

April 15, 2003

## **Support Tube Dis-assembly Sequence**

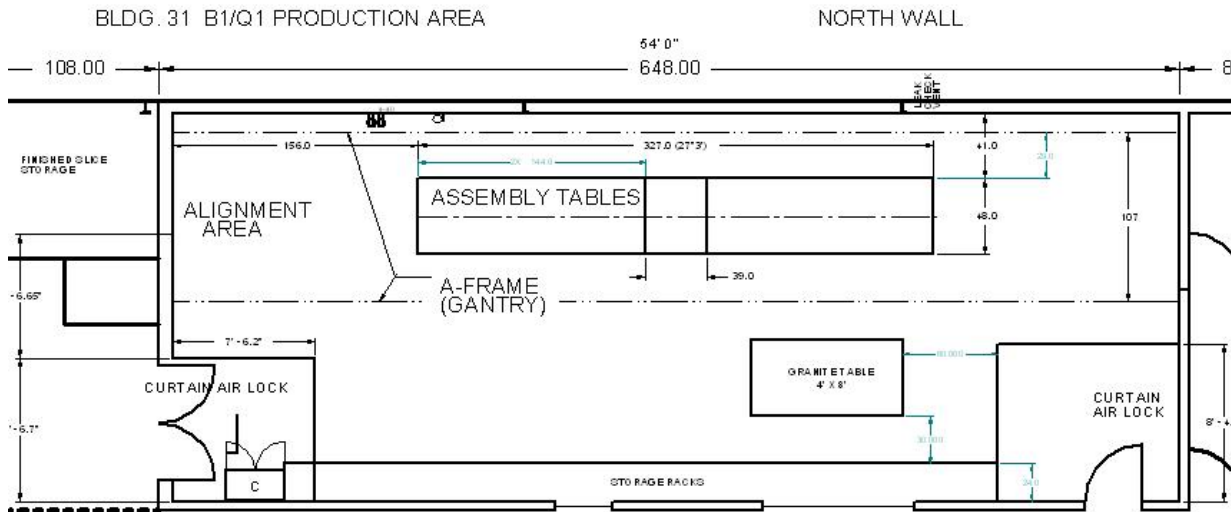
by Martin Nordby

### Revision History:

- Rev 1 (16March, 1999): dis-assembly moved to separate file, and updated based on experience of SVT dis-assembly.
- 24 Feb 1999: Written for ST dis-assembly for SVT installation.
- Rev 2 – 22 Aug 2002: Rewritten Dis-assembly of Support Tube by Mike Sullivan, Ben Smith, and Stan Ecklund

### **Support Tube Removal from IR-2**

1. Bolt Support Tube V-Blocks assembly (PF 343-931-39 and Rail Support SA 343-931-03) to underside of Support Tube, using ½-13 UNC x 1 ¼ SHCS's after removal from BARBAR for shipping. (Support Tube Assembly SA 343-910-01)
2. Pick up Support Tube from ends **ONLY**, using a full-length spreader bar and 4 nylon straps, choked around extension arms (Support Tube total weight = 5000 lbs, without spreader bar).
  - Snug up rigging
  - Loosen pusher bolt on top of Pivot Bracket to lower Support Tube, and allow crane to pick-up the load. When push bolt loosened, lift Support Tube with crane, to remove remaining slack.
  - Remove 1” bolts and brass shoulder bushing connecting Pivot Bracket and Support Tube Slider Plates. (See Step 3 for part numbers)
  - Lift Support Tube straight up to clear Pivot Bracket, then crane over shielding wall.
3. Reinstall brass bushing (PF 343-910-21) into Pivot Bracket (SA 343-910-20) And remove Stop Plate (PF 343-910-24) from end of Rafts. Send Pivot Brackets, Raft Stop Plates, and Pivot Bolts to Bldg 031 (Vacuum Bldg), along with Support Tube. Transport spreader bar with Support Tube, for use at Bldg. 031.
4. Set Support Tube on flat bed truck on the V-block sleds assembly **ONLY**. Orient so **BACK END OF SUPPORT TUBE** (long stainless tube) is at back end of truck (this avoids confusion at Bldg 031 when setting on assembly table). Strap down to truck **ONLY** at the V-BLOCK locations, this avoid bending the Support Tube.



**DIAGRAM 1 - BLDG 031, (CLEAN ROOM, FLOOR LAYOUT)**

### Building 031 Set-up

5. Back truck to Bldg 031 roll-up door. Use Pettibone to lift spreader bar, and rig Support Tube from the end extensions. (See Diagram 1)
6. Pick-up Support Tube with spreader bar, and set on roll-around steel frame (blue) cart, with V-Block assembly centered on dollies. This puts V-Block about 4 inches inside of nearest support column on the blue steel frame (cart). Back end (longest stainless tube) should go into building first.
7. Use unistrut and thread rod ½-13 UNC x 12.0 long thru V-block sleds to unistrut at underside of top steel frame. This is TOP-HEAVY, so clamp rods tight.
8. Push Support Tube on cart into Bldg. 031 high bay and wipe down. This takes 5 to 7 people to push and steer the cart.
9. Roll cart into clean room and position next to assembly table, position Support Tube 9 to 12 inches off center along table length in Z-direction, and underneath crane. Backward direction (-z) (longest stainless tube) of Support Tube should be at far end (east end) of the room. Install wheel blocks to cart. Table should be clean of all stands but not rails.
10. Swing Support Tube onto table (SA 343-931-01 & 02).
  - Unbolt unistrut from V-block sleds from cart.

- Rig hoist onto forward end by slinging Slider Plates with nylon straps.
  - Lift end of Support Tube and swing onto table, taking care to let opposite end rotate on top of cart frame, without falling off, set down on V-block.
  - Pick up Back End of Support Tube and swing onto table. The Forward end can slide/rotate on its V-block. Check approx Z-position of Support Tube and move if required to center on table in both X and Z.
11. Rig Backward End temporary support stands assembly (SA 343-910-32) and move into place on table. The clevises, bracket and push plate from the raft to be installed on temporary supports (larger black steel stands). Placing the slider plates on the Support Tube into the clevises bracket. Adjust clevises height and insert brass pivot bushings and bolts. Repeat for the Forward End.
  12. Level Support Tube using temporary support stand adjustment screw top center of clevises bracket to CENTER LINE 21.0 inches of table using a tape.
  13. Install Z adjustment (Clevis Coarse, PF 343-910-25, Clevis Fine, PF 343-910-26, and Turn-Buckle, PF 343-910-28) came with Support Tube from IR-2, on the Backward End. Check center of Support Tube on table (X and Y).
  14. Un-bolt V-blocks from Support Tube and store under table.
  15. Set up nitrogen purge on Backward End of Q1 flange. Keep purge line and Nupro valve within 1 inch from end of blank-off.
  16. Remove all tape from holes on Support Tube. Clear cables from survey holes. Remove plastic sheet to expose CFC Center Tube (PF 343-910-02).
  17. Survey Z-position of Q1 magnets, and move Support Tube to within .03 inch of center of table.
    - Use Z-strut to move Support Tube in place.
    - Build up blocking on table to hold the black stand the Z strut is mounted to.
  18. Align Support Tube in X, Y and Roll, so Q1 magnet centerlines are on table center axis and 21.0 inches above. Surveyors read tool balls on Q1 magnet.

**Q1 Load Transfer to Sleds Supports (See Diagram 2 and 3)**

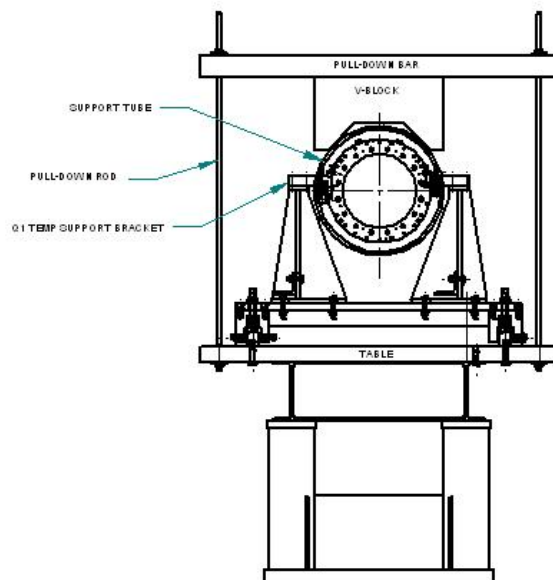
19. Assembly Q1 sleds (4X – Rail Support SA 343-931-03, 8X – Rail Guide SA 343-931-10, 8X – Q1 Temp Support SA 343-931-12) underneath Support Tube and align sleds to Q1.
20. Dis-assembly Support Tube V-blocks. Use only the V-blocks (PF 343-931-39) and set upside-down on top of Support Tube just to the rear of front Q1 support about 85 inches apart. Set pull-down bar on top of V-blocks (no bolts

required) and install 48 inches long ½-13 UNC threaded rod through holes in bar and table. Hand tighten hardware.

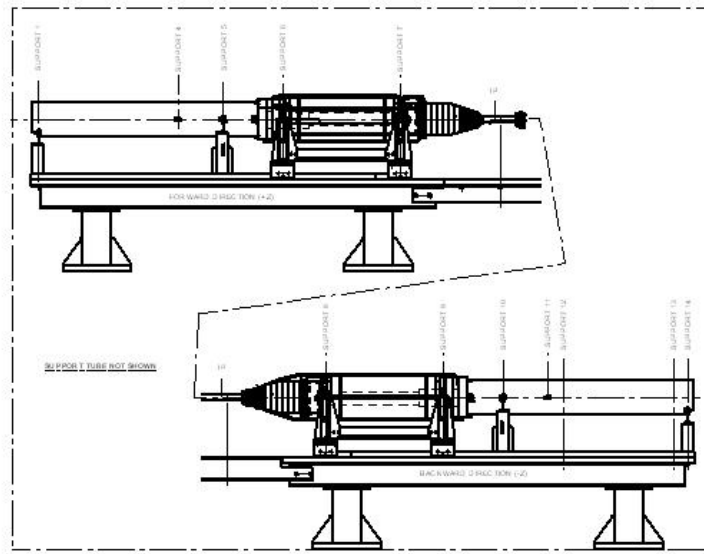
21. Position monitoring:

- Set levels on top of pull-down bars to ensure no roll is imparted on Support Tube.
- Set dial indicator under Central Tube approximate IP locations to monitor Support Tube bow.
- Set dial indicators under Slider Plate at each end to monitor compression of supports.
- Reach through bolt slots in Support Tube to pick up inboard end of Forward Q1 Magnet with dial indicator.

22. Tighten pull-down threaded rods until center dial indicator shows monition. Move equally both sides.



**DIAGRAM 2 - PULL-DOWN CROSSECTION**



**DIAGRAM 3 - SUPPORT LOCATIONS ON ASSEMBLY TABLE**

23. Raise Q1 sleds temp supports locations 6, 7, 8, and 9 (see Diagram 2 and 3). Bolts holding temp support (PF 343-114-49) down, are loosen between temp support and sled towers, and look for back end to tip up to show when temp support starts picking up load. This tipping only requires a space of a few mils.
24. Bolt down the temp support to sled towers, and bolt to brass Q1 supports Brackets (PF 343-910-51) using #10-24 UNC x 2 ½, two per bracket.
25. Loosen top nut on all 8 Q1 support studs (SA 343-910-50). Remove nut and spherical washer.
26. Tighten pull-down threaded rods, so Support Tube deflects 0.01” – 0.02”, or until nuts on inboard Q1 support studs (bottom) are free to spin down (monitor Q1 dial indicators to look for Q1 mention when deflecting Support Tube). Spin the nuts all the way down with a small hex driver or small screwdriver, and check outboard nuts as well.
27. Loosen and remove pull-down rods and bars. The Support Tube will move up (monitor Q1’s dial indicators, there should be no movement). This will put the Support Tube in a free state. Survey the Support Tube location.
28. Block up Back SST tube at both ends, and Forward SST tube at outboard end.
29. Unload Pivot Brackets (SA 343-910-32) set Support Tube on blocking and move brackets to storage area at west end of room.

## FORWARD SST REMOVAL

30. Prep Forward end for cantilever:
- Remove and label all water fittings from end of Q1
  - Bend Q1 H-Corrector trims leads into radial gap between Q1 and Support Tube, and remove connector panel.
  - Remove Q1 quad trim lead jumpers.
  - Bag all parts and label from Forward end.
31. Un-bolt CFC Central Tube joint with Forward Tube. There are high-strength Bolts (bag and label them). Leave 2 bolts each at top and bottom. Plus side bolts that are trapped by Q1 supports. (If TOP location of the Center Tube is not marked, mark it).
32. Hoist Cantilever Tube (SA 343-910-11) into position on back of Forward Q1C with crane and strips. Screw 12 3/8-16 UNC x 11.0" long (Grade 8) threaded rods into back of Q1C until bottomed-out (this is through Q1C into Q1, Q1C has 1/2" holes that the rods go through. Screw on and torque down Flange Nuts (30 ft lbs minimum).
33. Install cantilever supports (locations: 1 and 5), Rear Support (PF 343-931-07), Front Support (PF 343-931-08) and line them up with brackets on cantilever tube. Screw in 3/4-16 UNF x 8.0 threaded rod with flat washer on support, 2 spherical washers next to cantilever tube top and bottom, and nuts. Hand tighten the nuts on the under side of cantilever tube, support 5, leaving top nuts loose. Tighten both nuts on rear Support 1.
34. Check torque (30 ft lbs min) on Cantilever Tube flange into Q1C, and on support.
35. Dress cables down on top of Cantilever Tube, and tape in place making sure max diameter of 16.25".
36. Install dial indicators for monitoring at the following locations (5):
- Vertical and Horizontal indicators on inboard Cantilever Tube (support 5).
  - Vertical and Horizontal indicators on outboard end of Cantilever Tube (support 1)
  - Vertical indicator on inboard end of Q1 through Support Tube both sides (1 1/2 diameter hole on bottom of Support Tube)

37. Remove #10 SHCS's holding Q1 temp supports on sled to brass Q1 support brackets.
38. Rig Forward SST from hoist using 2 nylon straps, choked to tube. Straps must lay side by side, flat against tube, so they clear the support towers. Tape a level on tip of tube. Pick up tube until free to slide. Monitor Q1 dial indicators to ensure this does not lift the magnet.

### **Cantilever**

39. Raise nuts on Support 5 until temp support brackets (PF 343-114-49) on Q1 support tower (Support 6) start to lift off, let Support 1 free to move. Loosen temp support brackets (support 6) bolts to sled tower to gauge load on Support 5. Remove Q1 temp support brackets (Support 6) after load transfer. Support Tube is now bridged between Support 5 and 7.
40. Cantilever Q1 by driving down  $\frac{3}{4}$  top nuts at Support 1. Monitor dial indicators to look for X drift. Check Support 7, temp support by loosen bolts between tower and temp support and dial indicators to see when Q1 is fully cantilever (temp support will be free to move).
41. Remove Q1 temp support (Support 7). Unbolt and remove all four brass Q1 endwall brackets (PF 343-910-51) through cut-out in Support Tube. Remove studs and mounting blocks (TAKE CARE NOT TO DROP HARDWARE DOWN INTO SUPPORT TUBE). Remove remaining SHCS's holding the Forward Tube to the CFC Center Tube and bag with others.
42. Move Forward Tube and crane back from IP until the tube reaches Support 5 and open up Support 7.
43. Reinstall Q1 Endwall Brackets (4 Set) support, temp supports with #10 screws through to the brass brackets and re-bolt to sled supports 7. Watch dial indicators.
44. Come off Support 1 by screwing up top nuts to set Q1 back on Support 7 temp support and bolt down.

### **Reverse Loading**

45. Lift Support 1 until Support 5 lower nuts are free to turn.
46. Remove Support 5 and dial indicator.
47. Slide Forward SST over Cantilever Tube until end clears Q1, Support 6.

48. Reinstall Q1, (Support 6) brass endwall brackets, temp support with #10 screws through to the brass brackets, and re-bolt to sled supports. Q1 Magnet should not have moved much at all (sled towers have not moved, either) so supports should go back together. Monitor dial indicators to check positions.
49. Remove Support 1 and move Forward SST of Cantilever Tube and place on floor in wood cradle.

### **Central CFC Tube Removal Cantilever Prep**

50. Reinstall Cantilever Tube support (Supports 1 and 5) Repeat steps 33 thru 44.
51. Un-bolt SHCS's at CFC Center Tube joint with Backward SST and bag and label. Can be bagged with other bolts from step 31.

### **Cantilever**

52. Raise Support 5 of Cantilever Tube until Support 7 start to lift off temp support (let Support 1 move free). Loosen temp support bolts to gauge load on support. Remove Q1 brass support and temp supports.
53. Cantilever Q1 by driving down  $\frac{3}{4}$  nuts at Support 1. Monitor dial indicators for X drift. Check Support 7, temp support, and dial indicators to see when Q1 is fully cantilevered (temp support will be free to move).
54. Remove Q1 temp supports (Support 6 and 7). Unbolt and remove all four brass Q1 support brackets.
55. Move Central CFC Tube and crane over Q1 until the tube reaches Support 5 and open up Support 7.
56. Reinstall Q1 brass support brackets, temp support with #10 screws through to the brass brackets, and re-bolt to sled supports. Watch dial indicators.
57. Come off Support 1 by screwing up  $\frac{3}{4}$  nuts to set Q1 back on Support 7 temp support and bolt down.

### **Reverse Loading**

58. Lift Support 1 until Support 5 lower nuts are free to turn.



59. Remove Support 5 and dial indicator.
60. Slide Central CFC Tube over Cantilever Tube until end clears Q1, Support 6.
61. Reinstall Q1, Support 6, Q1 brass brackets, temp supports with #10 screws through to the brass brackets, and re-bolt to sled supports. Q1 Magnet should not have moved much at all (and sled towers have not moved, either) so supports should go back together. Monitor dial indicators to check position.
62. Remove Support 1 and move Central CFC Tube off Cantilever Tube and place on floor in wood cradle.
63. Remove cables from Cantilever Tube and un-bolt tube from Q1C. Remove the 3/8 rods (12), nuts and bag.

## **Backward SST Removal**

### Cantilever Prep

64. Prep Forward end the cantilever.
  - Remove and label all water fittings from end of Q1.
  - Bend Q1 H-Corr trims leads into radial gap between Q1 and Support Tube, and remove connector panel.
  - Remove Q1 quad trim lead jumpers and label.
  - Bag all parts and label from Backward end.
65. Hoist Cantilever Tube (SA 343-910-11) into position on back of Backward Q1C with crane and strips. Screw 12 3/8-16 UNC x 11.0" long (Grade 8) threaded rods into back of Q1C until bottomed-out (this is through Q1C into Q1, Q1C has 1/2" holes that the rods go through. Screw on and torque down flange nuts (30 ft lbs min).
66. Install cantilever supports (Support 1 and 5) (Rear Support PF 343-931-07, Front Support PF 343-931-08) and line them up with brackets on Cantilever Tube. Screw in 3/4-16 UNF x 8.0" threaded rod with flat washer on support, 2 spherical washers next to cantilever tube and nuts. Hand tight the nuts on the under side of cantilever tube front support, leaving top nuts loose. Tight both nuts on rear support.
67. Check torque (30 ft lbs min) on Cantilever Tube flange into Q1C, and on support.
68. Dress cables down to Cantilever Tube, and tape in place making sure max. diameter of 16.25".

69. Break torque and remove push-me/pull-you X adjust bolts between Backward Support Tube and Q1 Magnet (this is important, they tend to kick, Q1 around when the Support Tube is picked up by the crane).
70. Install dial indicators for monitoring at the following locations:
  - Vertical and Horizontal indicators on inboard Cantilever Tube.
  - Vertical and Horizontal indicators on outboard end of Cantilever Tube.
  - Vertical indicator on inboard end of Q1 through Support Tube.
71. Remove #10 SHCS's holding Q1 temp support on sled to brass Q1 support brackets.
72. Rig Backward SST from hoist using 2 nylon straps, choked to tub. Straps must lay side by side, flat against tube, so they clear the support towers. Tape a level on top of Tube. Pick up tube until free to slide. Monitor Q1 dial indicator to ensure this does not lift the magnet.

### **Cantilever**

73. Raise Support 11 until Q1 support (Support 9) start to lift off, let Support 14 free to move. Loosen temp support bolts on sled to gauge load on support 10. Remove Q1 temp support (Support 9).
74. Cantilever Q1 by driving down  $\frac{3}{4}$  nuts at Support 14. Monitor dial indicators to look for X drift. Check Support 8, temp support, and dial indicators to see when Q1 is fully cantilever (temp support will be free to move).
75. Remove Q1 temp support (Support 8). Unbolt and remove all four brass Q1 support brackets through cut-out in Support Tube. Remove studs and mounting blocks (TAKE CARE NOT TO DROP HARDWARE DOWN INTO SUPPORT TUBE).
76. Move Backward Tube and crane back from IP until the tube reaches Support 10 and open up Support 8.
77. Reinstall Q1 brass support brackets, temp support with #10 screws through to the brass brackets, and re-bolts to sled supports. Watch dial indicators.
78. Come off Support 14 by screwing up nuts to set Q1 back on Support 8 temp support and bolt down.

### **Reverse Loading**

79. Lift Support 14 until Support 11 lower nuts are free to turn
80. Remove Support 11 and dial indicator.
81. Slide Backward SST over Cantilever Tube until end clears Q1, Support 9
82. Reinstall Q1, Support 9, Q1 brass brackets, temp supports with #10 screws through to the brass brackets and re-bolt to sled supports. Q1 Magnet should not have moved much at all (and sled towers have not moved, either) so supports should go back together. Monitor dial indicators to check position.
83. Remove Support 14 and move Backward SST off Cantilever Tube and place on floor in wood cradle.