TS-SSC 90-039

June 26, 1990

MEMO TO: John Carson, Rodger Bossert, Bill Robotham, Greg Kobliska

FROM: Jim Strait

SUBJECT: Alternate Collar Outer Surface

In note[1] I finished yesterday I discussed the design for the collar outer surface. To generate the proper interaction between the yoke and the collars the design calls for a 5.5 mil horizontal radial interference and a 18 mil vertical radial clearance. This is achieved by making the collar radius (2.680) 10 mils larger than the yoke radius (2.670) and offsetting the center curvature down by 28 mils. The yoke clears the collars in the region of the keys, and the first contact, where the 5.5 mils interference occurs, is 9 degrees above the horizontal axis. In the attached figure the yoke is represented by the heavy solid line and this collar design is represented by the dashed line. (The collar is shown only above 10 degrees because there is no yoke collar contact for smaller angles.)

An obvious drawback is that the area of yoke-collar contact is small and the loading will be quite non-uniform. Contact is made over an angle of about 10 degrees or arc length of about 0.5". At room temperature 18 +- 6 kpsi of skin tension is balanced by the collars corresponding to a force of 3400 +- 1100 lb/in. Assuming that the yoke and collar laminations have about 50% of their edge at the full radius, the area of contact is 0.125 in**2/in, resulting in a contact stress of 27 +- 9 kpsi. The local stress at just above 10 degrees is likely to be considerably higher. This is below the yield of Nitronic 40 but may not be below the yield of the yoke steel.

An alternate design of the collars would generate the 5.5 mils interference between 10 and 30 degrees and the 18 mils clearance for larger angles by putting the collar surface on two different circles. Two versions of this are sketched in the attached figure. The solid line is a case in which the radius is equal to the yoke radius; the center of curvature is displaced 5.5 mils to the right for theta < 30 degrees and down by 18 mils for theta > 30 degrees. The dotted line is a case in which the collar center of curvature is coincident with the center of the yoke; the radius is increased by 5.5 mils for theta < 30 degrees and decreased by 18 mils for theta > 30 degrees. In both cases the area of contact is doubled and the load is made more uniform. The expected contact stress becomes 13.5 +- 4.5 kpsi.

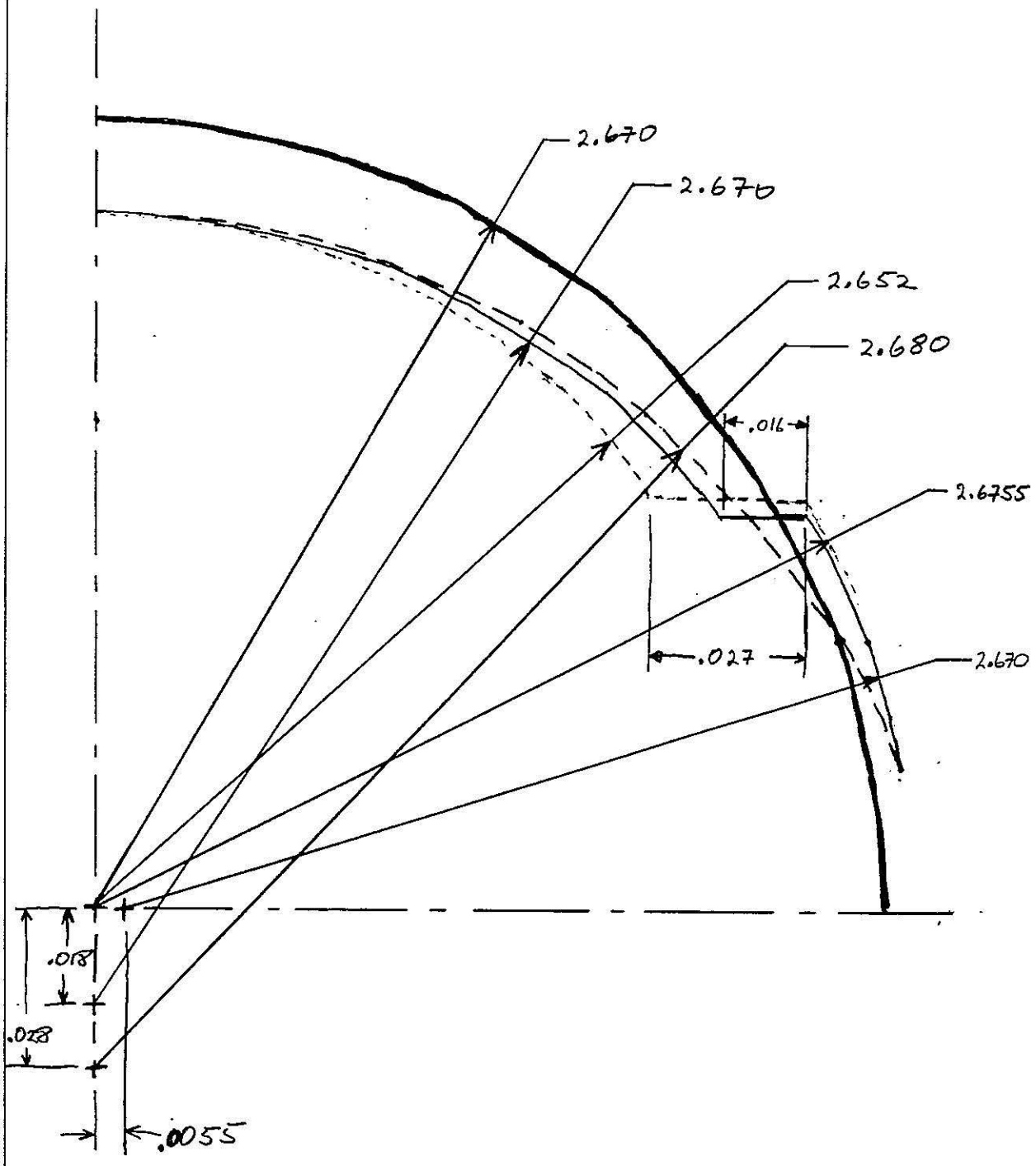
There is not a lot of difference between these two cases in terms of magnet mechanics. Perhaps a collar with coincident centers of curvature is easier to manufacture or inspect. Tooling to mate with the design whose radius is equal to the yoke radius would mate without shimming with the collars for the horizontally split yoke. I have a minor preference for the latter design.

Since no metal has yet been cut for the collars or the collaring tooling, we can still choose one of the alternate designs. We must act quickly, however, to avoid significant delays in the program. I would Appreciate your comments on the virtues of this alternate collar design, what problems, if any, there might be in manufacturing and inspecting the laminations, and what the impact on the tooling design would be.

Footnote

[1] J. Strait, Design of a Vertically Split Yoke and Associated Collar for the 50 mm SSC Collider Dipole: Yoke-Collar Interface, TS-SSC 90-033, 6/25/90

cc: Jim Kerby
Wayne Koska
Paul Mantsch
Gale Pewitt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