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Coldmass Diametral Variation Study

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Coldmass diameter measurements taken after shell welding show an out of round condition which is consistent from magnet to magnet. Five diameter measurements are made at one foot intervals along the entire length of the coldmass. The figure below shows the condition which exists on the 50mm magnets measured.

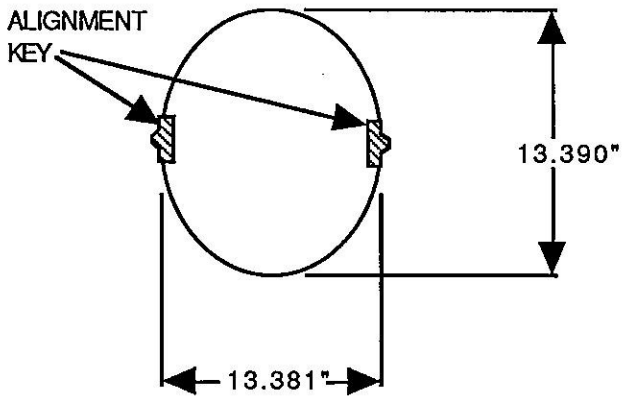

FIGURE 1

The diameters shown in the figure are the average of five magnets including one short model. When the diameters are normalized, with respect to the skin thickness, the average differential is 0.005 inches. This condition is not present at the ends of the magnets, over the filler packs.

An experiment was conducted on the short model magnet skinning press to determine the source of the out of round condition. A one foot section of skin, yoke and alignment key was placed at either end of the skinning press. Figure 2 is a sketch of the test set up. Collared coil sections were not used in this test.

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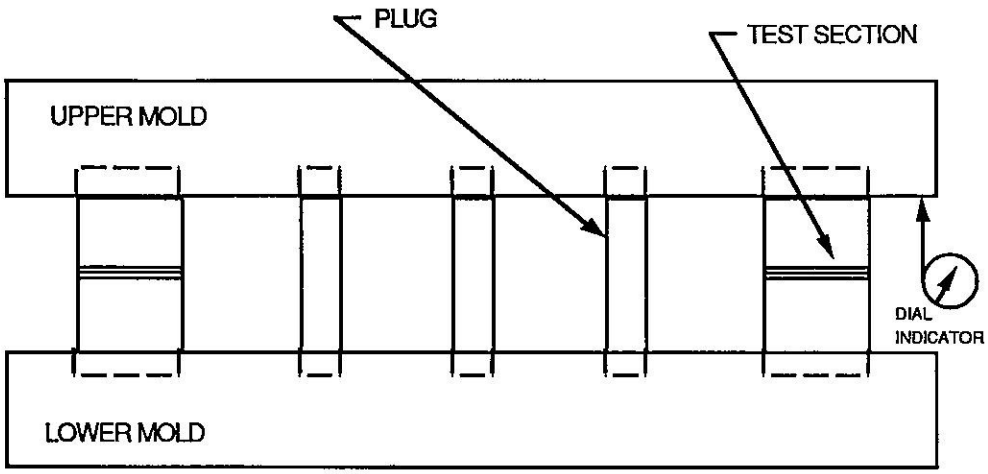

FIGURE 2

To measure the deflections during normal skinning, dial indicators were placed across the inner diameter of the yoke and the inner diameter of the skin in the horizontal and vertical directions. See figure 3. The press was energized, the pump pressure was increased to 700 psi and the dial indicators were zeroed. At this pressure the upper mold made full contact with the skin and the lower mold contacted the lower platen. Next, the pump pressure was increased in 500 psi increments. Dial indicator readings were recorded at each increment. The maximum pump pressure was 3500 psi. The pressure was then reduced to 2800 psi and the skins were welded. The ramping from 3500 psi to 2800 is standard practice for skinning short magnets. After welding the pressure was released in 500 psi increments and dial indicator readings were taken at each step. The outside horizontal and vertical diameters were measured after the welded assemblies were removed from the press.

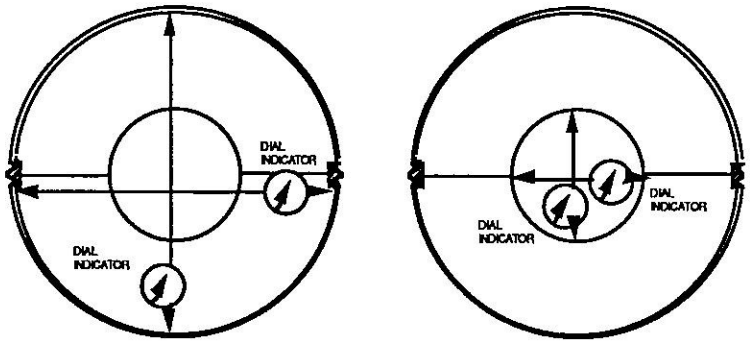

FIGURE 3

The distance between the upper and lower platen decreased 0.025 inches during the initial pressing from 700 to 3500 down to 2800 pump psi. The vertical inside skin diameter decreased 0.020 inches, while the vertical inside yoke diameter decreased 0.001 inches. The horizontal diameters decreased 0.002 inches. No noticeable change in the diameters occured during the welding. However, the parting plane gap between the yoke closed completely after the final root pass. As the hydraulic pressure was released the vertical inside skin diameter increased 0.005 inches and the vertical inside yoke diameter increased 0.001 inches. The horizontal diameters increased only 0.002 inches when the press pressure was released. The outside diameter checks confirmed what was observed in the skinning press, the vertical diameter was 0.005 inches larger than the horizontal diameter across the keys. The skin thickness did not very more than 0.001 inches. No gaps existed at the parting plane between the yoke halfs or between the skin and yoke.

The 0.005 inches increase of the vertical inside skin diameter while releasing the press pressure is significant. The yoke is compressed during pressing and welding. The welded skin contains the compressed yoke by applying azimuthal force. Due to friction between the yoke and skin, the azimuthal force is not equal around the circumference of the yoke. See figure 4. Strain gages mounted on the skin confirm the unequal distribution of stress. The reduced azimuthal force at the vertical axis permits the yoke to expand in this direction, causing the out of round condition.

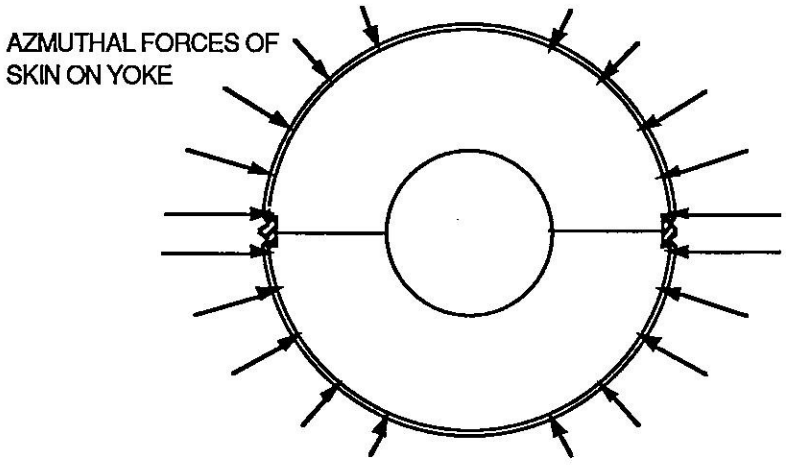

FIGURE 4