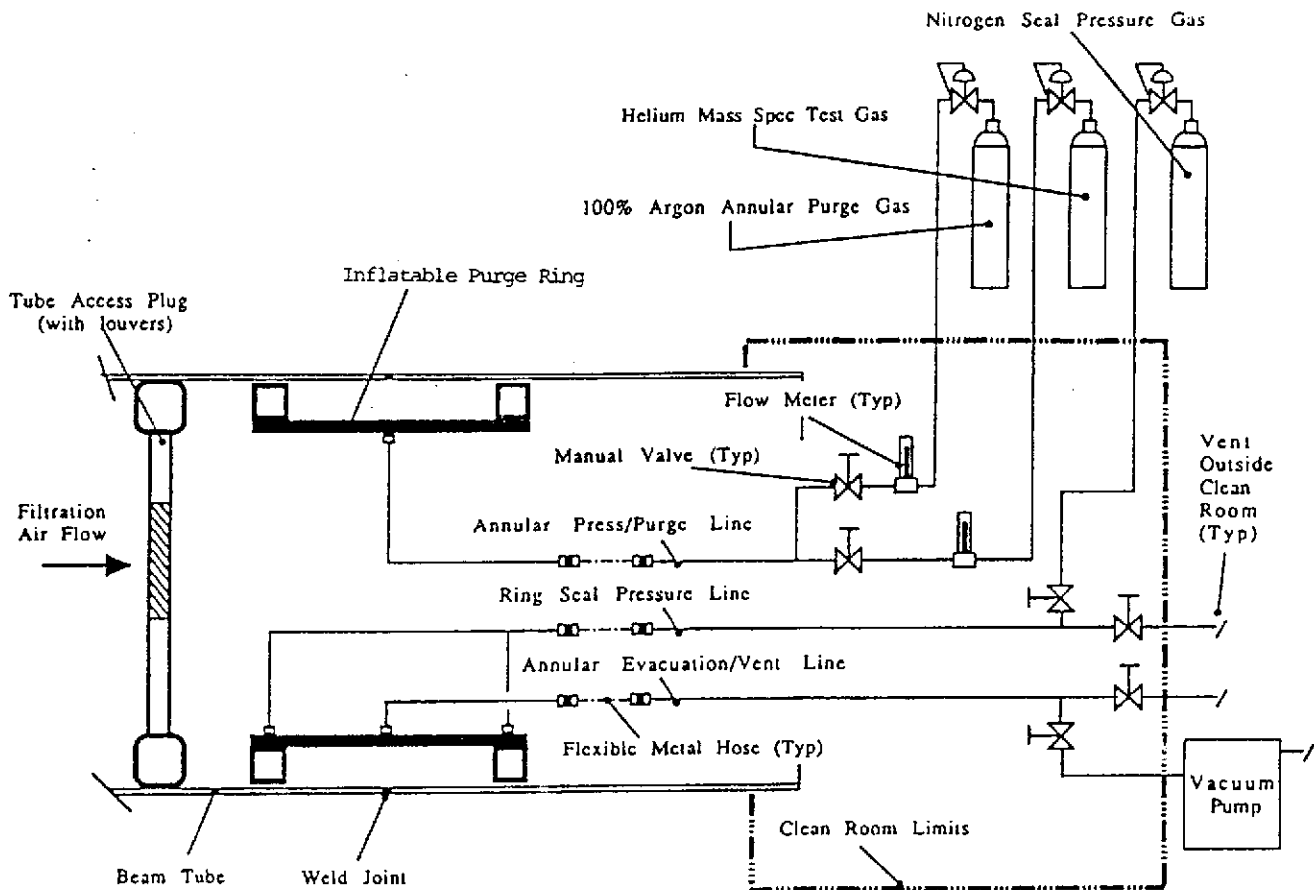


Figure 2.1 - Weld Joint Purging Arrangement

Warning

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



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

Reference

See

"Welding Procedure Specification
for Circumferential Welds"
Doc ID "WPS-ER308L/Circ".

2.16 Set up and position automatic weld equipment and complete welding of beam tube weld joint.

Reference

See

"Welding Procedure Specification
for Circumferential Welds"
Doc ID "WPS-ER308L/Circ".

2.17 Visually inspect closing weld joint.

2.18 Shut valve on annular space pressure/purge line from 100% Argon weld purge gas.

2.19 Shut valve on annular space evacuation line.

2.20 Evacuate annular space using vacuum pump to 29.9" Hg.

2.21 Immediately close vacuum pump valve and open valve to helium test gas. Flow helium for 5 mins at flow rate of 100 cfh (approximately four volumes or until the helium gas returns the annular space to atmospheric pressure) Then reduce flow maintaining helium test gas flow at 10-15 cfh (light positive flow) or just enough to maintain a positive outward flow of helium at the inflated seals.

2.22 Move or roll weld enclosure forward a minimum of 10 feet.

2.23 Move test enclosure forward and position over just completed beam tube weld joint.



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2.24 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"

- 2.25 If leak is detected, vent, repair and retest in accordance with the applicable steps of procedure HMST2N.
- 2.26 Remove helium mass spectrometer vacuum cover from weld joint exterior.
- 2.27 Shut helium test gas and nitrogen ring seal gas supply.
- 2.28 Open inflatable purge ring outer seal vent valve.
- 2.29 Close both evacuation valves associated with annular space evacuation line and purge ring outer seals after venting stops and weld joint purge ring has slackened.
- 2.30 Disconnect and remove the three (3) 3/8" diameter stainless steel purge/evacuation lines.
- 2.31 Remove inflatable purge ring.
- 2.32 Steps 2.33 thru 2.35 are for installation and testing of valve at the pump port. Skip if not applicable to specific beam tube can section.
- 2.33 Locally clean area associated with pump port.
- 2.34 Remove pump port blind flange and install valve with blind flange.



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Reference

See

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

Doc ID "HMST3N"

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

Reference

See

"Final Cleaning and Inspection of
Internal Surfaces Including Baffles"

Doc ID "CL3N"

Also during "back out" step install internal baffles as required per contract drawings for the respective beam tube.

- 2.38 Perform dimensional check information and complete records on beam tube can sections at support locations and installed baffles.
- 2.39 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.
- 2.40 Install clean room end cap and secure in position with band.
- 2.41 At this point installation is complete and next beam tube installation may be started.



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Note

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

- 2.42 Install contract structural support on proceeding beam tube section after rolling equipment has been moved forward of structural support point.
- 2.43 Remove the temporary adjustable supports.
- 2.44 Remove expansion bellows restraints (if applicable) after contract structural supports have been installed and prior to verification of alignment using the preliminary alignment pads.
- 2.45 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"
- 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"



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- 3.6 Cleanroom Transporting, Storage and Maintenance
Doc ID "CRITSM"
- 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 "FPCirc"
- 3.9 Welding Procedure Specification for Circumferential Welds
Doc ID "WPS-ER308L/Circ"

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".

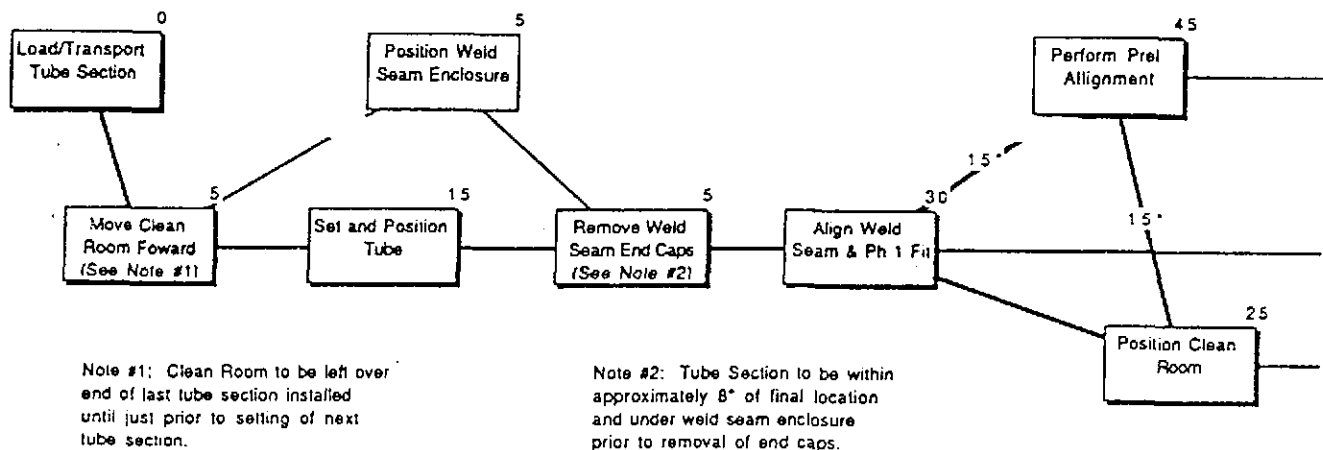


Figure 4.1A - Beam Tube Can Section Installation Sequence Diagram



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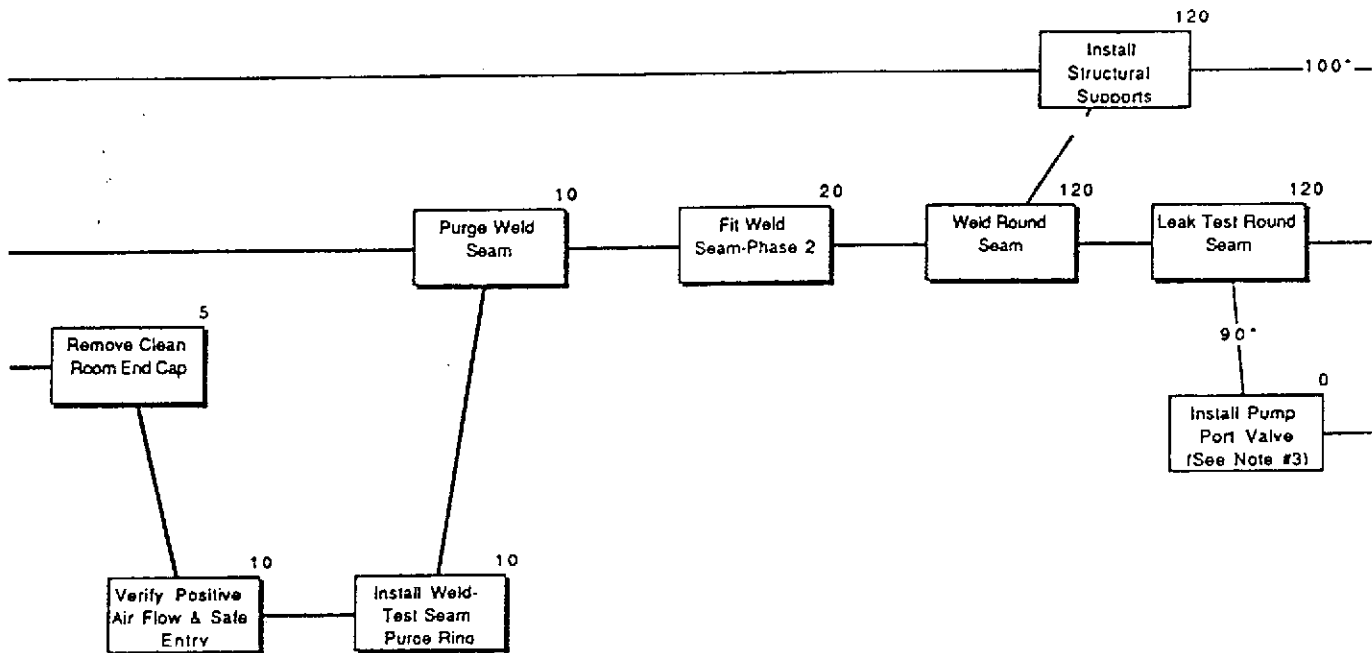
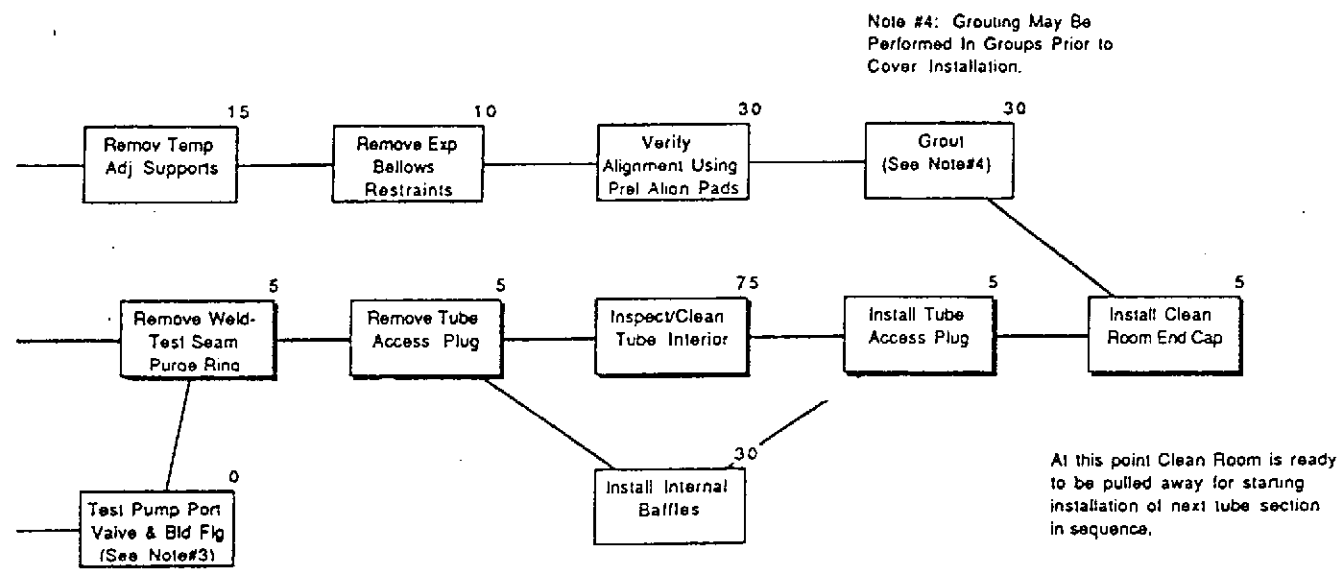


Figure 4.1B - Continuation of the Beam Tube Can Section Installation Sequence Diagram



Note #3: Installation Tasks as Required. Duration for Pump Port Valve Installation and Test Not Shown for Typical Sequence Presented.

Estimated Total Duration is 7 hours 50 minutes

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