TS-SSC 90-042

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SSC End Part Modifications

The first coils with "developable surface, grouped" end parts were wound and cured in June 1990. These are the first parts made by programs written by Joe Cook. The coils are SSC 40mm C358 short coils. The lead end parts were manufactured by Texas Instruments. Return end parts are made by T & R Industries in Red Rock, Texas. All parts were inspected and are made according to the points specified in printouts produced by Fermilab.

Two coils were potted and sectioned after curing. Some problems with conductor placement were evident. Problems are:

1.) During winding, the cables are not yet compressed into their final cured size. They are thicker than they will be after curing. The space allowed for the cables by the end parts is only enough for a cured, compressed cable. As a result the last turn in a current block may extend past the end of a shelf during winding as shown in Figure 1.

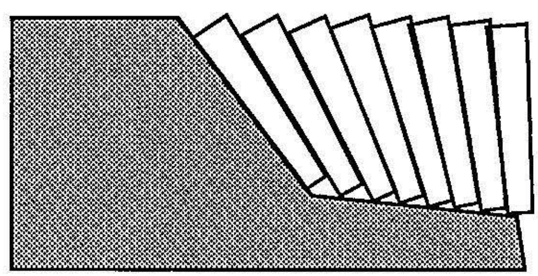

Figure 1.

This occurs for both the individually determined and grouped ends, but the effect is worse for grouped because the space allowed for the bottom edge of the cable is smaller. If the difference between the compressed and uncompressed current block is less than one cable width, this is not a problem. The cables are pushed into their final position when they are compressed. If, however, the current block is more than one cable width larger in the uncompressed state, the final turn is, before curing, completely beyond the end of the shelf as shown in Figure 2. The turn must then be pushed into it's final position in the curing mold. The final turn can become lodged between the shelf and the adjacent end part, causing the end to fail to close or insulation damage to the cable. This possibility becomes progressively more likely as the current blocks become larger.

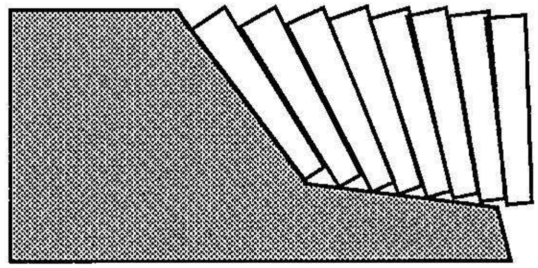

Figure 2.

The situation in Figure 2 occured for the first current block in these coils. This current block has 11 cables. This will be solved by artificially extending the shelf and undercutting the adjacent part as shown in Figure 3.

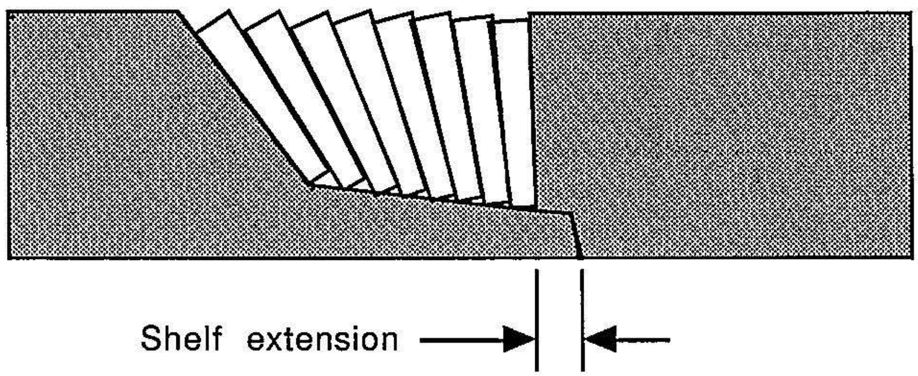

Figure 3.

2.) Cables, as they are wound around the ends, are unavoidably subjected to stresses due to the bend the hard way, bend the easy way and twist. These stresses result in local changes in the cross sectional shape of the cable. Two types of changes have been observed.

a.) The cable becomes "unkeystoned" due to the bend the hard way. As a cable is bent the hard way, the top (thick) edge becomes thinner while the bottom (thin) edge becomes thicker as shown in Figure 4. This is the most pronounced effect.

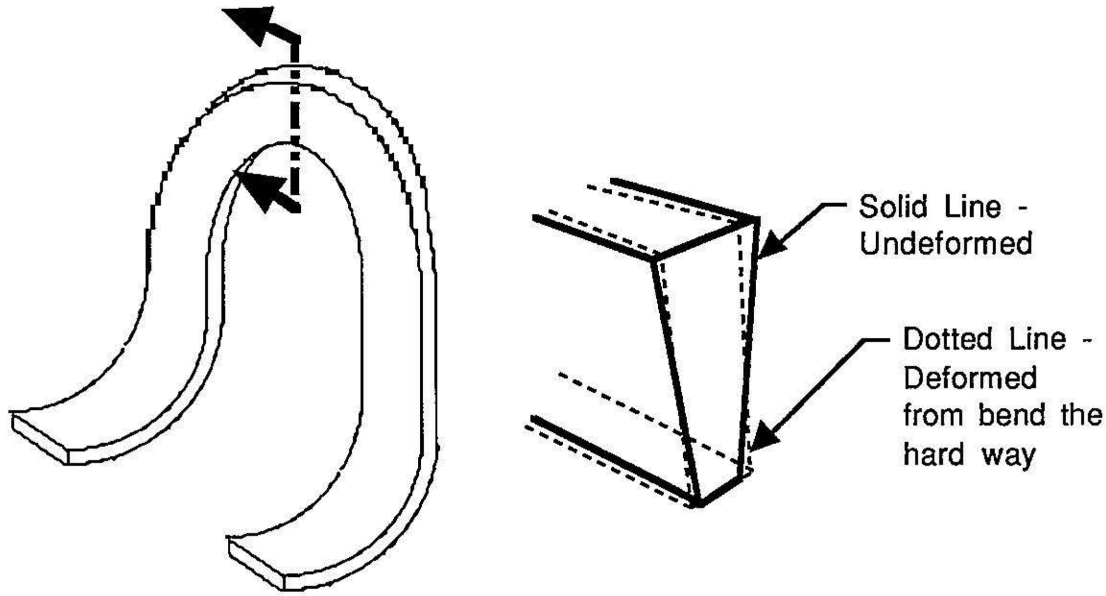

Figure 4.

b.) The midplane thickness can also increase. It is uncertain at this time how much of this effect is due to cable deformations and how much is due to inadequate preloading of the end windings. More analysis will need to be done and better end preloading techniques will need to be incorporated into our winding and curing procedure (including end preloading of each individual turn during winding) before this value can be accurately known.

The end program has been modified to accept local changes in cable shape. Both keystone and midplane thickness can be altered independently as shown in Figure 5. The changes are input based on empirical data.

The following changes have been incorporated into the 50mm end parts:

• At the beginning of turn (where the straight section ends) the cable is at the nominal compressed shape. Between the beginning of turn and a point halfway between the beginning of the turn and center of turn the cable is smoothly increased by 3% in midplane thickness while decreasing in keystone by 40%. From here to the center of turn, the midthickness decreases back to the nominal and the keystone increases by 10% (thereby becoming decreased from the nominal by only 30%). These conditions are mirrored on the other half of the turn.

• Shelves will be extended by..125 inches and adjacent parts will be undercut.

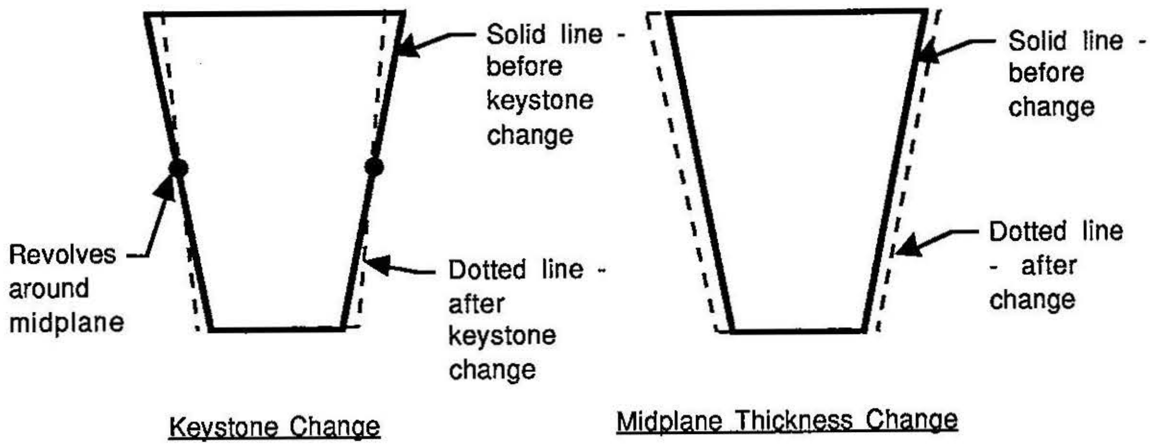
Solid line - before keystone change
Revolves around midplane
Dotted line - after keystone change
Keystone Change
Solid line - before change
Dotted line - after change
Midplane Thickness Change

Figure 5.