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RHIC-MAG-R-7393A

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1. Scope:

This procedure lists the details of the electrical testing of the RHIC dipole magnet cold mass after it is completely assembled. Checks are made of the insulation integrity and resistances of various components.

2. Applicable Documents:

| | |
|-----------------|---|
| RHIC-MAG-R-7228 | RHIC Dipole Coil Inductance and Q Measurements |
| RHIC-MAG-R-7242 | RHIC Dipole Hypot Testing |
| RHIC-MAG-R-7243 | RHIC Dipole Low Precision Resistance Insulation Test |
| RHIC-MAG-R-7306 | RHIC Dipole High Precision Resistance Insulation Test |
| RHIC-MAG-R-7244 | RHIC Dipole Megger High Voltage Insulation Test |
| RHIC-MAG-R-7319 | RHIC Dipole Ratiometer Test |
| RHIC-MAG-R-7320 | RHIC Dipole Resistance Measurement for Collard Individual Coils and Connected Coil Sets |

3. Requirements:

DC constant current source, 1.0 and 0.1 ampere, isolated from ground.

3.1 Safety - Each of the electrical test procedures given in Section 2 above have requirements on safety procedures to be followed. The technicians who perform the tasks listed below must be aware of these procedures and must follow them while completing the work.

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3.2 Procedure:

3.2.2 Main Coil Insulation Tests:

3.2.2.1 Record magnet temperature: _____°C.

Record RHIC-MAG-R-7242 Rev. No. _____.

Record RHIC-MAG-R-7243 Rev. No. _____.

Record RHIC-MAG-R-7244 Rev. No. _____.

3.2.2.2 Temporarily connect the main coil leads and voltage tap wires together. Connect the yoke, warm-up heaters, strain gauge wires and beam tube to ground. _____

Caution: Temporarily install a jumper across the diode terminals until all insulation testing is complete. _____

3.2.2.3 Perform an ohmmeter test of the resistance between the main coil leads/voltage tap wires and ground following RHIC-MAG-R-7243; check that it measures a minimum of 20 MΩ. Then perform a Megger test at 1 kV following RHIC-MAG-R-7244. Perform a hypot test at 5 kV following RHIC-MAG-R-7242; check that the leakage current is less than 50 μA. Fill in the measured resistances and hypot leakage current. _____

Ohmmeter _____ Ω (>20MΩ)

Megger at 1 kV _____ Ω

Hypot leakage current at 5 kV _____ μA (<50μA after one min.)

Describe any necessary repairs: _____

Above work done By: _____

Name & Life No., Date

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3.2.3 Warm-Up Heater Insulation Tests:

3.2.3.1 Temporarily connect all warm-up heaters together. Connect the main coil leads, yoke and beam tube to ground. _____

3.2.3.2 Perform an ohmmeter test of the resistance between the warm-up heaters and ground following RHIC-MAG-R-7243; check that it measures a minimum of 20 MΩ. Then perform a hypot test at 2 kV following RHIC-MAG-R-7242; check that the leakage current is less than 50 μA. Fill in the measured resistance and hypot leakage current.

Ohmmeter _____ Ω (>20MΩ)

Hypot leakage current at 2 kV _____ μA (<50μA)

3.2.3.3 Temporarily connect three (of four) warm-up heaters together and to ground. Perform an ohmmeter test of the resistance between the "fourth" warm-up heater and ground following RHIC-MAG-R-7243; check that it measures a minimum of 20 MΩ. Then perform a hypot test at 2 kV following RHIC-MAG-R-7242; check that the leakage current is less than 50 μA. Fill in the measured resistance and hypot leakage current in the table in Section 3.2.3.4.

3.2.3.4 Reconnect the warm-up heaters to test the insulation of the remaining three heaters following the description given above. Record the data in the table below.

| <u>Warm-Up Heater #</u> | <u>Ohmmeter (Ω)</u> | <u>Hypot Leakage Current at 2 kV (μA)</u> |
|-------------------------|-------------------------|---|
| 1 | _____ | _____ |
| 2 | _____ | _____ |
| 3 | _____ | _____ |
| 4 | _____ | _____ |

Describe any necessary repairs: _____

Above work done By: _____

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3.2.4 Spot Heater Insulation Tests:

3.2.4.1 Temporarily connect all spot heaters together. Connect the main coil leads, yoke and temperature sensors to ground. _____

3.2.4.2 Perform an ohmmeter test of the resistance between the spot heaters and ground following RHIC-MAG-R-7243; check that it measures a minimum of 20 MΩ. Then perform a hypot test at 2 kV following RHIC-MAG-R-7242; check that the leakage current is less than 50 μA. Fill in the measured resistance and hypot leakage current. _____

Ohmmeter _____ Ω (>20MΩ)

Hypot leakage current at 2 kV _____ μA (<50μA)

3.2.4.3 Temporarily connect three (of four) spot heaters together and to ground. Perform an ohmmeter test of the resistance between the "fourth" spot heater and ground following RHIC-MAG-R-7243; check that it measures a minimum of 20 MΩ. Then perform a hypot test at 2 kV following RHIC-MAG-R-7242; check that the leakage current is less than 50 μA. Fill in the measured resistance and hypot leakage current in the table below. _____

3.2.4.4 Reconnect the spot heaters to test the insulation of the remaining three heaters following the description given above. Record the data in the table below. _____

| <u>Spot Heater #</u> | <u>Ohmmeter (Ω)</u> | <u>Hypot Leakage Current at 2 kV (μA)</u> |
|----------------------|---------------------|---|
| 1 | _____ | _____ |
| 2 | _____ | _____ |
| 3 | _____ | _____ |
| 4 | _____ | _____ |

Describe any necessary repairs: _____

Above work done By: _____

Name & Life No., Date

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3.2.5 Strain Gauge Insulation Test:

3.2.5.1 Temporarily connect all strain gauge wires together. Perform a high precision ohmmeter insulation test between these wires and the yoke following RHIC-MAG-R-7306; check that the resistance measures a minimum of 2 GΩ. Fill in the measured resistance.

Record RHIC-MAG-R-7306 Rev. No. _____.

G-Ohmmeter _____ Ω (>2GΩ)

Describe any necessary repairs: _____

Above work done By: _____

Name & Life No., Date

3.2.6 Temperature Sensor Insulation Test:

3.2.6.1 Temporarily connect all temperature sensors together. Perform a high precision ohmmeter insulation test between these wires and the yoke following RHIC-MAG-R-7306; check that the resistance measures a minimum of 2 GΩ. Fill in the measured resistance.

Record RHIC-MAG-R-7306 Rev. No. _____.

G-Ohmmeter _____ Ω (>2GΩ)

Describe any necessary repairs: _____

Above work done By: _____

Name & Life No., Date

3.2.7 DC Resistance Tests:

Follow the procedure given in RHIC-MAG-R-7320 to measure voltage drops across various components of the magnet.

Record RHIC-MAG-R-7320 Rev. No. _____.

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3.2.7.1 Voltage Drops Across Main Coil Individual Windings

Supplying 1 amp DC across the entire magnet winding, such that the protection diode is reversed biased, measure the voltage drop across each coil. _____

Record magnet/coil temperature.

Temperature: _____ °C _____

| | | |
|-----------------------|-----------------|-----------------|
| | Coil #__ | Coil # |
| | Lower | Upper |
| <u>Coil (DVM No.)</u> | <u>Coil (1)</u> | <u>Coil (2)</u> |
| Voltage | _____ V | _____ V |

3.2.7.2 Voltage Drops Across Main Coils In Series

Supplying 1 amp DC across the entire magnet winding, such that the protection diode is reversed biased, measure the voltage drops between the positive lead and the voltage taps listed below.

For voltage tap locations, see BNL Dwg. _____.

| | <u>Voltage Tap Wire</u> | <u>Voltage (V)</u> | <u>Typical Values</u> |
|-------------|-------------------------|--------------------|-----------------------|
| Positive to | BLK | _____ | <u>0.0005 V</u> |
| Positive to | WHT | _____ | <u>1.6005</u> |
| Positive to | RED | _____ | <u>3.2001</u> |

3.2.7.3 Protection Diode Check:

Reconnect the 1 ampere constant current source so that the protection diode is forward biased and record the voltage drop across the entire magnet winding. _____

| | | |
|---------|-------------|---------------------|
| | | Typical Value |
| Voltage | _____ Volts | <u>.805 V</u> _____ |

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3.2.7.4 Voltage Drops Of Warm-Up Heaters

Supplying 1 amp DC separately across each warm-up heater, record the voltage drop over the length of each.
(Typical value = 1.8V) _____

| <u>Warm-Up Heater #</u> | <u>Voltage (V)</u> |
|-------------------------|--------------------|
| 1 | _____ |
| 2 | _____ |
| 3 | _____ |
| 4 | _____ |

3.2.7.5 Voltage Drops Across Spot Heaters

Supplying 0.1 amp D.C. separately across each spot heater at the terminal ends, record the voltage drops. _____

(Typical Values = 0.03 to 0.3V)

| <u>Spot Heater #</u> | <u>Voltage (V)</u> |
|----------------------|--------------------|
| 1 | _____ |
| 2 | _____ |
| 3 | _____ |
| 4 | _____ |

Describe any necessary repairs: _____

Above work done By: _____

Name & Life No., Date

3.2.8 Ratiometer Test:

Follow the procedure given in RHIC-MAG-R-7319 to perform a ratiometer test of the main coils. Record RHIC-MAG-R-7319 Rev. No. _____. Attach the test results data sheet to this traveler.

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Describe any necessary repairs: _____

Above work done By: _____

Name & Life No., Date

3.2.9 Inductance and Q Measurements:

Follow the procedure given in RHIC-MAG-R-7228 to measure the inductance and Q of the main coils. Use a 120 Hz series connection. Record RHIC-MAG-R-7228 Rev. No. _____. Typical Values: L = 28.35 mHy, Q = 3.75.

Temperature: _____ °C

Measured Inductance: _____ Hy

Measured Q: _____

Describe any necessary repairs: _____

Above work done By: _____

Name & Life No., Date

3.2.10 Temperature Sensor Diode Voltage Drops:

Using a Fluke 77 for diod test, measure diode voltage drop for each temperature sensor and record below. Verify polarity.

| <u>Temp. Sensor Diode</u> | (Typical Values = 0.6) <u>Voltage (V)</u> |
|---------------------------|--|
| 1A | _____ |
| 1B | _____ |
| 2A | _____ |
| 2B | _____ |
| 3A | _____ |
| 3B | _____ |
| 4A | _____ |
| 4B | _____ |

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Describe any necessary repairs: _____

Above work done By:

Name & Life No., Date

3.2.11 Strain Gauge Tests:

Read out the strain gauges and check that they are working properly. Attach test results data sheet(s) to this traveler.

Describe any necessary repairs: _____

Above work done By:

Name & Life No., Date

3.2.12 Fill in the required data in the "List of Equipment Used for Measurements" table or attach a listing to traveler. _____

Above work done by:

Name, Life No., Date

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List of Equipment Used for Measurements

| Nomenclature | Manufacturer | Model | Serial No. | BNL Bar Code |
|----------------|--------------|-------|------------|--------------|
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| Remarks: _____ | | | | |
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4. Quality Assurance Provisions:

4.1 The Quality Assurance Provisions of this procedure requires compliance with the procedural instructions contained herein and the recording of test results on the attached data sheets.

5. Preparation for Delivery:

N/A