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CONSTRUCTION OF A FERMILAB "SUPERFERRIC" TEST MAGNET

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ABSTRACT

This technical memo documents the construction of a cold iron superconducting test magnet. The "superferric" magnet design was based on a concept sketch provided by Bob Wilson. Construction & dunk testing of the magnet in a liquid helium dewar took place in a time period of less than one week. The magnet operated successfully to its design field of 2 Tesla with no training.

COIL CONSTRUCTION

1. Conductor

Fermilab energy saver conductor was used to wind the two coil halves. The kapton & spiral wrap fiberglass insulation system on the outside of the conductor was not altered.

2. Coil Construction

A coil winding form was machined out of hardwood as shown in figure 1. The conductor was held in place with "C" clamps as the winding progressed. Upon completiion of the coil winding the winding form with coil were placed in an oven and heated to 300° F. This heating cured the "B" stage fiberglass insulation so that the coil turns were bonded together when cooled to room temperature. After cooling to room temperature the first coil half was removed from the winding form & the second coil half was made by repeating the process.

3. Window Frame Iron (see figures 2 & 3).

The field shaping iron was made of mild steel. Hot rolled plate was used to make the top & bottom plates. Cold rolled square bar stock was used to make the side pieces. Five eights oversize holes were then drilled through the iron blocks to accommodate one half inch diameter clamping studs.

4. Magnet Assembly (see Figure 3).

The magnet was assembled by starting with the bottom iron plate & magnet support plate set-up on a working surface. The bottom coil half was positioned on the bottom steel plate & the beam tube was positioned inside the bottom coil half. Coil to ground insulation (G10) strips were then slipped into place as shown in Figure 4. The steel side pieces were then installed and the remaining ground insulation strips were installed. The steel top plate and magnet support plate were then positioned and the six clamping studs were installed. The clamping stud nuts were then torqued to preload the coil in the vertical direction. When contact was observed between the steel top plate and the steel side plates, "C" clamps were used between the steel side pieces to preload the coil in the horizontal direction. The six clamping studs were then final torqued. The next step in the magnet assembly was to support the coil ends which are outside of the steel. The radius block that was used to wind the coil shown in Figure 1 was used as a pattern to make four coil inner radius support insulator from G10 material. The inner radius support insulators were then trimmed to fit tightly between the inner radius of the coil and the bore tube. The final coil support blocks were made from two inch thick micarta blocks which were saw cut at 45° and surface finished to fit tightly between the steel plates and the coil. These micarta blocks were drilled and tapped in place and fastened to the magnet support plates with three eights inch diameter bolts. The four remaining coil support blocks were made in a similar manner and drilled and tapped in place. The coil end clamping bolts were then installed and torqued which clamped the coil ends tightly between the micarta coil support blocks. This completed the coil support system.

Next "C" clamps were again used to squeeze the steel side pieces together & preload the coil in the horizontal direction. This horizontal preload was maintained while the steel side pieces were welded to the top and bottom steel plates, then the "C" clamps were removed.

Finally, the top and bottom coil halves were connected together with the coil splice shown in Figure 3. The splice was clamped to the magnet support with insulator blocks and the magnet assembly was complete.

5. Test Results

The magnet was then installed into a liquid helium test dewar and cooled down to operating temperature. The coil was energized and field and current measurements were recorded. These test data are shown in Figure 5. For a more complete description of the magnet testing, the reader is referred to Fermilab TM 1121 titled "Performace Testing of a Super "Fe" magnet."

Acknowldgements*

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JH/sah

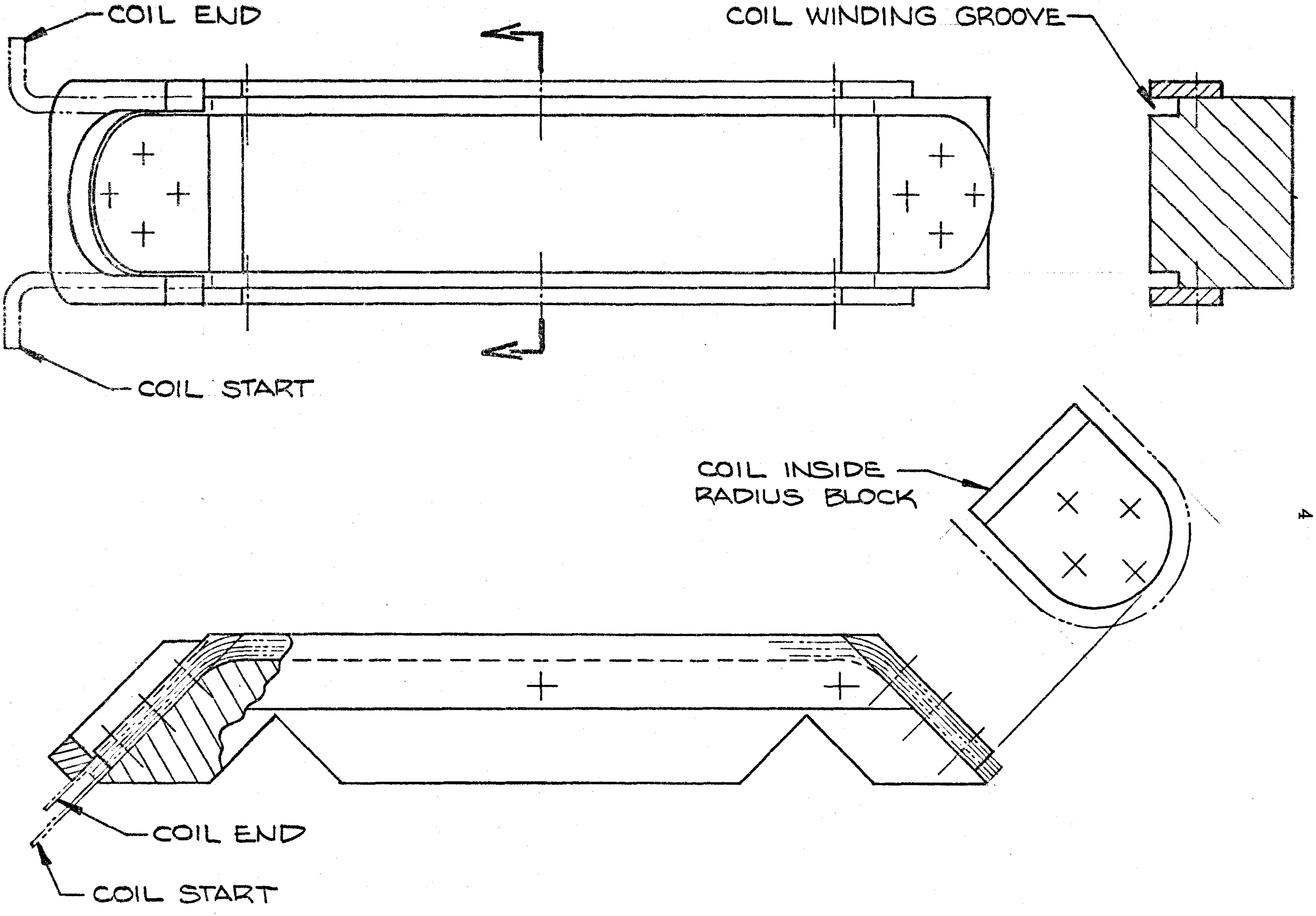

FIGURE 1 COIL WINDING FORM

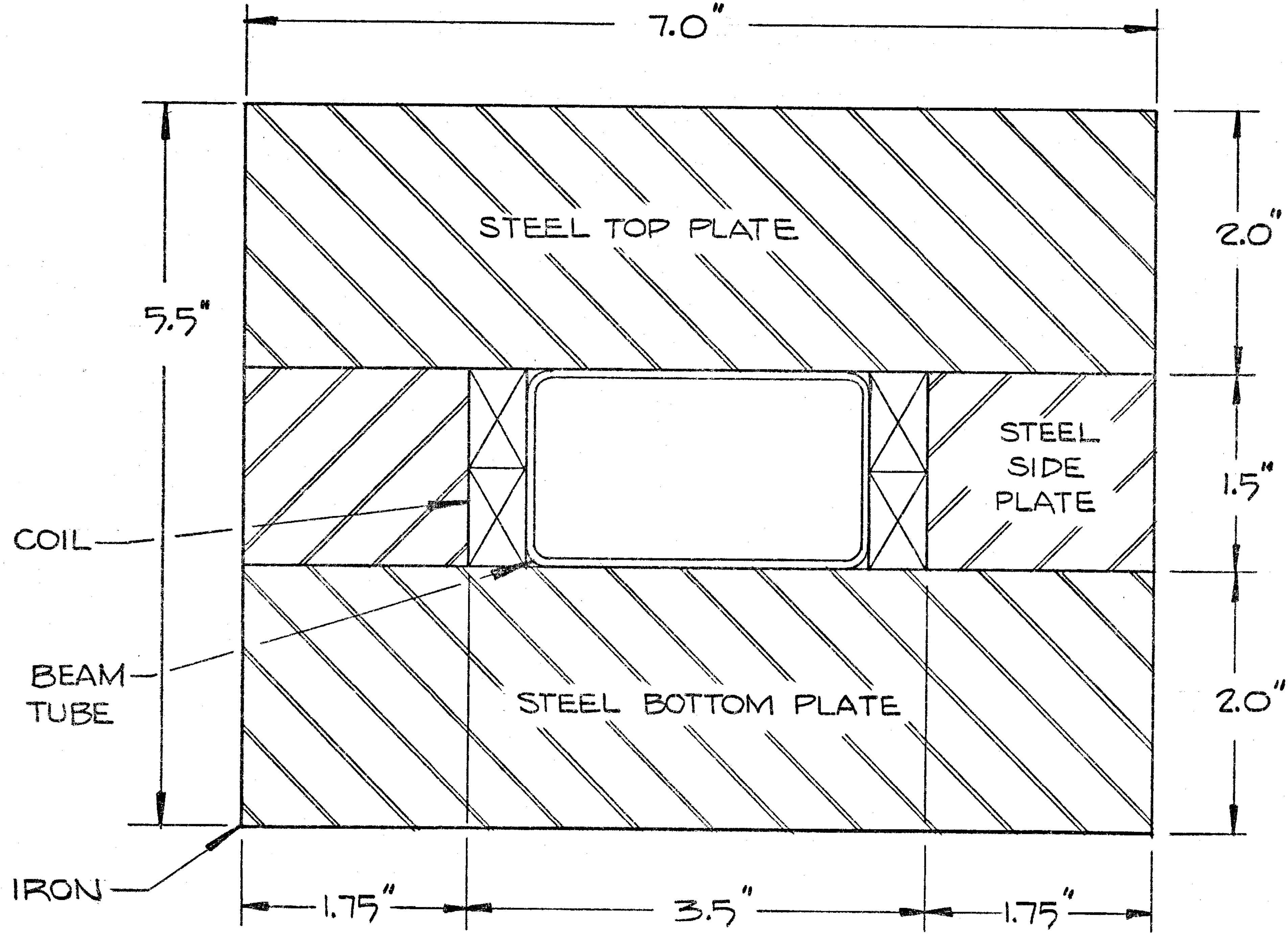

FIGURE 2 MAGNET CROSS SECTION

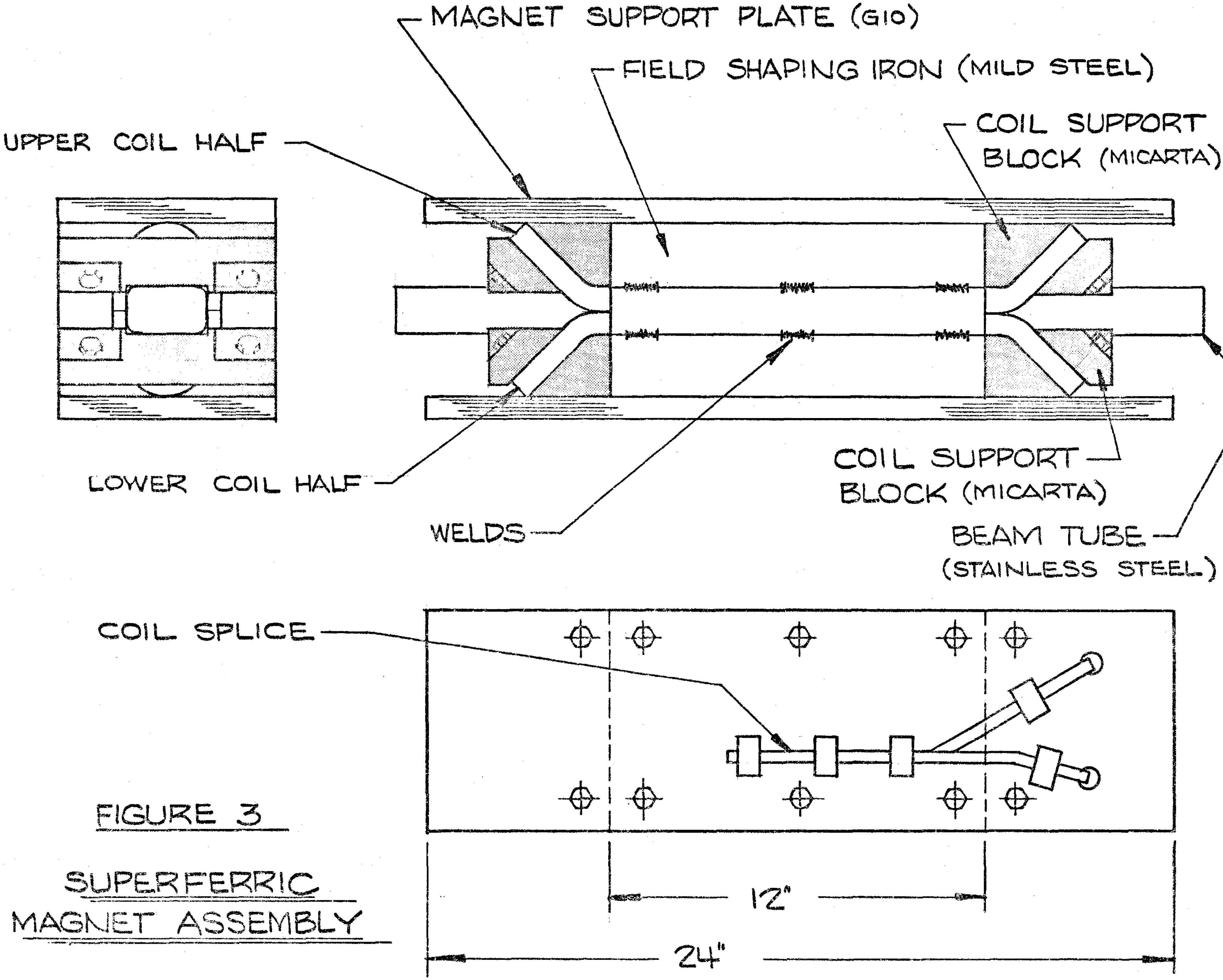

FIGURE 3

SUPERFERRIC MAGNET ASSEMBLY

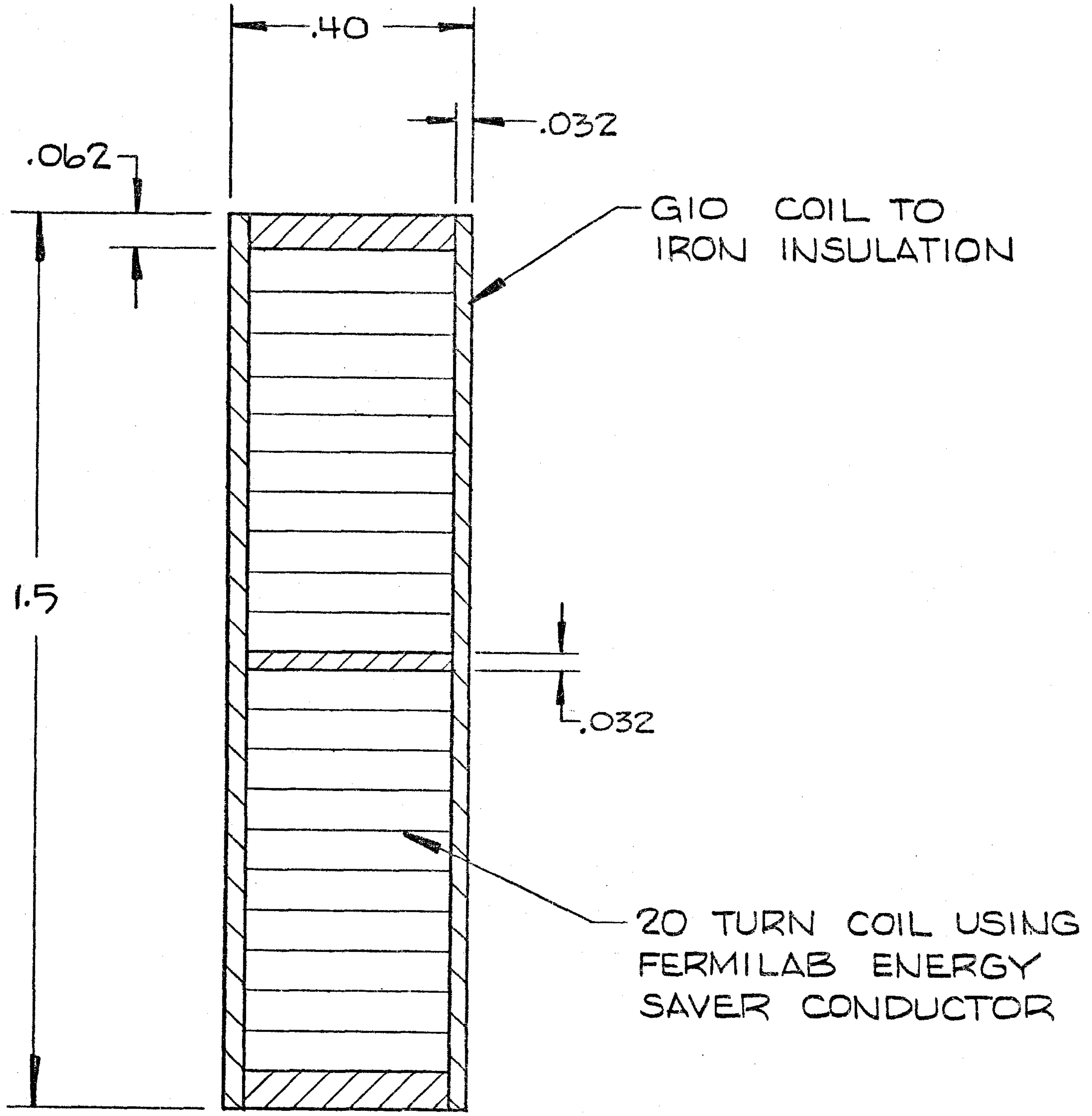

FIGURE 4 COIL CROSS SECTION

CURRENT (AMP)	FIELD (KG)
1000	6.5
1500	9.9
2000	13.2
2500	16.5
3000	19.6
3500	21.8

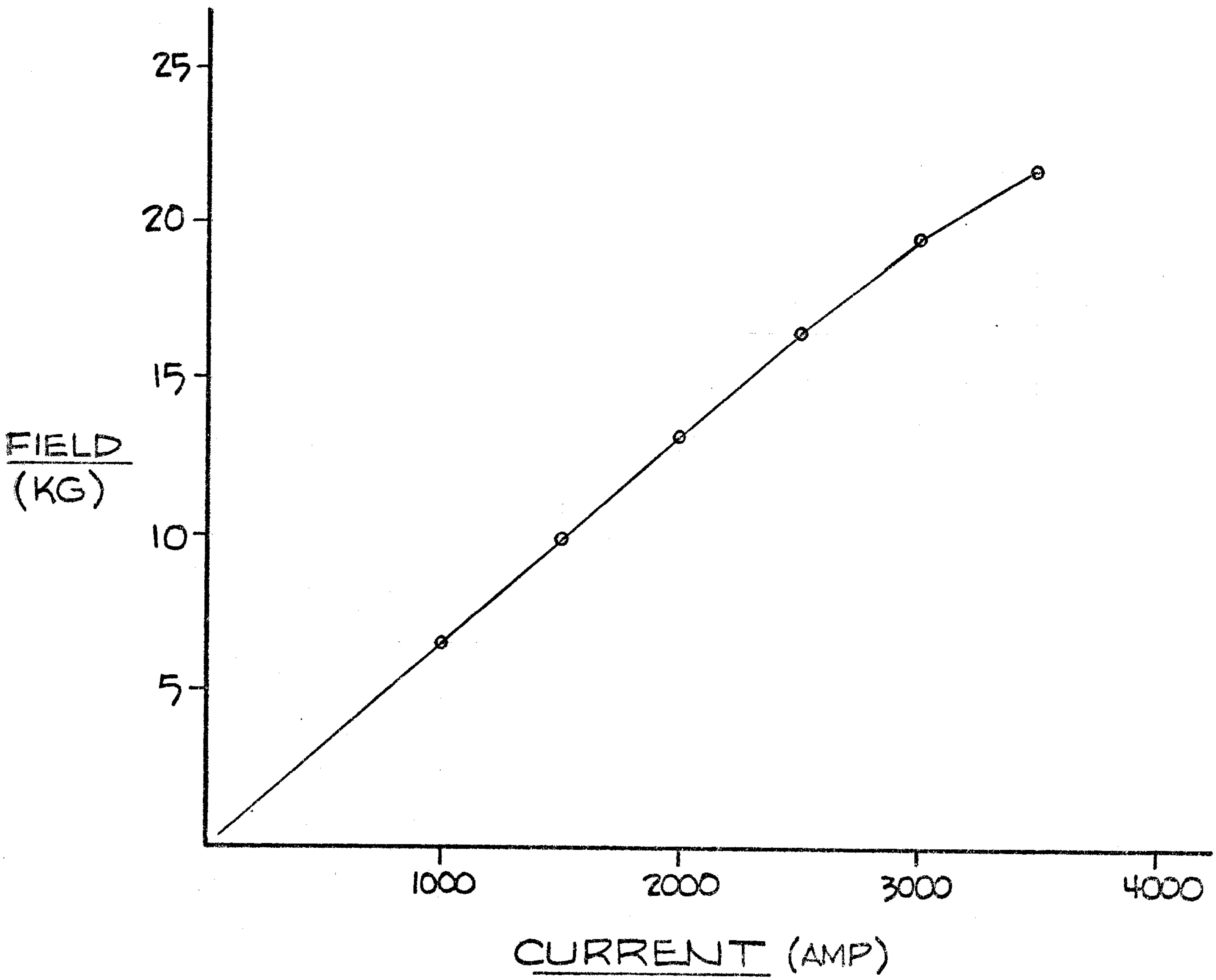

FIGURE 5 MAGNET TEST RESULTS