Procedures for

Determination of Helium Vessel Temperature

For

F2K, Titan & Rex Cylindrical Magnet Systems

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Magnet Business Group
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REVISION HISTORY

Rev	Auth Doc	Release	By	Date	Description of Revision
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LIST OF FIGURES & TABLES

1. PURPOSE AND SCOPE

This document prescribes procedures for determining the temperature of the helium vessel for F2K, Titan & Rex cylindrical magnets.

1.1 INTENDED USE

This document and procedure are intended for use ONLY by personnel who are thoroughly trained and qualified in safe practices related to cryogenic MRI magnets, including:

- working around high voltages;
- the dangers of strong magnetic fields; and
- the dangers and safe handling of cryogenic liquids and gases.

CAUTION

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THIS PROCEDURE MUST BE PERFORMED ONLY BY TRAINED AND QUALIFIED PERSONNEL. FAILURE TO PROPERLY PERFORM THIS PROCEDURE MAY RESULT IN DAMAGE TO EQUIPMENT.

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2. APPLICABLE DOCUMENTS

2.1 INTERMAGNETICS DOCUMENTS

43839	Procedures for Cool-down and Re-warming 2000-Series Magnets
43001	Drawing, Electrical Interconnection, F2K

2.2 THIRD-PARTY DOCUMENTS

3. DETERMINING THE TEMPERATURE OF THE HELIUM VESSEL

3.1 EQUIPMENT NEEDED

- Digital multimeter (DMM) with the following specifications:
  - Minimum 3½ digit display
  - Minimum 0.1 ohm resolution
- Test Leads

Optional:

- (2) #20 Socket test adaptors (Pomona 3560 or equivalent(see Figure 3&5))

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3.2 THERMISTOR SCHEMATIC

NOTE: This procedure is valid for all F2K, Titan & Rex cylindrical magnets

Type-2000 Magnets are equipped with Negative Temperature Coefficient (NTC) thermistor temperature sensors as shown schematically in Figure 1. The letters shown in Figure 1 for the thermistor connections represent the 41 pin connections (see Figure 2) on the cryostat MJ1. These thermistors give the temperatures corresponding to three locations within the cryostat. Two sensors (U-V and V-W) are located at bottom dead center of the helium space. These are critical for ensuring that liquid cryogens either are completely evacuated or collected within the helium space. The third sensor (X-Y) is used to determine when to begin and end the process of purging liquid nitrogen from the helium space. Its location is approximately the 40% liquid helium level of the cryostat. All three sensors can be used to determine the presence of liquid cryogens in the cryostat.

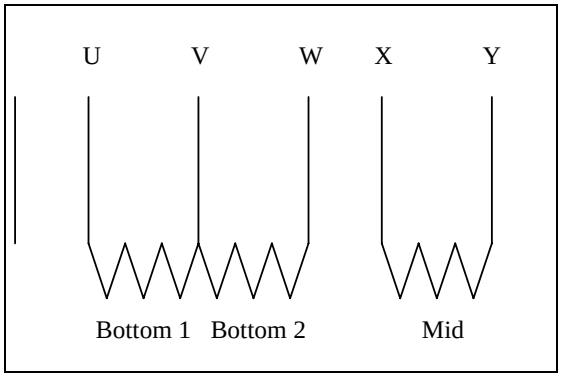

Figure 1 – Thermistor Schematic

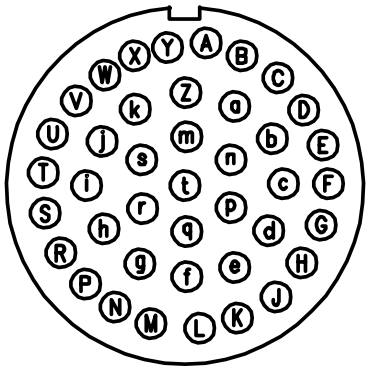

Figure 2 – MJ1 Pin Layout

Sensor	Location	Pin Connections
4KT-B0T1	Bottom	U – V
4KT-B0T2	Bottom	V – W
4KT-MID	Mid-point	X - Y

Table 1 – Sensor Identification Chart

3.2.1 Using Thermistors to Read Temperature

All thermistors are identical NTC thermistors and the procedure is valid for all magnet space locations.

1. Connect the DMM (see Figure 2, 4 & 5 and Table 1) across each thermistor; polarity is not critical. **Use caution when making connections to MJ1 to prevent damaging or bending the pins.**
2. Record the resistances for each thermistor
3. Use Table 2 to convert the resistance readings to determine the approximate temperature of the helium vessel.

NOTE

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NTC TEMPERATURE SENSING THERMISTORS ARE ***NOT*** ACCURATE FOR MEASURING TEMPERATURES LOWER THAN THAT OF LIQUID NITROGEN (77 K).

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Figure 3 – Test adaptors

Figure 4 – DMM Set-up to read thermistors

Figure 5 – Test adaptors connected to read thermistors

Thermistor Temp Sensor Conversion Chart

Temp (K)	Temp (°C)	Resistance (Ohms)	Temp (K)	Temp (°C)	Resistance (Ohms)
70	- 203	84,620	151	- 122	414.8
73	- 200	50,670	153	- 120	389.5
77	- 196	31,520	155	- 118	364.3
79	- 194	27,861	157	- 116	339.0
81	- 192	24,202	159	- 114	313.8
83	- 190	20,543	161	- 112	288.5
85	- 188	16,884	163	- 110	263.3
87	- 186	13,225	165	- 108	238.0
89	- 184	10,936	167	- 106	212.8
91	- 182	9230	169	- 104	187.5
93	- 180	7650	171	- 102	162.3
95	- 178	6852	173	- 100	137.0
97	- 176	6054	175	- 98	131.5
99	- 174	5256	177	- 96	125.9
101	- 172	4458	179	- 94	120.4
103	- 170	3660	181	- 92	114.8
105	- 168	3308	183	- 90	109.3
107	- 166	2956	185	- 88	103.7
109	- 164	2604	187	- 86	98.2
111	- 162	2252	189	- 84	92.6
113	- 160	1900	191	- 82	87.0
115	- 158	1774	193	- 80	81.5
117	- 156	1648	195	- 78	79.2
119	- 154	1523	197	- 76	76.9
121	- 152	1397	199	- 74	74.6
123	- 150	1271	201	- 72	71.3
125	- 148	1145	203	- 70	69.0
127	- 146	1019	205	- 68	66.7
129	- 144	893.6	207	- 66	64.4
131	- 142	767.8	209	- 64	62.1
133	- 140	642.0	211	- 62	59.8
135	- 138	616.8	213	- 60	57.5
137	- 136	591.5	215	- 58	55.2
139	- 134	566.3	217	- 56	52.9
141	- 132	541.0	219	- 54	50.6
143	- 130	515.8	221	- 52	48.3
145	- 128	490.5	223	- 50	46.0
147	- 126	465.3	248	- 25	35.0
149	- 124	440.0	298	+ 25	23.0

Table 2 - Temperature vs. Resistance for NTC Thermistors

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