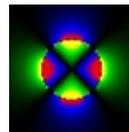


The only official copy of this file is the one on-line on the Superconducting Magnet Division website. Before using a printed copy, verify that it is the most current version by checking the document issue date on the website.

Magnet Division Procurement Specification

Specification Number: SMD-DX-2001

Revision: A



Superconducting
Magnet Division

DX Magnet Coil Curing Heater System Procurement Requirements

- Prepared by: [Signature on File 4/6/2009](#)
P. Kovach
- Cognizant Engineer: [Signature on File 4/6/2009](#)
P. Kovach
- Production Section Head: [Signature on File 4/6/2009](#)
M. Anerella
- Electrical Engineering: [Signature on File 4/6/2009](#)
P. Joshi
- Q. A. Approval: [Signature on File 4/6/2009](#)
R. Roberts
- ES&H Review: [Signature on File 4/6/2009](#)
S.H. Moss

Revision History

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.

SMD-DX-2001A

Page 1 of 7

1.0 SCOPE:

This specification establishes the overall requirements for the procurement of the DX Magnet Coil Curing Heater System.

2.0 GENERAL DESCRIPTION:

The DX Magnet Coil Curing Heater System shall be used for heating the DX coil mandrel and form block assembly (tooling) during the coil curing operation (see fig. 3, 4 and 5.). It shall consist of twenty four (24) heaters and all required controls as necessary to establish and maintain the required temperature profile, temperature accuracy and temperature uniformity in the mandrel and form block assembly during the coil curing cycle. The system shall be arranged in four zones consisting of eight heaters in each of two zones and four heaters in each of the remaining two zones. There shall be independent control of each zone by means of two type J thermocouples in each zone. The system shall control the temperature of each zone in response to the higher temperature thermocouple in each zone. This is intended to prevent part of any zone from exceeding the set point temperature and to allow the other thermocouple in each zone to “catch up” as the assembly heat-soaks in order to achieve a high degree of temperature uniformity throughout the thermal mass. The system shall also be capable of manual selection of the individual thermocouple in each zone to be used for control.

All controls, electrical components, etc. shall be packaged in a stand-alone cabinet or console. The console shall be connected to the heaters by means of cables as shown in figure 2.

3.0 TECHNICAL REQUIREMENTS:

The design of the DX Magnet Coil Curing Heater System shall include, but not necessarily be limited to the features, operating requirements and characteristics as specified herein. It shall be designed to best commercial practices and shall be constructed in a thoroughly workmanlike manner.

3.1 Operating temperatures: The Heater System shall ramp the mandrel and form block temperature from room temperature to 225 +/- 5 °C in two program controlled steps. The ramp-up times, the dwell times, the intermediate temperature and the final temperature shall be programmed prior to start of the heat treat cycle and shall be capable of adjustment during the cycle. The control system shall then maintain 225 +/- 5 °C for a predetermined time period before ramping down to room temperature in two program controlled steps. The ramp-down time, the dwell time and the intermediate temperature shall be programmed prior to start of the heat treat cycle and shall be capable of adjustment during the heat treat cycle. The final step down to room temperature need not be controlled. The ramp-up, dwell and ramp-down times shall be approximately 15 minutes to 2 hours each.

3.2 Control system:

The control system shall provide a PC interface by means of an RS232 or RS485 communication protocol. A BNL-supplied PC running LabVIEW software will be used for data logging and temperature set point and temperature profile uploading to the control system. The control system shall provide for both manual and automatic control.

- The temperature measuring system shall consist of two type J thermocouples in each of the four zones
- The control system shall provide for independent control of the 4 zones as specified in paragraph 2.0.
- The control system shall allow change of set-point temperature and temperature profile during operation as well as automatic or manual selection of the thermocouples to be used for control of their respective zones (see paragraph 3.1).
- The control system shall provide for display, recording and remote viewing of a minimum of the eight (8) control thermocouples.
- The control system shall store programs and settings through indefinite power outages
- An over-temperature interlock shall be provided
- The control system shall limit heater watt density to a value consistent with the requirements of paragraph 3.3.

3.3 Heaters:

The heaters shall provide for a minimum of 3100 watts output each (approximately 25 W/in²) for a total power output of 75 KW minimum for the 24-heater system. They shall be “single ended” and shall have a total sheath length of 92.5 inches and a minimum heated length of 91 inches (see fig.1). Power leads shall be flexible, over-braided, high temperature insulated wire. When installed in the tooling, the heaters will be inserted into full length holes of 0.69 inches ID (16 heaters) and 0.5 inches ID (8 heaters). The diameter of the heaters shall be chosen to ensure free passage into these holes with a minimum of .03 inches radial clearance. Their design shall ensure reliable operation under the power/watt density conditions specified herein.

3.4 Other:

3.4.1 Documentation: The following documentation shall be provided by the seller:

- User manuals (including instructions for start-up, operation, maintenance and trouble-shooting) for the control system
- Complete drawings including wiring diagrams
- Control system source files if applicable
- Copies of reports of all required inspections and tests
- Recommended spare parts list

3.4.2 Power requirements: Power supplied shall be 440 VAC, 3 phase, 4 wire, 60 Hz

- Phases shall be balanced to the maximum extent possible (see fig. 6 for a typical example).

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.

SMD-DX-2001A

Page 3 of 7

3.4.3 Safety: The system shall meet all applicable OSHA requirements as well as all applicable federal, state and local codes, including but not necessarily limited to NFPA 70E - Standard for Electrical Safety in the Workplace - 2009 ed.

3.4.3.1 NRTL Recognition: The Seller shall secure NRTL recognition for the heater system.

4.0 OPTIONS:

None specified at this time.

5.0 QUALIFICATION TESTS:

5.1 Test requirements: The system shall pass qualification/acceptance testing at the seller's facility and upon completion of installation at Brookhaven National Laboratory. Testing shall demonstrate as a minimum all applicable requirements set forth in this specification.

6.0 SELLER'S QUOTE:

The seller's quote shall include, but not necessarily be limited to the following:

- Any exceptions or qualifications to this specification. The seller may propose alternatives where cost, schedule and/or performance improvements may be realized
- Description and drawings of the general arrangement of the system
- Electrical schematics of the heater connections and controls
- Maximum power requirements
- Warrantee description

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.

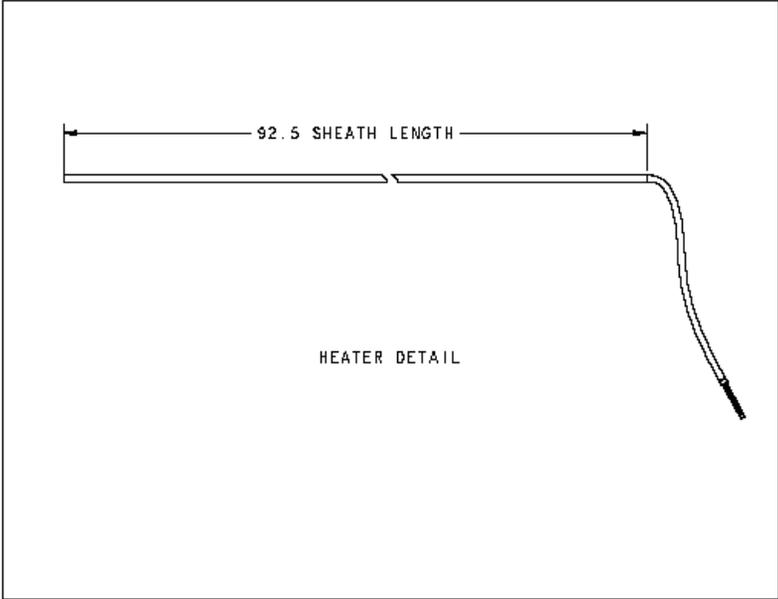


Figure 1.
Heater Detail

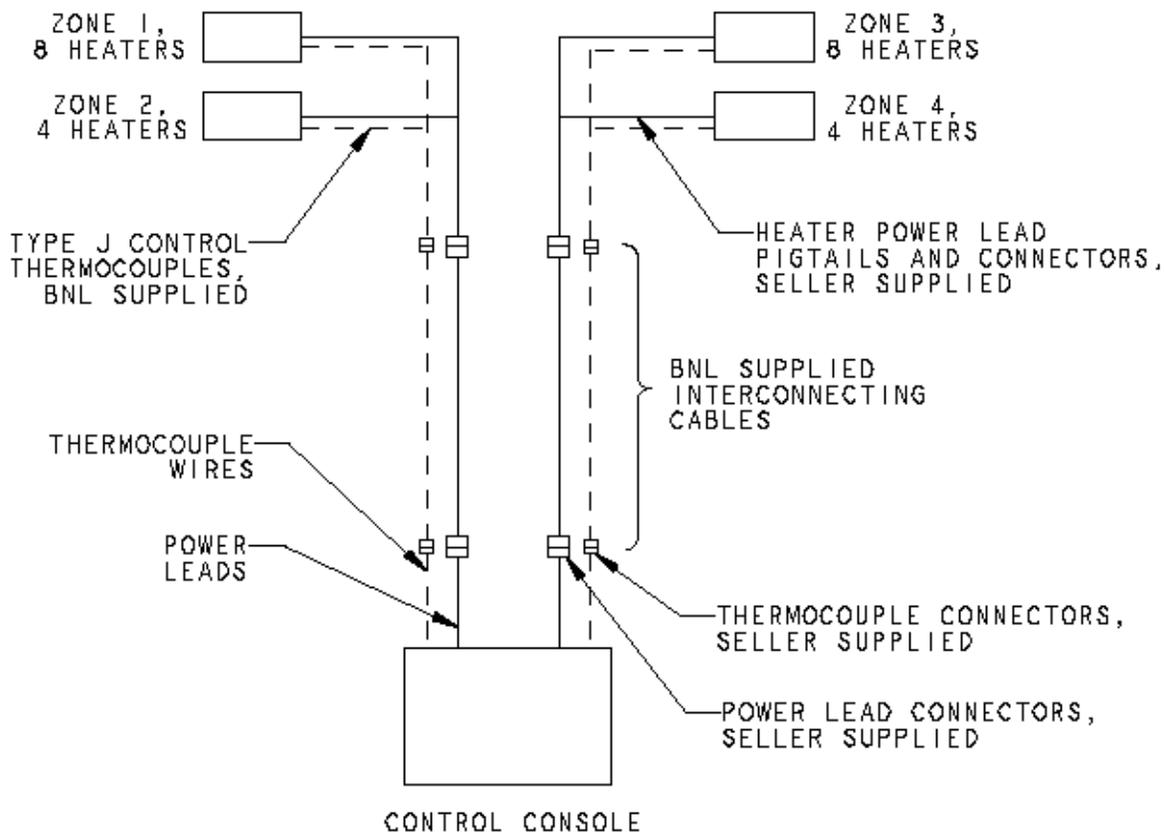


Figure 2.
System Block Diagram

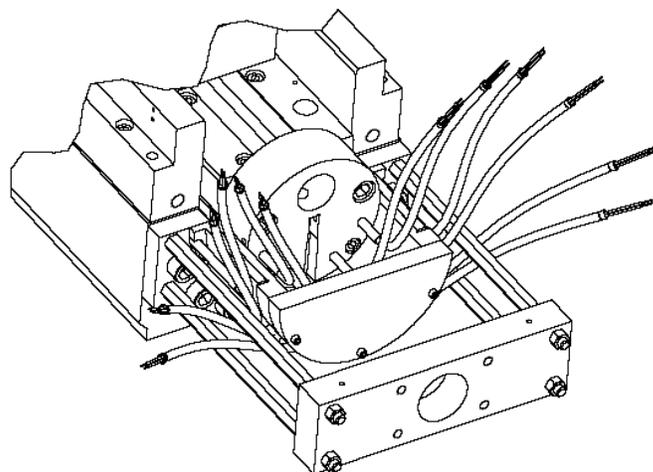


Figure 3.
Heaters Installed in Form Block/Mandrel Assembly

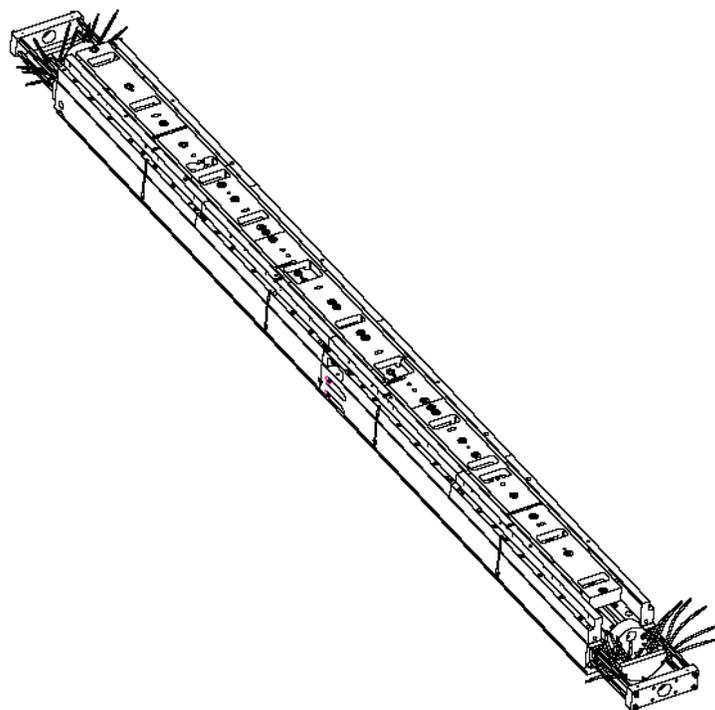


Figure 4.
Form Block/ Mandrel Assembly

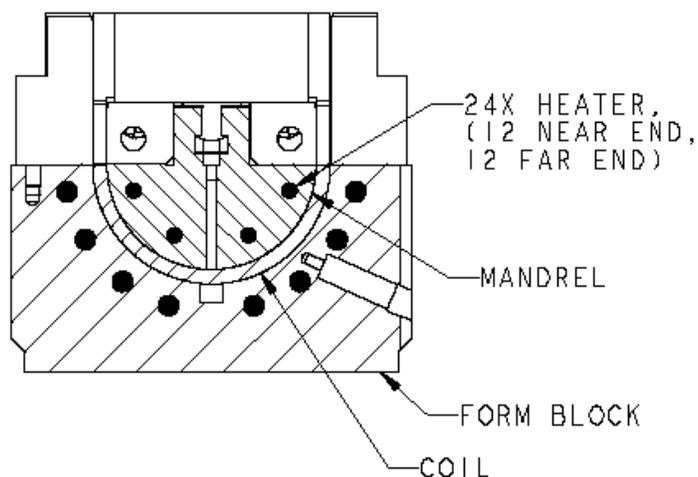


Figure 5.
Form Block/ Mandrel Assembly Section

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.

SMD-DX-2001A

Page 7 of 7

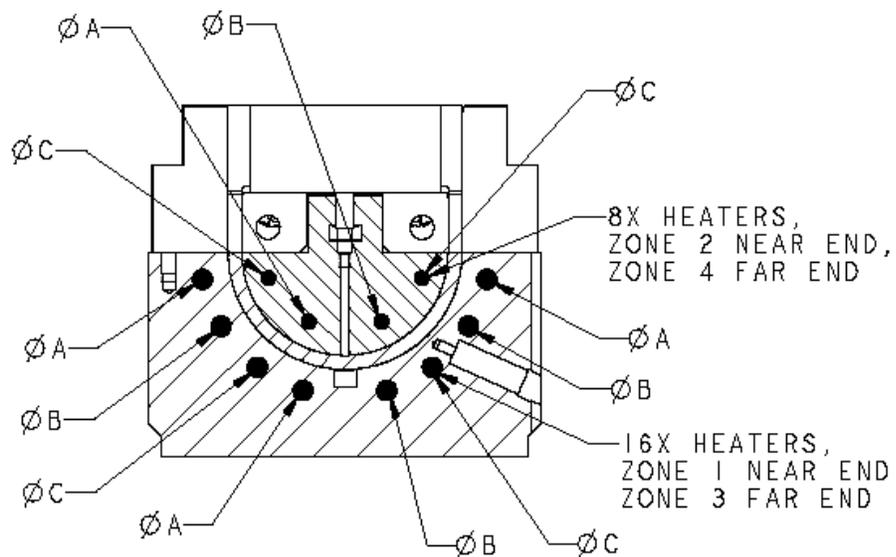


Figure 6.
Heater Power Phasing (example)