LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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Replacement guide for HAM Support Tube Clamps

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LIGO Scientific Collaboration

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1. Purpose:

To supply suggested clamp assembly process.

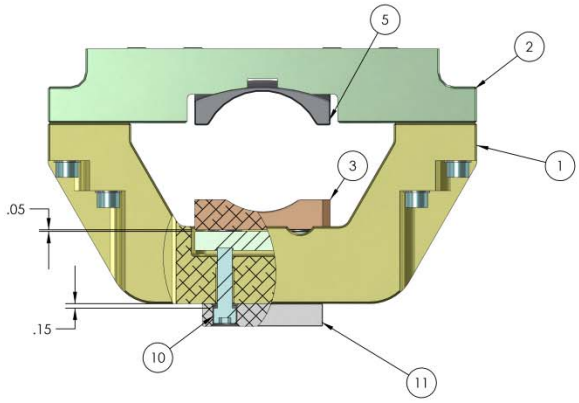
2. Required Tools:

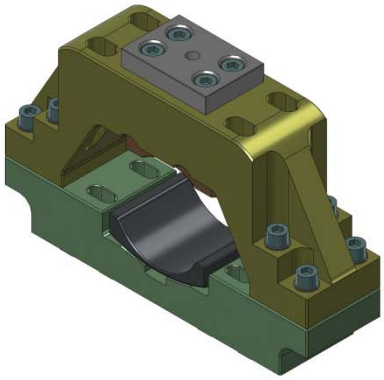
- Acme Jack Screw Mcmaster Carr P/N 62255K999 Qty 4
- Support Tube Brackets Ligo P/N TBD Qty 4
- Support Tube Table Ligo P/N TBD Qty 4
- Bosch 2" X 2" Channel With t/nuts Cut to length as required
- Bosch corner brackets Qty 16
- leveling feet TE-300-4 Qty 16
- Dial Indicators With support Rods. Qty 12

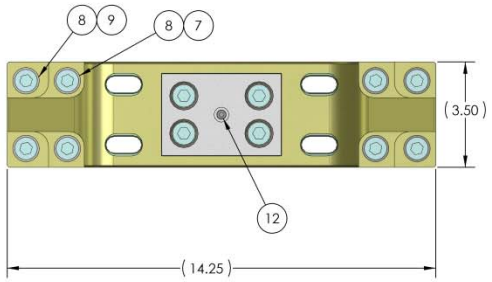
3. D080373 see Figure 1. and Drawing D080373, for Ref only do not preassemble apply 4 1/2-13 x 2 diameter helicoils to Item (1) Clamp Cap.

Additional Hardware not in Figure 1

- Socket Head cap screw 1/2-13 x 3.75 lg. Holokrome 72247 Qty 16
- Flat Washer 1.25 od. x .51 id. x .06 thk. Qty 16
- Lock Washer 1/2" Mcmaster 92146A033 Qty 16





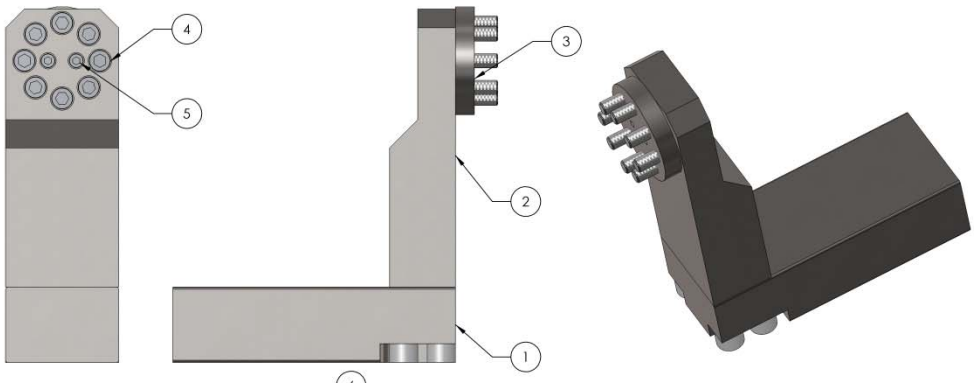


ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	REQ
13	MSC_87925996	hex head screw 1/4-20 x 3/8 lg	18-8 SSTL	2
12	HOLOKROME_79020	SHCS, #10-32x.50"	18-8 SS	1
11	D1000480	Clamp Screw Guard, HAM Support Tube	PTFE	1
10	Holokrome_72234	Screw, 1/2-13 x 2.0" SHCS	Alloy Steel	4
9	Holokrome_72238	Screw, 1/2-13 x 2.5" SHCS	Alloy Steel	4
8	MCMASTER_98017A210	Flat Washer, 1/2" Screw, .51"x.88"x.06"	AISI 304	8
7	Holokrome_72246	Screw 1/2-13 x 3.5" SHCS	Alloy Steel	4
6	MCMASTER_9713K78	Belleville Washer, .567"IDx1.125"ODx.038", .018" Defl.	302 SS	6
5	D080378	Clamp Sleeve, HAM Support Tube	2024-T351 AL	1
4	D080377	Clamp Washer Plate, HAM Support Tube	17-4 PH SSTL, H 1150	1
3	D080376	Clamp Preload, HAM Support Tube	6061-T6 AL	1
2	D080374	Clamp Base, HAM Support Tube	303 SSTL	1
1	D080375	Clamp Cap, HAM Support Tube	6061-T6 AL	1

Figure 1

4. Assemble D1100077 see Figure 2. and Drawing D1100077

In the case where an old Gullwing Hepi System is being retrofitted the use of this assembly will be used to support the Support tubes D972610.



ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	REQ
6	HOLOKROME_78120	SHCS, 1/2"-13x2.0"	300 SSTL	4
5	HOLOKROME_78062	SHCS, 1/4"-20x1.0"	18-8 SS	2
4	HOLOKROME_78104	SHCS, 3/8"-16x1.75"	18-8 SS	8
3	D1100076	HAM SUPPORT TUBE SPACER	Alloy Steel	1
2	D1100058	HAM SUPPORT TUBE MOUNT BLOCK	Alloy Steel	1
1	D1100059	HAM SUPPORT TUBE LEG	Alloy Steel	1

Figure 2

Note: Item (4) 3/8-16 x 1.75 lg. screws are used to attach to D972610 Support Tube.

5. Removal and disassembly of exiting Support tube clamps and Cross beams. System shown is what exists at Lasti the process for the old Gullwing style will be similar.

- If this is a new install skip this section and proceed to section 6.

5.1 Mount the Support Tube Arm Assy (D1100077) to the Support Tube D972610. Place the Jack Screw and table under (D1100077) level table. There are 3 holes on the bottom side of the (D1100077) which will accept the shaft of the jack screw. See Figure 2, adjust to allowable space. Level the table using precision levels. The sites must design the leg structure supporting the table, jack screw and Support Tube Assy. due to the space limitations. When two chambers are mounted adjacent to each other the space is very restricted. Good Planning is required.

5.2 Set up (3) dial indicators as shown. These are used to monitor any motion that may occur during this operation, a maximum motion of .020 in is allowable.

5.3 Raise the jack screws till they make contact with D1100077, monitor the dial indicators once the dial indicators move then you have made contact, preloading the Support Tube (D972610). Do this in all 4 corners of the chamber. Figure 3.

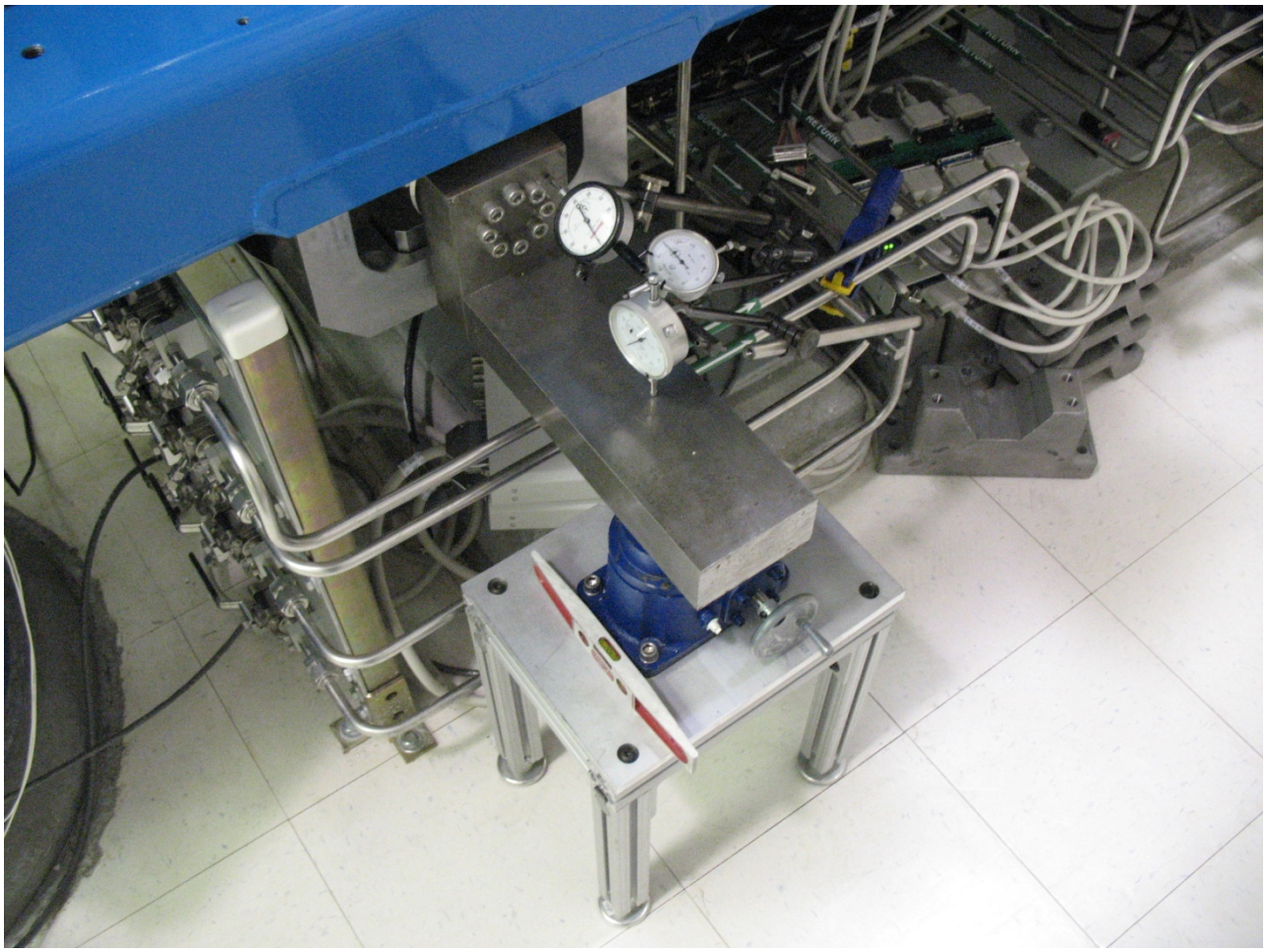


Figure 3

5.4 Now that (D972610) Support Tubes are supported it is time to unload the Hepi Springs. Once you are sure the weight is properly supported by the jack screws, while watching the digital read outs for the load cells, slowly start unscrewing the spring nuts, unloading each spring in small increments of 50 lbs. per spring and alternate. Figure 4.

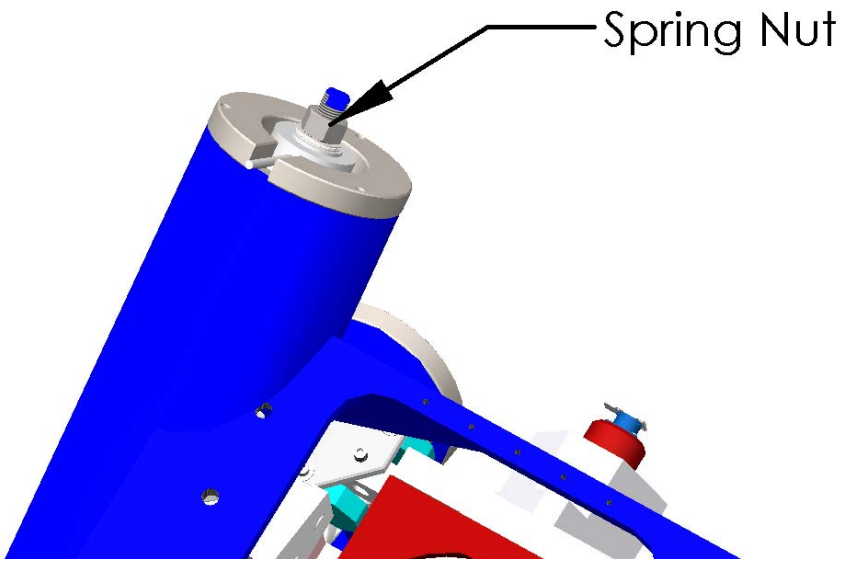


Figure 4

5.5 Connect straps and spreader bar to Cross Beam using a load cell to monitor all weight transfer.

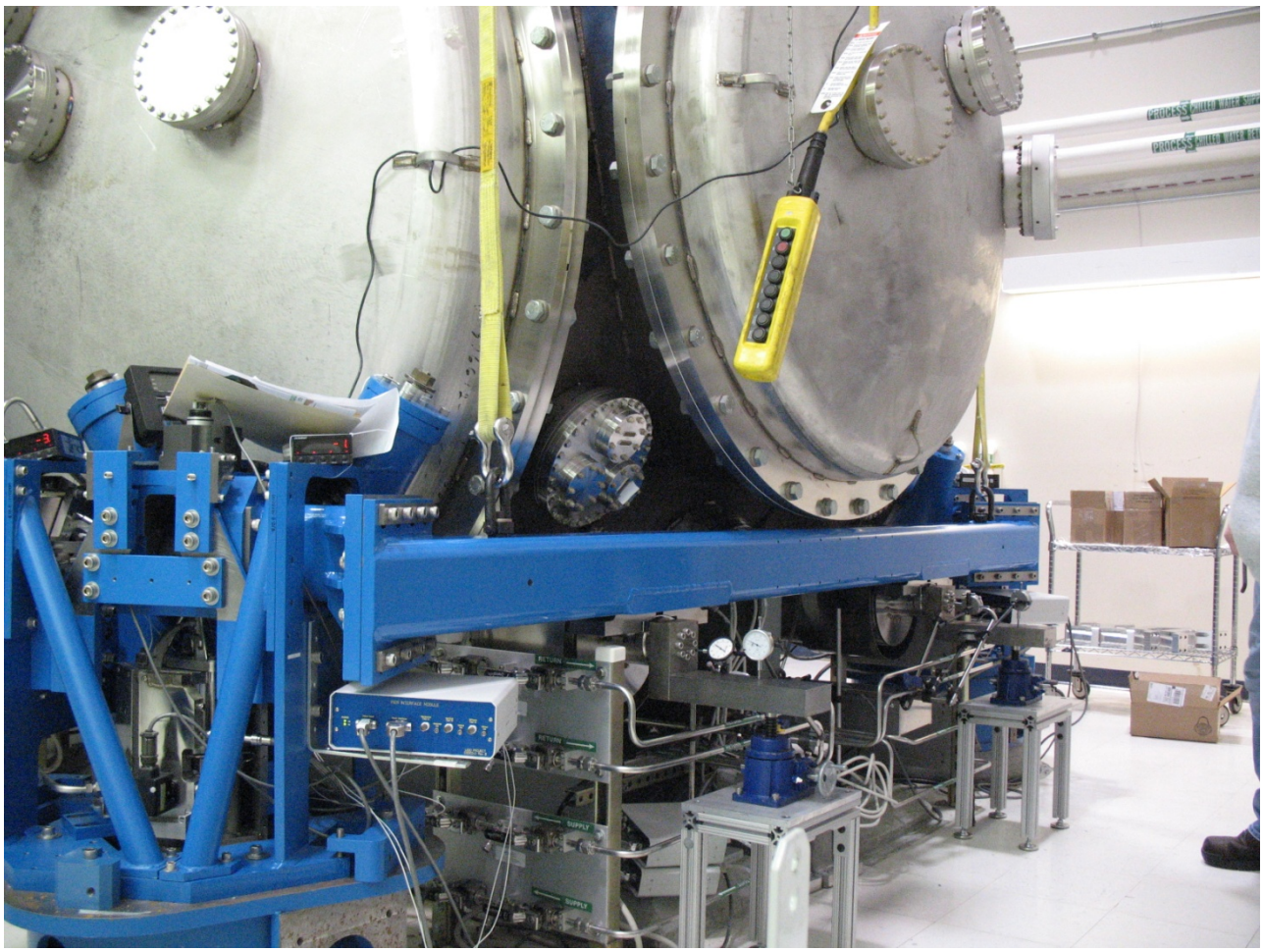


Figure 5

Figure 5**.** Photo taken during installation of the prototype Crossbeams and Clamps at LASTI. The overhead crane (connected via a spreader bar and straps) is supporting some of the weight of the Crossbeam. Use load cells between the spreader bar and the lifting eyes, to monitor the load transfer.

5.6 When the Support Structure is attached to the jack stands and overhead crane, as described above, the bolts between the Crossbeam and the Crossbeam Connector on either end should be loosened. Check the load cell readings on the crane, to ensure smooth transfer of weight. Simultaneously watch for changes in the height of the Support Tubes, as measured with the dial indicators. Once you are sure the weight is properly supported by the jack stands and the crane, you may begin loosening the screws within the Clamps. Once the Clamps are loose, you should raise the Crossbeam straight up and out, such that it comes out of contact with the Tubes. Remove the remaining pieces of the Clamps. Figure 6. and Figure 8

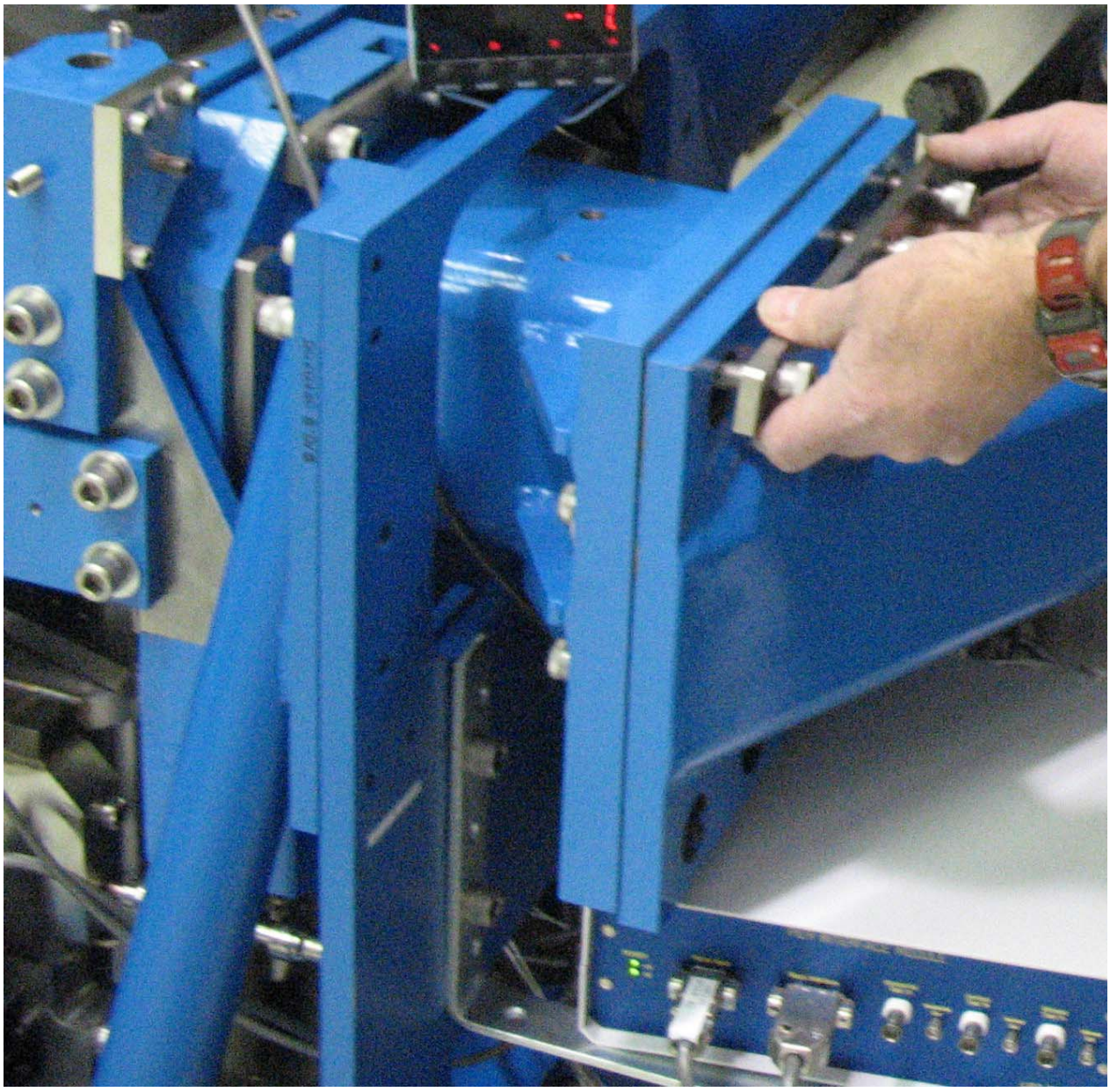


Figure 6

Note: On the chamber side without the bellows there is only .73 inches nominal between the top of the Cross Beam and the Bottom Tangent point of the flange on the bellows side of the chamber the Flange extends beyond the Cross beam (Figure 7) on this side you may not need to completely remove the Cross beam as shown in Figure 8.

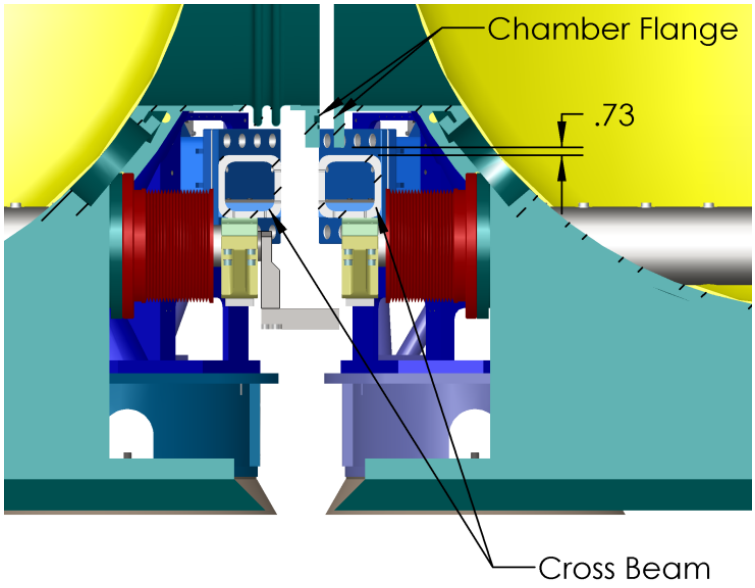


Figure 7

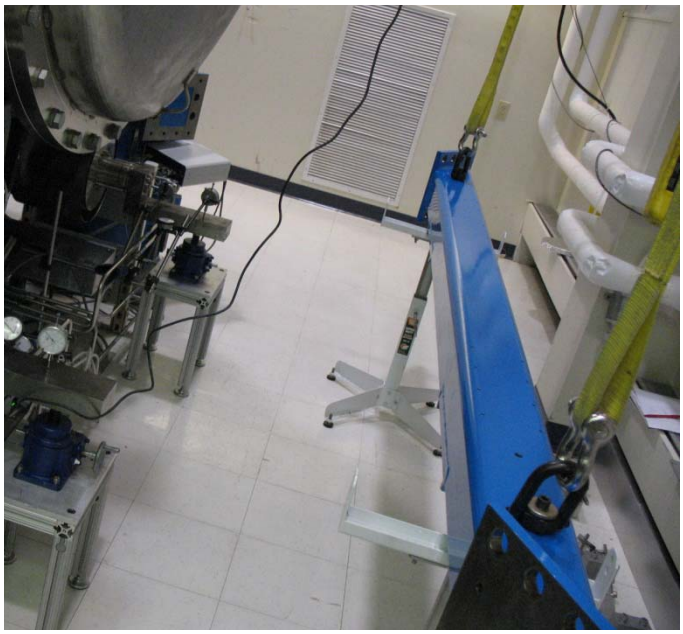


Figure 8

6. Install clamp base D080374 to cross beam hand tighten the mounting screws, D080374 must be allowed to float for adjustment to the Support tube Figure 9. This needs to be done to both sides of the beam simultaneously.

- Socket Head cap screw 1/2-13 x 3.75 lg. Holokrome 72247 Qty 16
- Flat Washer 1.25 od. x .51 id. x .06 thick. Qty 16
- Lock Washer 1/2" McMaster 92146A033 Qty 16

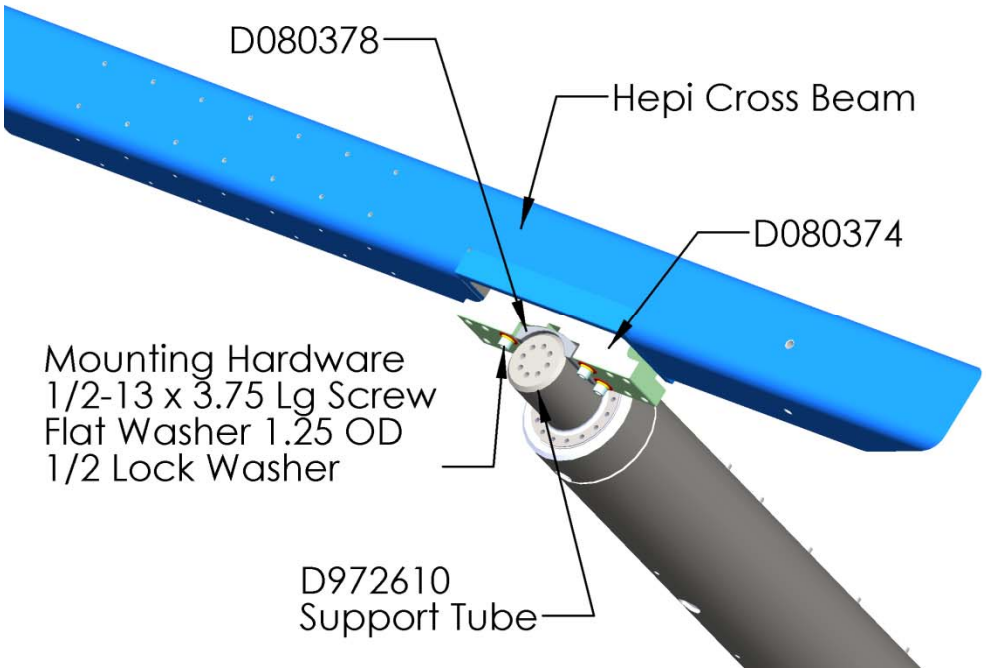


Figure 9

6.1 Place Clamp sleeve (D080378) to support tube on D972610 Support Tube Figure 9 now lower the Cross Beam with D080374 attached on to D972610 and D080378. As you place the cross beam back in place monitor the load cell readings. This is important the weight displayed by the digital read out should be around 475 lbs.

6.2 With the Cross Beam in place, gently lower the cross beam as it lowers the load cell reading will change lower the beam until 0-10 lbs is subtracted from the readout this will apply a small preload. Now center the clamp sleeve (D080378) to the support tube (D972610) by rotating it, then center the clamp base (d080374), by translating it side to side, to the Support Shaft (D972610). Use gage blocks to measure side to side spacing must be equal. Nominal dim is .24 inches Figure 10.

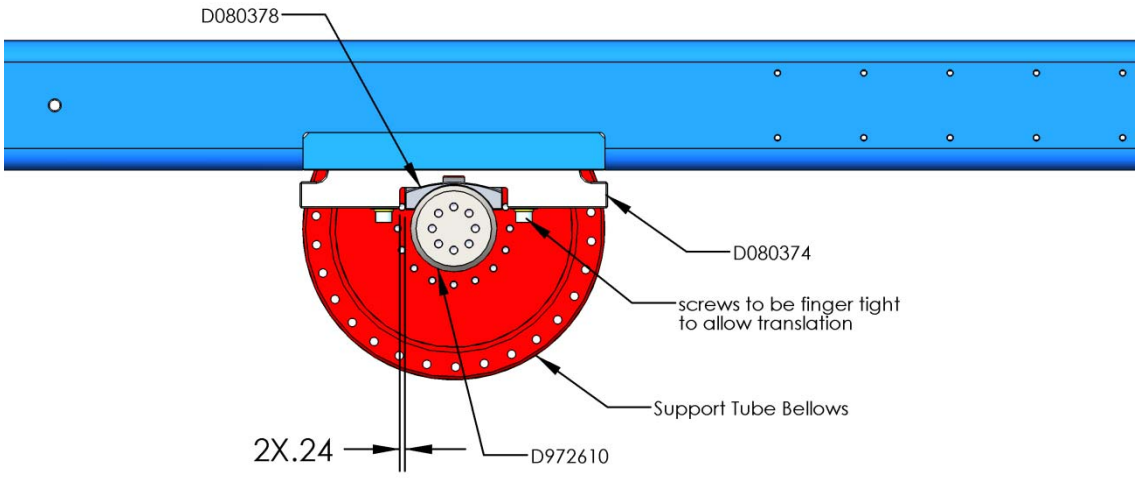


Figure 10

6.3 Once both clamp bases are centered slowly lower cross beam, this will transfer the weight from the hoist to the Support tubes. Small shifting of the parts is ok as the load on the support tubes increases the clamp base will self center. Lower the beam untill the load cell read zero.

6.4 Tighten the Clamp Base mounting screws, (Alloy Steel Figure 9), to a torque of 100 ft*lbs in increments of 20 ft*lbs alternating diagonally.

6.5 Install the bottom portion of the Clamps. First place Clamp Washer plate Item (4) (D080377) as shown in Figure 11 into Clamp Cap (D080375), including the Belleville washers Item (6) and hex screw item (13). Be sure to assemble as shown in Figure 12. The Hex screw does nothing more than to prevent the top Belleville washer from sliding off.

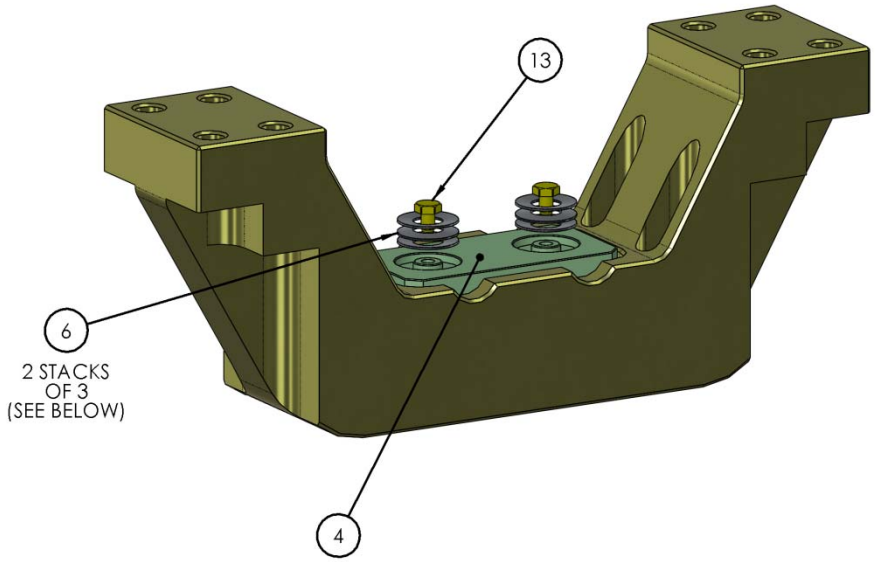


Figure 11

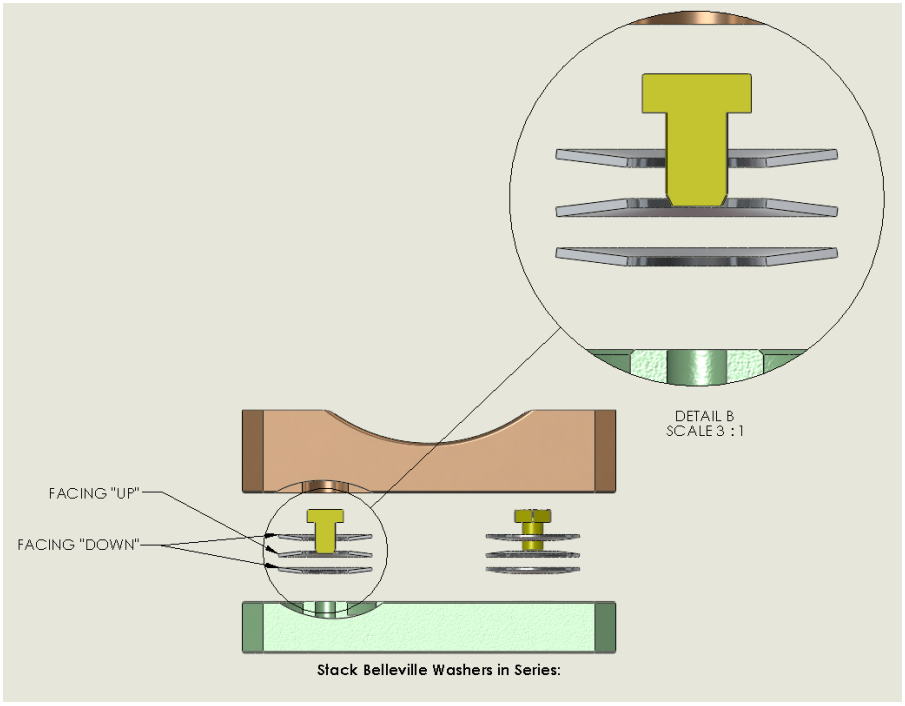


Figure 12

6.6 Place Clamp Preload (D080376) Item 3 on top of the stack Figure 12 and 13. Once all parts are in place insert Item (10) 1/2-13 x 2" bolts as shown they will engage item (4) with shallow c-bores this is to prevent the part from walking as the preload is applied. The screws when tighten will apply a preload to the Support Tube (D972610) only loosely tighten at this point. Note Item (11) is a screw guard and may be applied at any point after this step using Item (12) 10-32 screw.

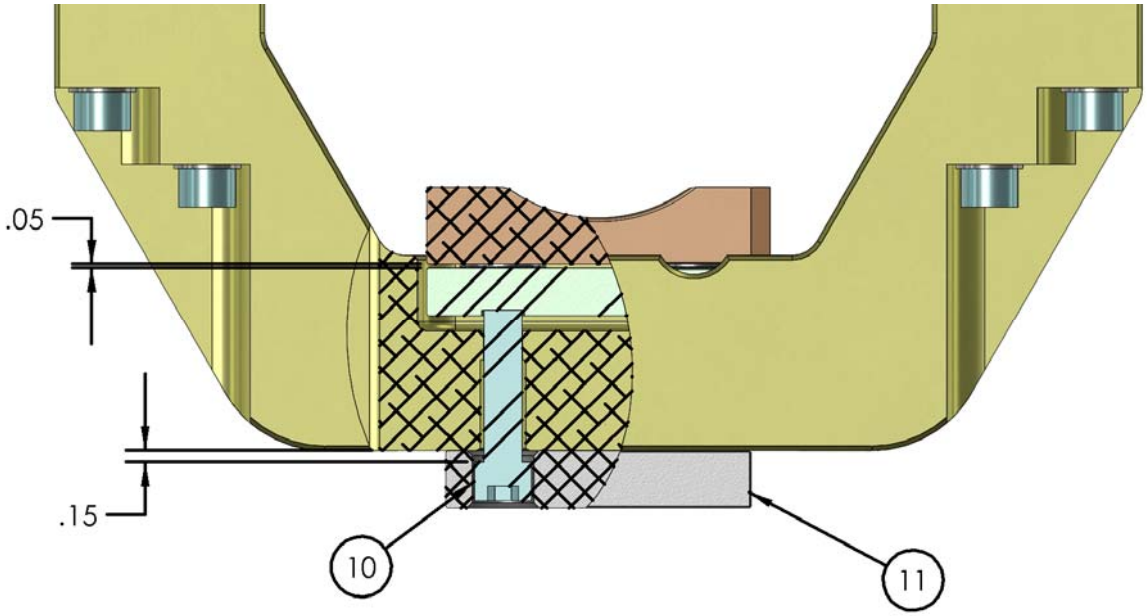


Figure 13

6.7 Move assembly into position as shown Figure 14 once it is in place secure with Item(7) (9) and (8). 1/2-13 x 3.5, 1/2-13 x 2.5, 1/2 flat washer tighten to 100 ft*lbs. in increments of 20 ft*lbs alternating diagonally, be sure clamp part is centered.

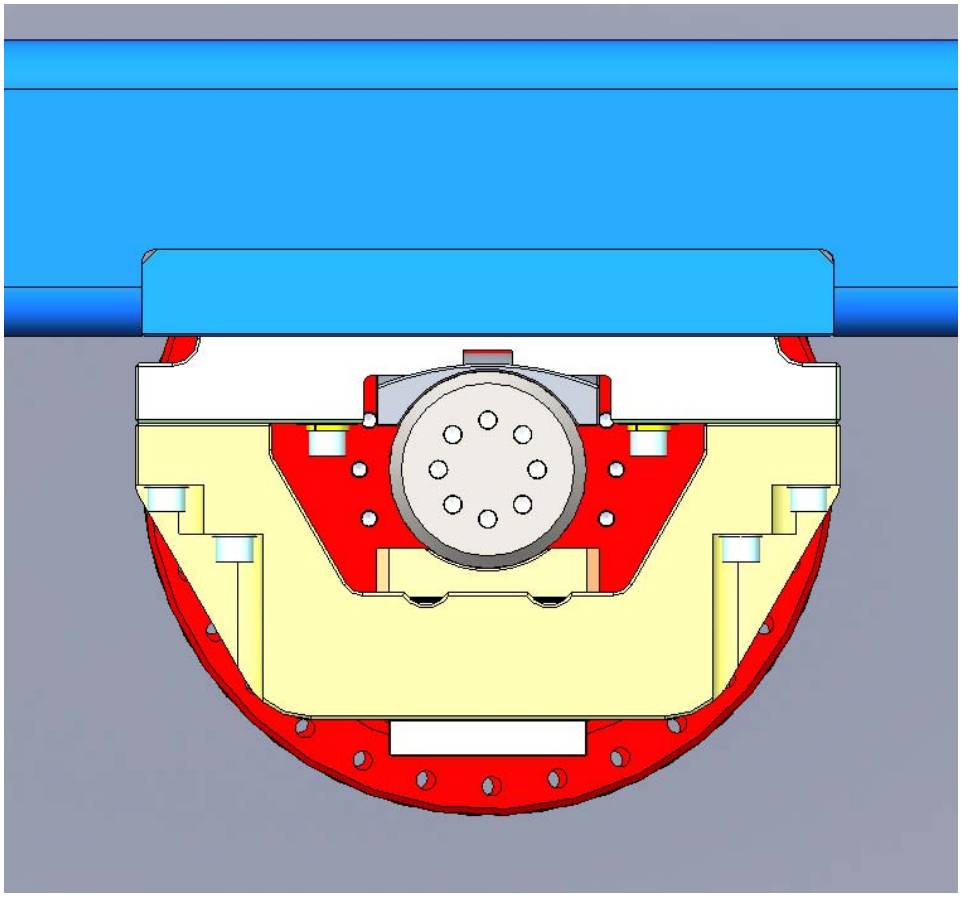


Figure 14

6.8 Apply the preload using Item (10) 1/2-13 x 2" lg screws Figure 13 in increments of 1/4 turns alternating diagonally This will center the clamp to the Support Tube. Once you have tightened each screw 3/4 turn then .050 gap between the clamp washer D080377 and the clamp preload (D080376) is gone Figure 13. Now Torque the 4 preload screws Item (10) to 50 ft*lbs.

Once all 4 clamps are replaced then it is time to mount the Cross beam back to the Hepi unit and transfer the weight back to the Hepi springs this is the reverse sequence of step 5.