

LS-189

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Thermal and Mechanical Measurements of the Prototype SR Quadrupole

The magnet warm-up time and motion of the alignment fiducials was investigated. Type K thermocouples were used to measure the temperature of the magnet steel, ambient, and supply and return H₂O. The vertical position of alignment targets was measured using optical levels. A laser position-sensitive laser detector was placed on top of the magnet, and the motion of the detector with respect to a laser (part of the Danfysik measurement bench) was recorded (Figure 1).

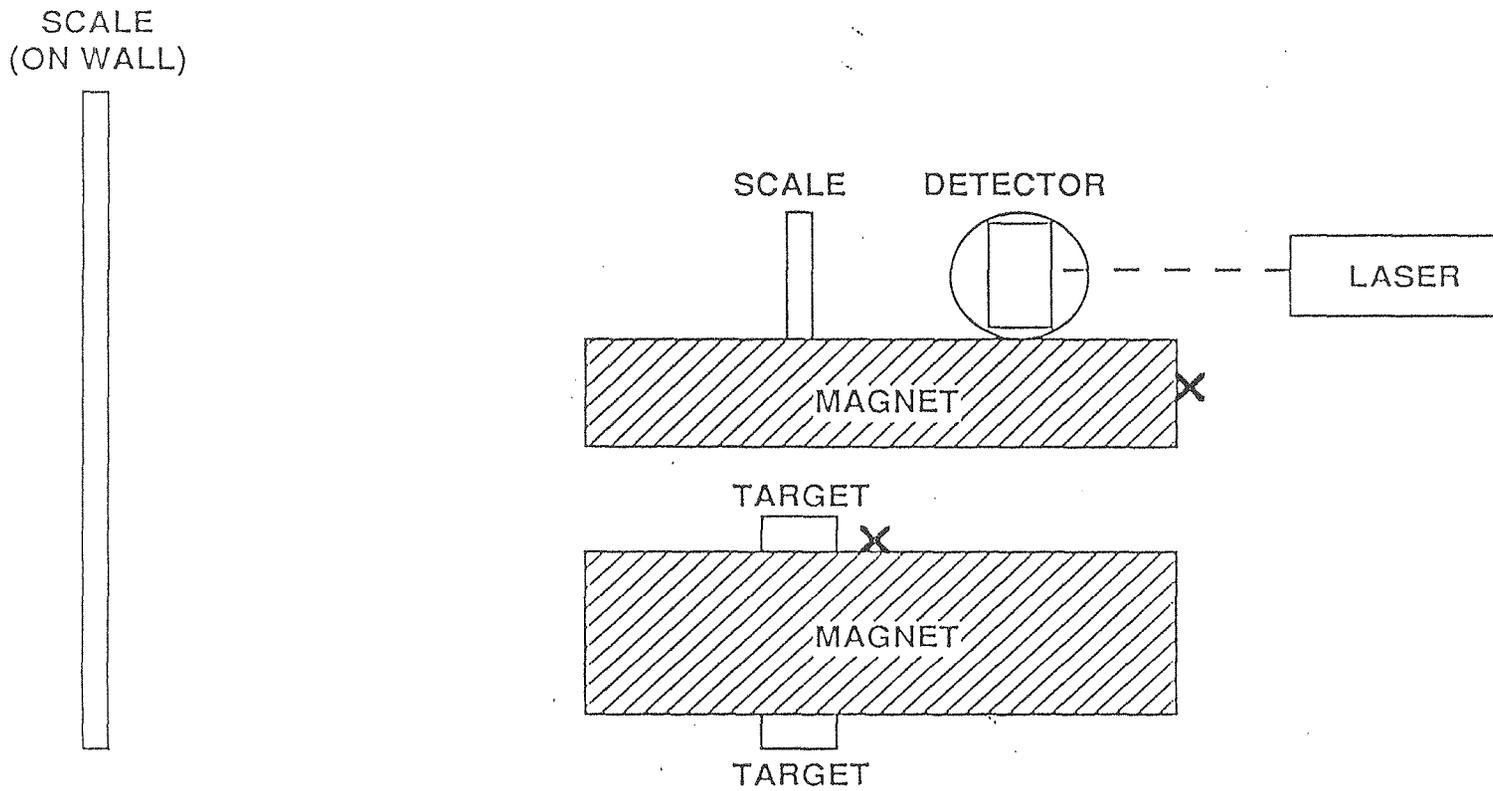
Data was recorded with the power and cooling H₂O off. Then the current was ramped to 400 amps (7GeV) and the water cooling turned on to 80 psi pressure and 91^o F. (Design Handbook values). The temperature of the cooling water, coils, and return water came into equilibrium in about 25 minutes (Figure 2). The magnet steel came into rough equilibrium with the ambient temperature change in about 4 hours (Figure 3). During this time the position of the laser detector changed by .0016 inches (.041mm) (Figure 4). No motion of the optical targets was detected. Table I summarizes the results. The motion of the laser detector is in agreement with that expected from thermal expansion within experimental error. The null result from the optical methods is also within experimental errors. After 330 minutes of elapsed time, the magnet power and cooling water were shut off. No appreciable change in steel temperature or fiducial position was observed for 40 minutes.

Conclusions: The magnet fiducials move less than can be reliably measured by conventional optical means, and, therefore movement is not a big problem. If the magnets are positioned by more accurate methods, then the 4 hour warm-up time is appreciable. The long decay time (>40 minutes) means that alignment can likely be done with the power off. A longer term study involving the alignment girder and its motion is recommended.

Table I. Position Changes (top of magnet)

Position Change (inches)	Method
0.0016 +/-0.0004	Laser Detector
0.0 +/-0.001	Optical Targets and Levels
0.0013	Calculated from Thermal Expansivity including ambient change.

Figure 1. Setup for Position Measurement



Notes:

X — Thermocouples on Magnet Steel

Figure 2. Water and Coils Temperature vs Time

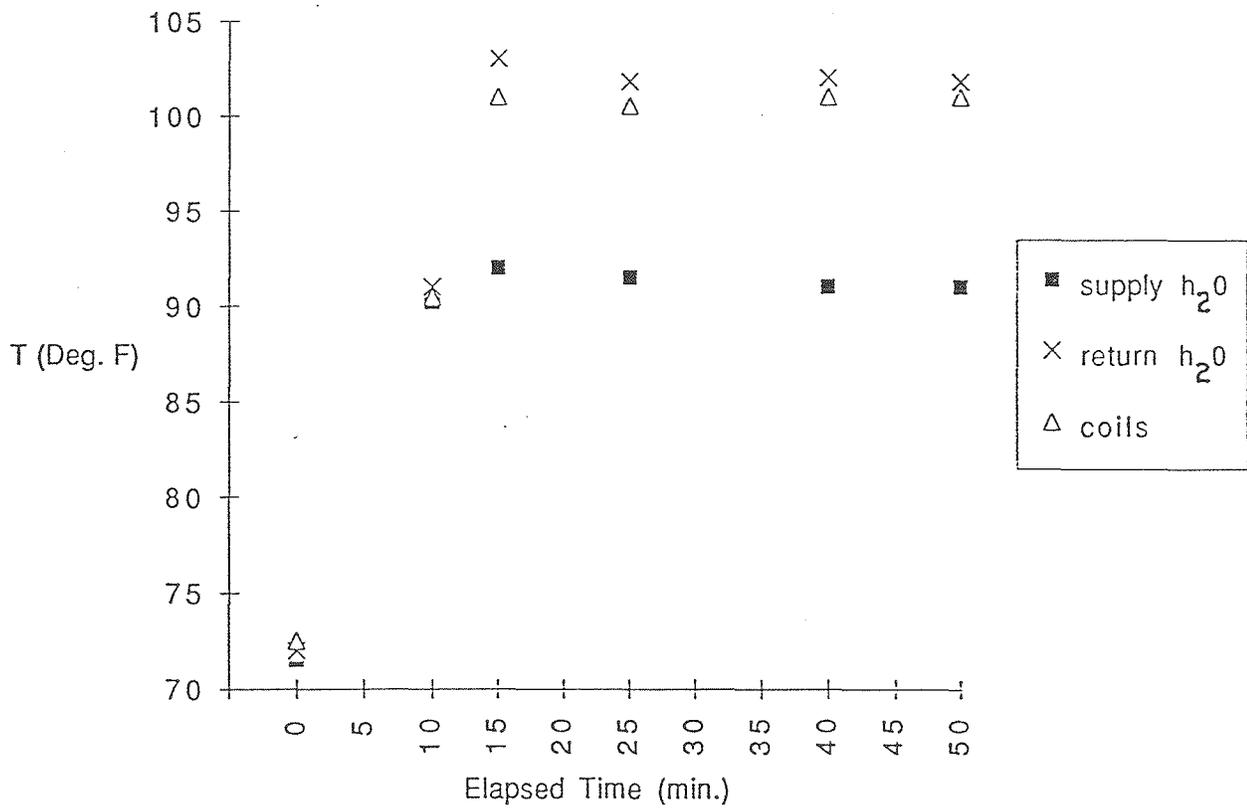


Figure 3. Steel and Ambient Temp. vs. Time

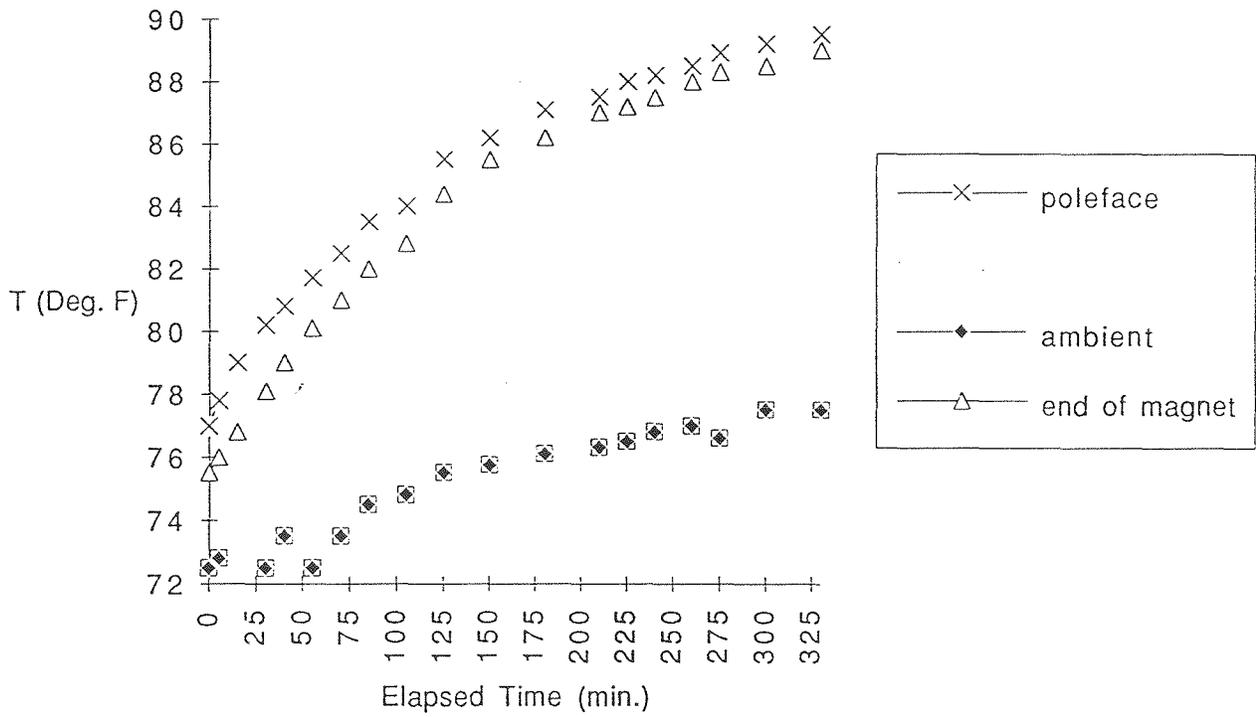


Figure 4. Laser Detector Position vs. Time

