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TITLE ADJUSTMENT OF FIXED AND GUIDED SUPPORTS		IDENTIFICATION SUP-ADJUST LIGO-E980336-03-B			
		REFERENCE NO. 953570		SHT 1 OF 7	
PRODUCT LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		OFFICE LIGO		REVISION 3	
		MADE BY MLT	CHKD BY DTR	MADE BY MLT	CHKD BY GPB
		DATE 3/7/96	DATE 3/11/96	DATE 10/7/98	DATE 11/4/98

APPROVED

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DATE

LIGO

1.0 SCOPE:

This procedure describes the steps required to adjust the fixed and guided supports to the positions determined by the appropriate alignment procedure. Interior fixed and guided supports may be adjusted with the beam tube at vacuum. The beam tube termination supports can not be adjusted when subjected to a vacuum induced axial loading, additionally, adjustment of the termination supports affects the module valve and vacuum equipment. Prior to adjusting a termination support verify that a differential pressure does not exist across the valve and that the movement will not adversely affect the module valve and vacuum equipment.

2.0 EQUIPMENT AND MATERIALS

The following equipment and materials are required to adjust the fixed and flexible supports.

Tools and Equipment needed for adjusting Fixed Supports

- 1- 8 ton hydraulic jack
- 1- 1/2" X 10" carbon steel plate (jack base plate)
- 4- 1/2" Dia. X 8" long round stock rollers (under jack plate)
- 1- 10,000 psi porta-power pump w/ 9" ram
- 2- 1-5/8" open end wrench w/ 3ft. extension
- 2- 1-5/8" combination wrench
- 1- calibrated height gage

Tools and Equipment needed for adjusting Guided Supports

- 1- Hydraulic cable tensioner consisting of:
 - 1- 4 port manifold w/ independent valves and gauges (hoses to each ram)
 - 4- 2" x .920 sq. in. hydraulic rams
 - 4- 1-1/4" nut rotator
 - 4- 3/4" X 10 threaded ram sleeve
 - 4- 7/8" nut rotator
 - 4- 1/2" threaded ram sleeve
 - 2- 1/4" X 8" long round stock adjusting rods for nut rotator
- 2- 5 ton hydraulic floor jack w/saddle to support tube



		IDENTIFICATION SUP-ADJUST			
TITLE	ADJUSTMENT OF FIXED AND GUIDED SUPPORTS	REFERENCE NO. 953570		SHT	2 OF 7
		OFFICE LIGO		REVISION 3	
PRODUCT	LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY	MADE BY MLT	CHKD BY DTR	MADE BY MLT	CHKD BY GPB
		DATE 3/7/96	DATE 3/11/96	DATE 10/7/98	DATE 11/4/98

- 4- 7/8" combination wrench (horiz. cables and base plates)
- 4- 1-1/4" combination wrench (vert. cables)
- 4- 8" vise-grip (holding cables)
- 2- Turnbuckles 10" to 18" (or ratcheting load binders)
- 2- 10" Torpedo level (leveling horiz. cables)
- 1- 10,000 psi Porta-Power pump (hose to manifold)
- 2- 4 ft. pry bars

Tools and Equipment needed for adjusting Termination Supports

- 2- 8 ton hydraulic jack
- 2- L6 x 6 x 3/8 x 18" long
- 2- 1-13/16" combination wrench
- 2- 1-5/8" combination wrench
- 1- 2" combination wrench
- 2- dial indicator gauge

3.0 PROCEDURE FOR FIXED SUPPORT ADJUSTMENT

- 3.1 Position a 8 ton jack beneath the centerline of the beam tube near the junction of the longitudinal stiffener (Pc Mk 7-1 or 7-3) and the horizontal transfer lug (Pc Mk 7-2 or 7-10). Place the jack base plate on the round stock with it oriented to allow lateral movement.
- 3.2 Raise the jack to just contact the stiffener. Gradually increase the jack pressure until the jack supports the beam tube.
- 3.3 Slowly loosen the 1" diameter bolts holding the clamping plates to allow movement of the cross beam (assembly Pc Mk 6-A or 6-C). Loosen the bolts by slightly loosening on each side until the clamping force is removed. Tap the end of the cross beam with a 4 pound hammer periodically as the bolts are being loosened to break the clamping surfaces as the bolt load is removed. Clamping bolts should remain snug at all times.
- 3.4 Once the tubular cross beam is free to move, raise or lower the jack to position the beam tube at the desired elevation.



TITLE ADJUSTMENT OF FIXED AND GUIDED SUPPORTS		IDENTIFICATION SUP-ADJUST			
		REFERENCE NO. 953570		SHT 3 OF 7	
PRODUCT LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		OFFICE LIGO		REVISION 3	
		MADE BY MLT	CHKD BY DTR	MADE BY MLT	CHKD BY GPB
		DATE 3/7/96	DATE 3/11/96	DATE 10/7/98	DATE 11/4/98

WARNING: The vertical jacking adjustment should not exceed one inch. If greater than one inch is necessary, the fixed support adjustment should be made in steps with the adjacent guided supports.

- 3.5 For lateral adjustment, position the jacking cylinder of the Porta-Power between the support lug assembly (Pc Mk 8-A or 8-B) and the horizontal transfer lug (Pc Mk 7-2 or 7-10) on the side away from the direction the beam tube needs to move. Jack the beam tube to the desired lateral position.
- 3.6 Once the beam tube has been moved to its desired position, tighten the 1" diameter clamping bolts to secure the cross beam to the support brackets. Tighten the bolts using the turn of the nut method per AISC as described on CBI drawing 8, sheet 1, note 4.
- 3.7 Relieve the jacking pressure and remove the 8 ton jack and the Porta-Power jacking cylinder.

4.0 PROCEDURE FOR GUIDED SUPPORT ADJUSTMENT

- 4.1 Position two floor jacks beneath the centerline of the beam tube, one on each side of the guided support frame centered between the support stiffener ring and the adjacent vacuum stiffener ring. Orient the jacks so the wheels allow lateral movement of the beam tube.
- 4.2 Raise both floor jacks to make firm contact with the beam tube. Do not take the entire weight of the beam tube on the jacks at this time. Loosen the vertical cables by loosening the 3/4" diameter nuts at the top of the cable. Allow the beam tube to rest on the jacks.
- 4.3 Raise or lower the beam tube to the required elevation using the floor jacks. Care must be taken to raise both jacks uniformly to prevent imposing an offset at the expansion joint. During the jacking process, keep the lateral cables horizontal by moving the cable gusset plate (Pc Mk 19-7) up or down with the beam tube by tapping on it with a hammer.

WARNING: The vertical jacking adjustment should not exceed one inch. If greater than one inch is necessary, the guided support adjustment should be made in steps with the adjacent fixed supports.

- 4.4 Once the beam tube is at the desired elevation, set up the hydraulic cable tensioner as shown in Fig 4.1 and confirm that all manifold isolation valves are open. Use the tensioner to evenly apply tension to each cable until the weight of the beam tube is just taken on the



TITLE ADJUSTMENT OF FIXED AND GUIDED SUPPORTS		IDENTIFICATION SUP-ADJUST			
		REFERENCE NO. 953570		SHT 4 OF 7	
PRODUCT LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		OFFICE LIGO		REVISION 3	
		MADE BY MLT	CHKD BY DTR	MADE BY MLT	CHKD BY GPB
		DATE 3/7/96	DATE 3/11/96	DATE 10/7/98	DATE 11/4/98

cables. During the cable tensioning, make sure that the insulating grommets at both ends of each cable are seated properly and not damaged.

- 4.5 Once the weight of the beam tube is on the vertical cables, slowly lower the two floor jacks. The elevation of the beam tube should not move at this time. If movement is detected, raise the beam tube to the proper elevation with the hydraulic tensioner.
- 4.6 With the beam tube at the desired elevation, lock the vertical cables by tightening the 3/4" diameter nuts at the top of the cables using the nut rotator. Remove the hydraulic cable tensioner assembly from each vertical cable. The beam tube elevation should not change at this time. If movement is detected, raise the beam tube back to the desired elevation by turning each of the 3/4" diameter nuts an equal amount, not exceeding 1/2 turn at a time.
- 4.7 Install and snug the locking nut against the 3/4" diameter cable nut.
- 4.8 Attach the turnbuckles or load binders to the lugs (Pc Mk 19-24) on the frame column (Pc Mk 19-1) and base plate (Pc Mk 19-23) on each side of the beam tube. Tighten the turnbuckles or load binders until they are "snug".
- 4.9 After the beam tube elevation has been set, and the lateral position has secured, loosen the 1/2" diameter nuts on the clamping anchors (Pc Mk 19-6) which hold the 4" X 4" cross frame members in place. The clamping nuts should be snug at all times. The nuts holding the base plate should remain tight at all times and should not be loosened during adjustment of the guided support/beam tube position.

Note: Lateral adjustment of the beam tube position per the following steps does not require loosening and retensioning of the horizontal cables. The tension has been set previously. The guided support frame/horizontal cables are holding the beam tube in position laterally. The tension in the cables will vary from one side of the beam tube to the other depending on which direction the beam tube is trying to move. Loosening and retensioning the horizontal cables will create lateral movement in the beam tube. If, for some reason, the horizontal cables need to be loosened and/or retensioned using the hydraulic tensioner, the lateral adjustment of the beam tube **must** be completed after the tensioning of the horizontal cables.

- 4.10 Move the guided support frame/beam tube laterally until the beam tube is in the desired position by adjusting the turnbuckles or load binders. Move each side of the guided support frame equally to keep from imposing an offset at the expansion joint and to maintain the support frame symmetrical to the beam tube.



TITLE ADJUSTMENT OF FIXED AND GUIDED SUPPORTS		IDENTIFICATION SUP-ADJUST			
		REFERENCE NO. 953570		SHT 5 OF 7	
PRODUCT LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		OFFICE LIGO		REVISION 3	
		MADE BY MLT	CHKD BY DTR	MADE BY MLT	CHKD BY GPB
		DATE 3/7/96	DATE 3/11/96	DATE 10/7/98	DATE 11/4/98

- 4.11 Once the guided support frame/beam tube is in the proper position, clamp the frame in place by tightening the 1/2" diameter nuts onto the clamping anchor bar (Pc Mk 19-6) in accordance with CBI drawing 19, sheet 1, note 5.
- 4.12 After verifying that the beam tube is in the desired position, and checking that the guided support frame is oriented to the beam tube and all cables are positioned properly and all nuts/bolts are tight, remove the jacks and the turnbuckles/load binders.

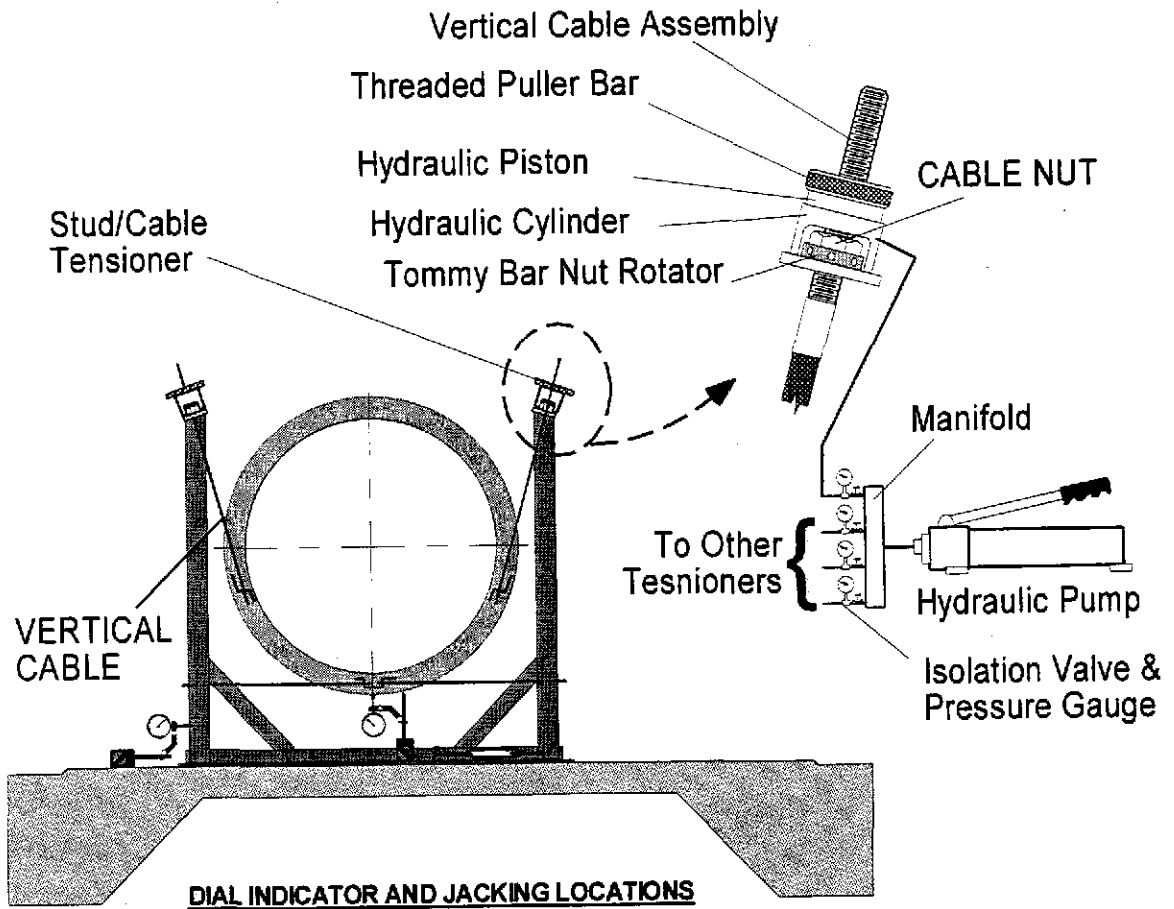


FIGURE 4.1



		IDENTIFICATION SUP-ADJUST			
TITLE	ADJUSTMENT OF FIXED AND GUIDED SUPPORTS	REFERENCE NO. 953570		SHT	6 OF 7
		OFFICE LIGO		REVISION 3	
PRODUCT	LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY	MADE BY MLT	CHKD BY DTR	MADE BY MLT	CHKD BY GPB
		DATE 3/7/96	DATE 3/11/96	DATE 10/7/98	DATE 11/4/98

5.0 PROCEDURE FOR TERMINATION SUPPORT ADJUSTMENT

- 5.1 Position the 8 ton jacks beneath the valve on the two reinforcing plates on the bottom of the valve body. Position a dial indicator gauge adjacent to each jacks.
- 5.2 Raise the jacks to just contact the valve. Gradually increase the jack pressure until the jack just begins to lift the valve (0.002"). Do not raise either side of the valve more than 0.005". Monitor the valve with the dial indicator gauges and verify that both sides of the valve are raised slightly.
- 5.3 Slowly loosen the 1 1/8" diameter bolts (Pc Mk 20-20) holding the clamping plates to allow movement of the beam tube. Loosen the bolts by slightly loosening on each side until the clamping force is removed. Clamping bolts should remain finger tight at all times.
- 5.4 Once the clamping plates are free to move, raise or lower the jacks to position the valve at the desired elevation. (Lower the spring pack, if needed, to lower the valve.) Tighten the clamping bolts per CBI drawing 20, sheet 1, note 11. Slowly release the pressure on the jacks and verify that the valve is at the desired elevation.

WARNING: The vertical jacking adjustment should not exceed one inch. If greater than one inch is necessary, the termination support adjustment should be made in steps with the adjacent guided support.

- 5.5 Adjust the spring pack per CBI drawing 22, note 2.
- 5.6 For lateral adjustment, position the jacks between the two square cross beams (Pc Mk 20-1) and the outer base plate anchor bolts (Pc Mk 20-11). Use 18" long angles (minimum cross section 6"x 6" x 3/8") spanning across the anchor bolts for a jacking surface. Mark the location so movement may be monitored. Protect the bolt threads by loosening the locknuts and raising them to the top of the bolts. Verify that the angles bear on the flats of the nuts.
- 5.7 Slowly loosen the 1" diameter bolts (Pc Mk 20-10) holding the clamping plates (Pc Mk 20-14) to allow movement of the cross beam (Pc Mk 20-1). Loosen the bolts by slightly loosening on each side until the clamping force is removed. Clamping bolts should remain snug at all times.
- 5.8 Apply pressure to both jacks simultaneously to move the beam tube to the desired lateral position. Verify that both ends of the support move the same amount.



TITLE		IDENTIFICATION			
		SUP-ADJUST			
ADJUSTMENT OF FIXED AND GUIDED SUPPORTS		REFERENCE NO.		SHT 7 OF 7	
		953570			
LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		OFFICE		REVISION	
		LIGO		3	
LIGO BEAM TUBE MODULES QUALIFICATION TEST CALIFORNIA INSTITUTE OF TECHNOLOGY		MADE BY	CHKD BY	MADE BY	CHKD BY
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WARNING: The lateral jacking adjustment should not exceed one inch. If greater than one inch is necessary, the termination support adjustment should be made in steps with the adjacent guided support.

- 5.9 Once the beam tube has been moved to the desired lateral position, tighten the 1" diameter clamping bolts to secure the cross beam. Tighten the bolts per CBI drawing 20, sheet 1, note 10.
- 5.10 Relieve the jacking pressure and remove the jacks. Verify that the tube is in the desired position. Tighten the locknuts on the base plate anchor bolts.