

The only official copy of this file is the one on-line on the Superconducting Magnet Division website. Before using a printed copy, verify that it is the most current version by checking the document issue date on the website.

RHIC-MAG-R-8793B
Page 1 of 7

1. Scope:

This specification describes the procedure for final cold mass assembly on the CQ13 combined element units. Included are beam tube/BPM installation, end volume installation, electro-mechanical electrical tests, tie rod block, beam tube flange, and cover patch welding.

2. Applicable Documents:

The following documents, of the issue in effect at the time of release for manufacture, form a part of this procedure to the extent specified herein:

RHIC-MAG-Q-1004	Discrepancy Reporting Procedure
RHIC-MAG-Q-1000	Procedure for Control of Measurement Test Equipment
RHIC-MAG-R-7398	RHIC CQS Final Electrical Testing of Cold Mass

BNL Drawings:

12050384-01 thru -08	13cm CQ1 Integrated Cold Mass Assy
12050380-01 thru -08	13cm CQ2 Integrated Cold Mass Assy
12050382-01 thru -08	13cm CQ3 Integrated Cold Mass Assy
12020552-01 thru -04	CQ1 Electro-Mechanical Assembly
12050236-01 thru -04	CQ2 Electro-Mechanical Assembly
12050239-01 thru -04	CQ3 Electro-Mechanical Assembly
12020558-01 thru -08	CQ1 Beam Tube/BPM & End Volume Assy
12050254-01 thru -08	CQ2 Beam Tube/BPM & End Volume Assy
12050255-01 thru -08	CQ3 Beam Tube/BPM & End Volume Assy

3. Requirements:

All assembly work shall be done in accordance with the drawings and parts lists, and the installation and welding sequence described below.

All welding shall be performed by welders qualified in accordance with ASME Section IX. The welding parameters shall be set in accordance with those specified during welding process development.

The only official copy of this file is the one on-line on the Superconducting Magnet Division website. Before using a printed copy, verify that it is the most current version by checking the document issue date on the website.

RHIC-MAG-R-8793B
Page 2 of 7

3.1 Material/Equipment:

Electronic Digital Micrometer Depth Gauge
(Starrett No. 735BZ-6RL)
Electronic Digital Micrometer Height Gauge
(Starrett No. 752)

25-1603.01-4	CQ13 Twist Bridge with Inclinometer
25-1679.01-5	CQ13 Inspection Fixture
25-1666.01-5	CQ13 Combined Element Joining Fixture
25-1674.01-5	End Volume Positioning Dolly (CQ1-LE/CQ2-LE)
25-1674.02-5	End Volume Positioning Dolly (CQ1-NLE)
25-1674.03-5	End Volume Positioning Dolly (CQ2,CQ3 NLE)

3.2 Safety Precautions:

- 3.2.1 Welding operations shall be conducted in Designated Cutting/Welding Areas or with a welding permit. Failure to observe these safety precautions may result in fire.
- 3.2.2 Operators shall be trained by their cognizant technical supervisor and qualified in the operation of the welding equipment
- 3.2.3 No welding shall take place unless all welding screens are in place around the welding station, and all personnel not directly involved with the welding process are outside the screens. Any personnel inside the screens shall wear protective gear to prevent eye injury, and shall be clothed to prevent burns caused by intense ultra-violet light.
- 3.2.4 All lifting and handling operations requiring overhead crane operations shall be performed by holders of valid Safety Awareness Certificates. They shall also be trained and certified in the use of the appropriate lifting device by the Cognizant Engineer or Technical Supervisor.
- 3.2.5 Hard hats are required when the overhead crane is in use. Failure to observe this caution may result in head injury.
- 3.2.6 The technicians shall be qualified by their cognizant technical supervisor in the operation of the required electrical test equipment and the electrical testing procedures. They shall be familiar with the latest revisions of the applicable documents referenced in Section 2. In addition, some of these tests require the technician to have special training.

3.2.7 Some of the electrical test procedures have specific safety requirements. The technicians performing these specific tests shall rigorously follow all the safety requirements listed as well as those prescribed by the BNL ES&H Standard.

3.2.8 Hypot and impulse testing pose a Class "C" electrocution hazard. At least two properly trained technicians must be present to perform this testing. When testing, a trained technician shall be stationed at any point where the item under test is accessible to unauthorized people, and barriers shall be set up. Signs shall be posted reading "DANGER HIGH VOLTAGE" and warning lights shall be turned on.

3.3 Procedure:

3.3.1 Beam Tube/BPM Installation

3.3.1.1 Support the cold mass assembly either on the roller bench or on the welding (joining) fixture (vise pads engage yoke survey flats thru shell holes). The cold mass must be right-side up.

3.3.1.2 Make one last physical inspection of the end volume electro-mechanical hardware before closing it up. Check for potential grounding problems and that warmup heater leads and voltage tap leads are properly routed and strain relieved.

3.3.1.3 Select a complete and leak checked Beam Tube/BPM assembly from the storage rack. Visually inspect for possible damage to the conflat flange knife edge, feedthru, bellows, and Kapton insulation.

NOTE: In the case of the CQ2, there is no BPM assembly.

3.3.1.4 (CQ1 and CQ3 only) Verify that the BPM mounting and alignment plates are properly installed, that the mounting bolts are fully welded to the mounting plate (not just tacked), and that the surfaces of the mounting plate, alignment plate, and the mating BPM flange are clean and free of protrusions.

3.3.1.5 At the beam tube lead end, where the Kapton insulating wrap terminates (end of wrap direction) check that the Kapton insulation has been secured against unraveling with Kevlar string and epoxy. If for some reason this has not been done, apply the Kevlar and epoxy in accordance with the applicable engineering drawing before installing the beam tube into the magnet.

- 3.3.1.6 (CQ1 and CQ3 only) Orient the Beam Tube/BPM assembly properly for insertion into the CQ13 from the non-lead end. The two dowel pins in the mounting flange must engage the corresponding mating holes in the alignment plate.
- 3.3.1.7 (CQ1 and CQ3 only) Attach the nylon protective plug to lead end of the beam tube. Carefully insert the Beam Tube/BPM assembly into the CQ13 from the non-lead end taking care not to damage the beam tube Kapton insulation or the coil ID. The dowel pins must be fully inserted and the BPM flange fully seated against the alignment plate (by hand force only) before any mounting bolts are installed. If the BPM mounting flange fails to fully seat against the alignment plate with minimal effort, carefully remove the Beam Tube/BPM assembly, and determine and remedy the cause of obstruction.
- 3.3.1.8 (CQ1 & CQ3 only) Install the eight mounting bolts and lock washers, and torque to 75 in.-lb. in increments of 25 in.-lb. using a crisscross torquing sequence.
- 3.3.1.9 (CQ2 only) Attach the plastic plug to lead end of the beam tube (Kapton wrap always terminates at the lead end). Carefully insert the tube into the CQ2 assembly from the non-lead end (corrector end) taking care not to damage the beam tube Kapton insulation or the coil ID.

NOTE: It is very important to slide the beam tube into the cold mass so that the end of the Kapton wrap enters first. This is the preferred direction of insertion since it will minimize catching, ripping, and chafing of the Kapton insulation.

3.3.2 End Volume Installation

- 3.3.2.1 Set the cold mass unit onto the welding fixture with the lead end facing the roller dolly. The vise pads must engage the yoke survey flats at each end, closest to the end plates. Lightly tighten the vises. Then clamp down the cold mass against the vises with band clamps. Finally, tighten the vises firmly against the vertical yoke survey surfaces.
- 3.3.2.2 Install the end volume positioning fixture onto the roller dolly of the CQ13 joining fixture.
- 3.3.2.3 Obtain the correct set of approved and leak checked end volume assemblies. Note that end volumes to be installed on corrector ends must have the corrector lead flex hose assembly welded, leak checked, and secured with the support bracket in place, prior to their use.

The only official copy of this file is the one on-line on the Superconducting Magnet Division website. Before using a printed copy, verify that it is the most current version by checking the document issue date on the website.

RHIC-MAG-R-8793B
Page 5 of 7

- 3.3.2.4 Install the lead end volume onto the positioning fixture. Set its rotational position and lock it onto the fixture.
- 3.3.2.5 Roll the lead end volume in its fixture towards the cold mass assembly until the end volume contacts the cold mass lead end plate. On CQ3 units, feed the corrector power leads through the flex line and support it adequately. Adjust the height and lateral position of the end volume until it can slide over the end plate and then lock these positions. Set the axial position of the end volume (allow for approximately .050 length reduction due to MIG weld shrinkage). Then, lock it in its axial position.
- 3.3.2.6 Tack weld the end volume to the end plates using 2 inch long TIG tacks of P/N 12010441-03 filler wire equally spaced around the end volume in 8 places. Tack in a skip-weld pattern, placing 4 welds on the first pass, and following with 4 more welds on the second pass.
- 3.3.2.7 Unclamp the cold mass unit from the fixture, lift it up, turn it around end-to-end, and lower it back onto the fixture (also rotate it 180 deg. for Q3 only). Engage the vise pads and band clamps per 3.3.2.1 in preparation for positioning and tacking of the non-lead end volume.
- 3.3.2.8 Install the non-lead end volume and its positioning fixture onto the roller dolly. Set its rotational position and lock it onto the fixture.
- 3.3.2.9 Roll the non-lead end volume in its fixture towards the cold mass assembly until the end volume contacts the cold mass non-lead end plate. On CQ2 units, feed the corrector power leads through the flex line and support it adequately.
- NOTE: When tack welding the Q3 NLE end volume, the cold mass must be upside-down for the exiting power leads to clear the fixture.
- 3.3.2.10 On CQ3 units, the non-lead end volume assembly lacks the end flange thereby facilitating installation. Fit it into place with the 6.75 inch OD conflat flange facing upward (cold mass is upside-down) and the triplet power lead cables fed through the 4 inch OD pipe.
- 3.3.2.11 Adjust the height, rotation, and lateral position of the end volume until it can slide over the end plate and then lock these positions. Set the axial position of the end volume so to achieve the overall length from end volume face-to-face as called out on the assembly drawing (allow for approximately .050 length reduction due to MIG weld shrinkage). Then, lock the end volume in its axial position.

- 3.3.2.12 Tack weld the non-lead end volume per step 3.3.2.6.
- 3.3.2.13 On CQ3 units, Fit the non-lead end volume flange onto the sleeve, while feeding the corrector power leads through the flex line. Set its axial position in order to achieve the overall length from end volume face-to-face as called out on the assembly drawing (allow for approximately .050 length reduction due to MIG weld shrinkage). Then, lock the flange in its axial position. Tack weld the flange to the sleeve per step 3.3.2.6.
- 3.3.2.14 Perform the complete series of final E/M electrical tests per RHIC-MAG-R-7398.
- 3.3.2.15 Transport the cold mass assembly to the rotary MIG welding fixture. MIG weld the end volumes to the end plates. On the CQ3 unit, also MIG weld the outer flange to the sleeve of the non-lead end volume. If two weld passes are required, stagger the start of the second pass 180 deg. from the start of the first pass. If three weld passes are required, stagger the start of the second pass 120 deg. from the start of the first pass and stagger the start of the third pass 120 deg. from the start of the second pass. Allow the weld to cool for at least 15 minutes between weld passes so as not to overheat the interconnect wires.

NOTE: Thoroughly and carefully secure all power lead harnesses so that they do not get bruised by being stepped on, become entangled in machinery, or burned by weld splatter.

3.3.3 Additional Welding Operations

- 3.3.3.1 Transfer the cold mass to the roller bench. On CQ1 and CQ3 units, seal weld the BPM collar to the face of the end volume by TIG welding using filler wire (12010441-03).
- 3.3.3.2 Seal weld the beam tube at the lead end to the end volume by TIG welding using filler wire (12010041-03). On CQ2 units, seal weld the beam tube to the end volumes at both ends.
- 3.3.3.3 Weld the beam tube flange at the lead end. On CQ2 units, do the same at the non-lead end.

The only official copy of this file is the one on-line on the Superconducting Magnet Division website. Before using a printed copy, verify that it is the most current version by checking the document issue date on the website.

RHIC-MAG-R-8793B
Page 7 of 7

- 3.3.3.4 On CQ1 and CQ2 cold mass units, weld two tie rod blocks to each end volume in accordance with the applicable engineering drawing and cold mass model designation. On CQ3 cold mass units, weld two tie rod blocks to only the lead end volume in accordance with the applicable engineering drawing and cold mass model designation.
- 3.3.3.5 Transport the cold mass to the TIG patch welding station. Weld the .25 inch thick cover patches over the shell holes.
- 3.3.3.6 After all welds have cooled, measure the overall cold mass length across the face of the end volumes and record this measurement in the traveler.
- 3.3.3.7 Have a certified weld inspector check all welds for defects.
- 3.3.3.8 Mark the finished assembly with the part number, model number, and cold mass serial number as shown on the assembly drawing.

4. Quality Assurance Provisions:

- 4.1 The Quality Assurance provisions of this procedure require that all assembly and test operations be performed in accordance with the procedural instructions contained herein.
- 4.2 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.
- 4.3 All discrepancies shall be identified and reported in accordance with RHIC-MAG-Q-1004.

5. Preparation for Delivery:

N/A