Field Mapping Procedure

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# Timeline

|  |  |  |  |
| --- | --- | --- | --- |
| **Stage** | **Current (A)** | **Activity** | **Duration (hour)** |
|  | Ramp up: 0.2A/s | ½ |
| Final Training6 hours | **440** | NMR | ¼ |
| Ramp up: 0.2A/s | ½ |
| **800** | NMR | ¼ |
| Ramp up: 0.12A/s | ½ |
| **1000** | NMR + Central Line | 1 |
| Ramp up: 0.12A/s | ½ |
| **1200** | NMR + Central Line | 1 |
| Ramp down: −0.12A/s | 1 |
| **800** | NMR + Central Line | 1 |
|  | Add Dewar | 8 |
| Soak3 hours | Ramp up: 0.12A/s | ½ |
| **1000** | NMR | 1 |
| Ramp up: 0.12A/s | ½ |
| **1200** | NMR | 1 |
| Ramp up: 0.06A/s | ½ |
| Mapping Shift26 hours | **1300** | NMR + Central Line | 1 |
| Ramp up: 0.06A/s | ¼ |
| **1355** | NMR | ½ |
| Ramp up: 0.06A/s | 0 |
| **1350** | NMR + 2 Lines | 2 |
| Ramp down: −0.06A/s | ¼ |
| **1300** | NMR + 15 Lines | 16 |
| Ramp down: −0.06A/s | ½ |
| **1200** | NMR + Central Line | 1 |
| Ramp down: −0.12A/s | 1 |
| **800** | NMR + Central Line | 1 |
|  | Ramp down: −0.2A/s | 1 |

# Single line mapping procedure

1. Move the guidance tube to the desired position
2. Start LabView mapping program
3. Verify real time readings from Hall probe, inclinometer and laser distance meter
4. Create a new data file with the following name scheme: Field\_Data\_*YYYYMMDD*\_*HHMM*\_R*xx*\_P*xxx*\_Ixxxx\_*remarks*.dat , where R(radius) is in inches, P(phi) is in degrees, I(current) is in A.
5. Type in radius(inch) and phi(degree) in the LabView program
6. Load the Z location preset file corresponding to the radius
7. Move the probe to the Z location indicated by the program
8. Make sure that both Z and inclinometer readings are within tolerance (both in green), take a measurement
9. Continue steps 7 and 8 until the end of the list of Z locations has been reached.

1

2

# Lines to be mapped at 1350 A

### Required

1. R = 00, Phi = 135
2. R = 32, Phi = 135

Y (up)

X (left)

Z (beam)

ϕ

# Lines to be mapped at 1300 A

### Required

1. R = 32, Phi = 135
2. R = 22, Phi = 135
3. R = 12, Phi = 135
4. R = 00, Phi = 135
5. R = 22, Phi = 315 (R = −22, Phi = 135)

2

4

5

3

1

9

8

7

6

10

11

12

13

15

14

1. R = 22, Phi = 270 (R = −22, Phi = 090)
2. R = 12, Phi = 090
3. R = 22, Phi = 090
4. R = 32, Phi = 090
5. R = 32, Phi = 180
6. R = 22, Phi = 180
7. R = 12, Phi = 180
8. R = 22, Phi = 000 (R = −22, Phi = 180)
9. R = 22, Phi = 225
10. R = 32, Phi = 225

### Optional

1. R = 12, Phi = 225
2. R = 22, Phi = 045 (R = −22, Phi = 225)

### Unmapped

1. R = 12, Phi = 315
2. R = 32, Phi = 315
3. R = 12, Phi = 270
4. R = 32, Phi = 270
5. R = 12, Phi = 000
6. R = 32, Phi = 000
7. R = 12, Phi = 045
8. R = 32, Phi = 045

The Solenoid Mapping Apparatus consists of:

D000001313-1080 Assembly

D000001313-1081 Hall Probe Holder

D000001313-1082 Pipe-Sensor

D000001313-1083 NMR Probe Assy

D000001313-1085 Probe Extensions

Overview;

The Solenoid Mapping Assembly consists of a Hall Probe Holder (D000001313-1081) and extensions (D000001313-1085) that are pushed by hand to defined positions within the Pipe Sensor (D000001313-1082) which is straight to within 1 mm. The Probe Holder is concentric to the Pipe sensor within 1 mm. The Pipe Sensor is mounted against a Aluminum Unistrut channel (called the “Strut”) with a hole pattern of exactly 2.000 inches between holes along its length. The radial position along the strut length is defined by the Pipe Locating Angle (D000001313-2137) and the bolts through the holes in the Strut. Pushing the bolts to the ‘bottom edge of the larger holes). The radial position of the Strut (and its hole pattern) is set by an adjustment screw at its base. The adjustment is done when the Pipe Sensor is at the center of the bore and a gage bar is used to center the pipe outer surface with respect to the inner surface of the yoke bore. The Strut may be set at 14 positions in Phi (vertical plus every 15 degrees plus two positions coinciding with the yoke feet) using two sets of plates. The plates are accurately fastened to the Yoke ends and have accurate tapped hole patterns for the sterut mounts corresponding to the required angles. The result is that the Pipe Sensor may be accurately placed to a multitude of positions, providing good coverage of the entire field volume. See Figure 1 for an early concept.

The three axis Hall Probe is mounted at the front end of the Hall Probe Holder along with an inclinometer. A Distance Measuring Laser Unit is mounted at the downstream end of the Pipe Sensor, aimed at the face of the Hall Probe mount. Thus axial position of the hall probe within 1 mm is obtained and may be recorded for every reading taken. The inclinometer provides rotation in Phi information for the readings. The probe is to be held nearly horizontal for every reading, but the inclinometer will record any error in angle for further analysis.

An NMR probe is mounted to an add-on slug to mount to the Hall Probe Holder. An NMR reading can then be coincidentally taken along with the axial reading of the hall probe, as the sensors or face to face. Taking this reading at several magnet currents will calibrating the hall probe’s axial axis and assess linearity. Note that the NMR will only “lock” in uniform field between 0.7 T and 2.2 T. A uniformity pinch point exists only on the solenoid’s axis, 5 ft upstream of the downstream edge of the Yoke. 440 Amps is probably the current at which 0.7 T is exceeded. The probe is mounted to the Hall Probe Holder using cable ties and its cord is fed trough the Pipe Sensor, exiting out the downstream end.

Changing Probe Tube Positions along one Phi angle.

Two sets of Pipe Locating Angle are available, one for the existing position. The second set is for pre-mounting to the next position. When a change of the Pipe Sensor is required, un hook the bungie cords holding the pipe to the Strut/Angle. With personnel at both ends of the solenoid, use the ropes and pullies to guide the pipes to the next position. Make sure the ridge formed by plastic pipe segments fits along the upstream and downstream edges of the upstream strut. This action will create a constant axial position of the pipe for all readings. Seat the pipe downward and to the right using the bungie cords. The “front porch” segment that helps launch the Probe Holder into the Pipe Sensor attaches to the front of the Pipe Sensor. Experience will guide if the front porch has to be removed before moving the Pipe sensor to a new position. In any case, use the supplied rope and special attachment feature to support the upstream-most end of the front Porch.

Moving measurements to a new angle in Phi

Remove the bungies at the strut and support the pipe sensor using the ropes and pullies, lifting it out of the way of the Strut. Disengage the brackets attaching the strut to the Plates (Do NOT loosen the bracket attachment to the Strut). Move to the new angle position and re-apply and tighten the bolts. No further action is necessary.