



April 26, 1990

MEMO TO: Rodger Bossert, John Carson  
FROM: Jim Strait  
SUBJECT: Collaring Tooling Dimensions and Procedures

In this note I discuss my understanding of the relevant dimensions of the collars and the collaring tooling and what they imply about collaring procedures. I compare naive expectations with the experience collaring DS0307 (twice) and DS0309 and suggest the procedures to be used for the next collaring of DS0307 and the collaring of DS0310. Please review this to make sure that I have understood things correctly.

Assuming no deflections of any components, when the collaring tooling is fully closed (that is, the upper surface of the upper and lower mold parts are in the same plane) the centers of curvature of the upper and lower tooling are coincident. The radius of the collaring tooling is 2 mils larger than the design radius of the C358D collars. Our collars are 1 mil smaller than the design and are therefore 3 mils smaller than the tooling. The keys are offset relative to the center line of the collars so that, in the absence of deflections, when the keys and key slots just fit (zero clearance, zero interference) the centers of curvature of the upper and lower collars are each displaced two mils above and below the center of the assembly. Therefore if no shims are used and there are no deflections, when the tooling is fully closed the key slots should be 1 mil (in a radial sense) underclosed. If a 3 mil shim is used between the collars and the tooling to match their radii, then with the tooling fully closed and no deflections, there should be 2 mils of clearance between the key slots and each surface of the keys.

Several effects may lead to the key slots being less closed than the simple discussion above suggests. Compression of the tooling and the collars reduces the effective closure of the tooling. The collars have a tendency to bend outwards at the mid-plane causing misalignment of the upper and lower key slots. Both the collars and the tooling are laminated. Presumably the dimensions quoted above refer to the "high spot" along the edge of the lamination. Depending on the fractional die break and how the collar and tooling lamination line up, a couple of mils could be "lost". We do not have good quantitative estimates of any of these effects but it seems plausible to me that they could easily add up to several (2-4?) mils on the radius. Thus it would seem a reasonable guess that with a 3 mil radial shim and fully closed tooling, the keys might not quite go in.

Recent practice (collaring DS0307 with Kapton+brass and DS0309) has been to use a 3 mil radial shim, a 5 mil "vertical" shim between the upper press platen and the upper collaring mold, and to insert the keys when the largest gap between the upper platen and the lower tooling is 5 mils. This is roughly equivalent to using no vertical shim and fully closing the tooling. In the previous collaring of DS0307 (with all Kapton insulation), a 6 mil radial shim and no vertical shim were used and the press was closed until the largest gap was 5 mils. This should result in 1) the collars being 0.5 mils on the radius more closed and 2) less outward bending of the collars. Earlier collaring cycles of DS0307 and the collaring of DS0308 were done with half the press cylinders not energized causing the press to close asymmetrically, so I ignore those cases.

In all 3 cases there is strong evidence that the keys were not "placed" in as we desired but were driven in against some resistance. The key insertion caused the average coil stress to rise by 0.6 kpsi and 1.1 kpsi for DS0307 with the 6 and 3 mil radial shim and by 0.4 kpsi for DS0309. In the second DS0307 case and in DS0309 the keys were found to be not fully driven in (by perhaps 10 mils) toward the center of the magnet. This confirms the expectation that with a 3 mil radial shim and the tooling fully closed (or with a 5 mil vertical shim and the tooling 5 mils open) the key slots present an interference fit to the keys. I suggest that in the next collaring of DS0307 we use a 6 mil radial shim and no vertical shim and that we require that the press be fully closed before key insertion. If the strain gages still show an increase with key insertion we should collar DS0310 with a 2 mils vertical shim and the press fully closed.

cc: W. Koska  
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