



1            Scope:

This procedure describes the steps to assemble D2 /D4 QQS magnet assemblies.

2            Applicable Documents:

14060007	QQS Assembly, D2
14060009	QQS Assembly, D4
<a href="#">RHIC-MAG-Q-1004</a>	<a href="#">Discrepancy Reporting Procedure</a>

3            Requirements:

3.1          Material/Equipment:

Welding Fixture	BNL Dwg. 25-1884.01
Lifting Beam	BNL Dwg. 25-1782.02

3.2          Safety Precautions:

3.2.1        All lifting of the cryostatted magnet shall to conform to Appendix A.

3.2.2        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.

3.2.3        Operators shall be trained by their cognizant technical supervisor and qualified in the operation of the required welding equipment.

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 instructed in the use of the appropriate lifting device by the Cognizant Engineer or Technical Supervisor.

3.2.5        Examine all pressure test equipment before pressure is applied to ensure it is tightly connected.

3.2.6        Suitable precautions shall be taken during pressure testing to eliminate hazards to personnel in the proximity of the test in the event of a rupture.

3.2.7        Safety glasses must be worn during potential eye damaging operations.

3.2.8        All relief devices and gauges used for pressure tests shall meet the requirements of ES&H standard 1.4.1.

- 4 Procedure
- 4.1 Pressure Test
  - 4.1.1 Trim and cap the t line at the lead end and the two test lines on the non-lead end.
  - 4.1.2 Install a wire canister on the lead stub (M/C) of the cold mass.
  - 4.1.3 Install a blank flange on the D stub flange.
  - 4.1.4 Pressurize the cold mass with nitrogen to 305 psig and hold for 10 minutes.

**NOTE**

**This pressure is equivalent to 290 PSIA, the MAWP of the vessel**

- 4.2 Lead End Preparation
  - 4.2.1 Trim the M/C and D stubs on the lead end.
  - 4.2.2 Install and weld the machined flanges on the M/C and D stubs, using argon purge inside.
  - 4.2.3 Trim the heat shield line at the lead end.
  - 4.2.4 Install and weld adapter piece to the heat shield line, using argon purge inside.
- 4.3 Piping Installation
  - 4.3.1 Remove caps from LD and CL stubs on top of end volume, taking care not to allow chips inside. Remove flanges from heat shield connections.
  - 4.3.2 Install e2 line through the heat shield and position the lead end as shown on the assembly drawing.
  - 4.3.3 Install and weld the retainers for the e2 line at both ends.
  - 4.3.4 Determine proper direction of QQS piping in accordance with type of assembly being built.

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- 4.3.5 Install temporary alignment jig to position all four pipes in their proper orientation. Jig will align pipe ends to conform with positions dictated in D2/D4 Interface Specifications.
- 4.3.6 Locate LD, CL, e1, and e2 pipes in the jig. Align other end of each pipe to the appropriate pipe ends prepared. Tack weld in place.
- 4.3.7 Complete full penetration welds, using argon purge inside.
- 4.3.8 Temporarily blank off the e1 line at the lead end. Attach a vacuum pump and leak detector to the e1 line at the QQS.
- 4.3.9 Pump down and check externally for leaks using helium. Leak rate not to exceed  $2 \times 10^{-10}$  Std cc He /Sec.
- 4.3.10 Repeat for the e2 line.
- 4.3.11 Temporarily and simultaneously blank off the D and m/c lines at the lead end. Temporarily blank off the CL line at the QQS.
- 4.3.12 Attach a vacuum pump and leak detector to the LD line at the QQS.

### **WARNING**

#### **Explosive Hazard !**

**Hydrogen Deuteride is highly flammable. No spark producing operations are permitted near area. Extreme caution is require to prevent gas accumulation**

- 4.3.13 Pump down and check externally for leaks using Hydrogen Deuteride (HD). Leak rate not to exceed  $2 \times 10^{-10}$  Std cc Hydrogen Deuteride /Sec.

### **NOTE**

**This check is done using the same leak rate as that used during the checks done with helium**

- 4.3.14 After completion of test, relieve the vacuum by backfilling with nitrogen.
- 4.3.15 Remove the blank flange, wire canister, and blank-off plates from lead end.

**NOTE**

**No pressure testing of these four welds will be done until installation of the magnet at CERN.**

- 4.3.16 Attach the flat terminal of each thermal stationing strap to the e1 and e2 pipe bosses using stainless screws and lock washers. There is one strap per pipe. The proper attachment boss must be determined from the drawing and the dash no. being constructed.
- 4.4 Insulating Pipes & End Volumes
  - 4.4.1 Helically wrap MLI around each pipe in accordance with the drawing, 2 layers at 50% overlap each layer. Wrap over the thermal stationing bosses. In addition, wrap the strap assemblies more loosely with one layer at 50% overlap to allow maximum flexibility.
  - 4.4.2 Tie each loose end of insulation using Kevlar cord. Secure surgeon's knot with epoxy.
  - 4.4.3 Apply pre-made MLI blankets to the end volume domes and sleeves. Tape in place and tie securely using Kevlar cord and epoxy.
- 4.5 Heat Shield Extension Assembly
  - 4.5.1 Position the heat shield extension so that it is resting on the lower heat shield and butted against the main upper heat shield.
  - 4.5.2 Place temporary ceramic fiber blanket over cold mass MLI to prevent burning during welding.
  - 4.5.3 Tack weld the shield extension to the main shield and to the lower shield while maintaining proper alignment.
  - 4.5.4 Complete all heat shield welds in accordance with the weld call-out on the drawing.
  - 4.5.5 Remove the two ceramic fiber blankets. Inspect cold mass MLI.
- 4.6 Insulating Heat Shield Extension
  - 4.6.1 Install both inner and outer MLI blankets for the heat shield extension. Tape them to the main blanket at the two butt joints.

4.7 Heat Shield Hood

4.7.1 Install the three piece pipe guide around the pipes just above the shield as shown on the drawing. The guide is designed to clamp around the MLI on the pipes. Do not over tighten the screws or the inserts will pull out of the G-10 holes.

4.7.2 The heat shield hood is made in three sections, two vertical and one horizontal.

4.7.3 Attach the two vertical hood sections to the respective curved terminal ends of the thermal straps that were previously installed on the e1 and e2 pipes, using the hardware specified on the drawing.

4.7.4 Weld the two vertical hood sections together.

4.7.5 Attach the vertical hood sub-assembly to the upper heat shield extension using shoulder screws. The hood sub-assembly must be free to slide longitudinally for a distance of .63 inches away from the magnet's center. Therefore, the hood must be positioned initially as close to the longitudinal center as possible. (In operation, the main magnet shield and attached extension slide toward the magnet center, but the hood remains fixed with respect to the vacuum vessel.)

4.7.6 Slide the horizontal hood section over the pipe ends and align it to the vertical section at the miter joint.

4.7.7 Weld the horizontal and vertical sections together.

4.8 Insulating Heat Shield Hood

4.8.1 Install the MLI blankets on the vertical and horizontal sections of the hood. There are two layers of blankets to be installed. Tape the MLI joints securely to prevent slipping of the blankets.

4.8.2 Mount the shield stand-offs (.50 dia. G-10 dowels) on the outside of the MLI. The positions of the two transverse planes are not critical. There are four stand-offs per plane. Thread the cord through the stand-off, around the outside, tie a knot at the entrance point, thread through the hole again, then tie at the exit point. This is necessary to prevent the stand-offs from shifting position or bunching together.

- 4.8.3 Apply epoxy to the knots in the cord, to the tape joint edges at the miter(in case of adhesive failure), and to the cord where it touches the MLI (to prevent slippage).
- 4.9 Cryostat Extension Assembly
  - 4.9.1 Align the cryostat extension with the main cryostat.
  - 4.9.2 Tack weld the cryostat extension onto the main cryostat.
  - 4.9.3 Install the filler piece of the cryostat extension. Tack weld in place.
  - 4.9.4 Install temporary ceramic fiber blankets inside the cryostat extension under the weld joints.
  - 4.9.5 Final weld the extension parts together and to the main cryostat. Let cool.
  - 4.9.6 Remove the ceramic fiber blankets and inspect MLI.
- 4.10 Cryostat Hood
  - 4.10.1 The cryostat hood is made in two sections. Place the two hood sections together around the heat shield insulation. Check fit of .50 dia stand-offs inside the hood. They should be in contact and only slightly compressing the MLI.
  - 4.10.2 Attach the two sections together with tack welds.
  - 4.10.3 Align the hood sub-assembly on the cryostat extension. At the bottom end the hood should be centered on the hole in the cryostat extension. Its surface at the interface end must be parallel to the magnet's longitudinal axis.
  - 4.10.4 Tack weld the hood sub-assembly to the extension in accordance with the weld symbols on the drawing.
  - 4.10.5 Final weld the hood sub-assembly together and complete the welds to the extension.
  - 4.10.6 Vacuum leak check the extension and hood sub-assemblies. Leak rate not to exceed  $1 \times 10^{-9}$  atm cc/sec helium.

## 5 Quality Assurance Provisions:

- 5.4 The Quality Assurance provisions of this procedure require that all assembly and test operations be performed in accordance with the procedural instructions contained herein.

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- 5.5 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.
- 5.6 All discrepancies shall be identified and reported in accordance with RHIC-MAG-Q-1004.

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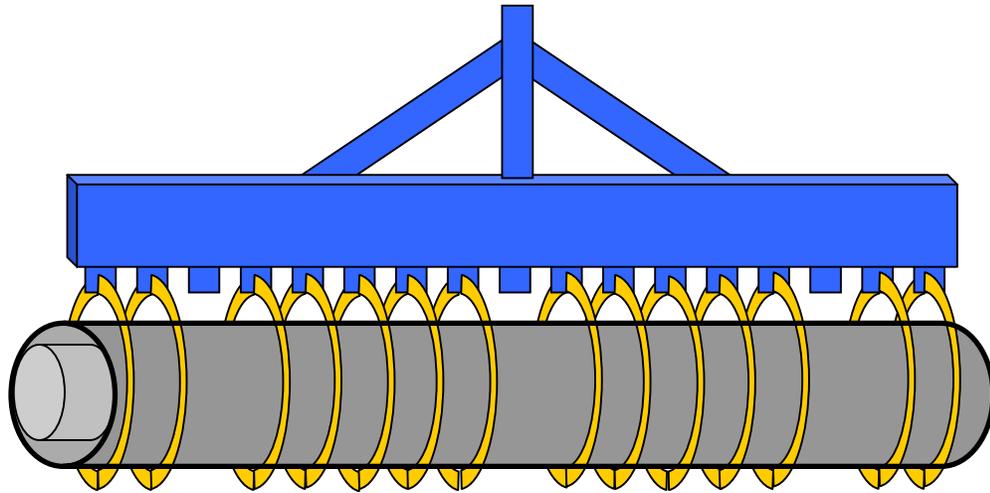
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Appendix A - Lifting Scheme for Cryostatted D2 Magnet

**CAUTION**

**Weight of D2 Magnet Assembly exceeds rating of the Lifting Beam (BNL Dwg. 25-1782.02). Use of this device is permitted to lift the D2 Magnet Assembly only if load is equally distributed on 14 of 17 lifting lugs (center lug and lugs 3 from each end are not used).**

Using 14 slings and Lifting Beam 25-1782.02 as shown below to move the magnet assembly.



**Magnet Assembly Rigging**