Some Considerations for the Welded MCWF Joint Assembly Sequence

Bob Ellis

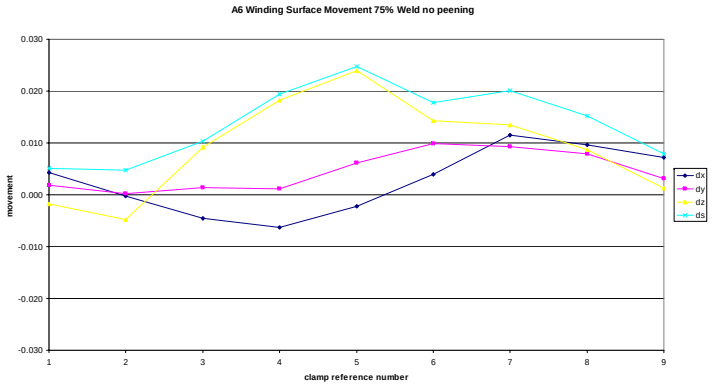
August 23, 2007

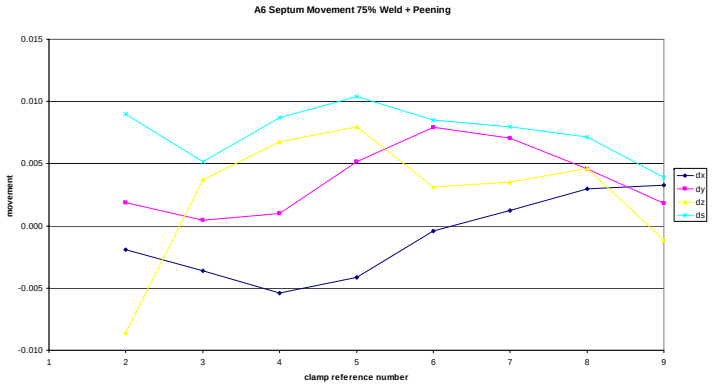
The A6-B6 Weld Test has Shown Unacceptable Coil Distortions

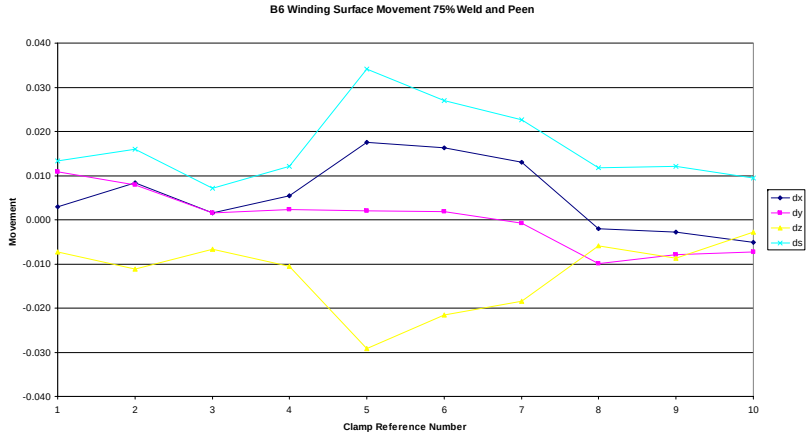
- As of the third weld pass, the maximum distortion at the septum of B6 is .045”
  - .034” after peening.
- Distortions of A6 are significantly less.
  - A6 is restrained by the weight of B6; top surface of B6 is free.
- The movement of external fiducials on the coils follows this general trend.
- Our ability to align our measurement equipment to the coils may be jeopardized.
- The results of the weld test, to date, point towards an assembly sequence that will minimize distortions.

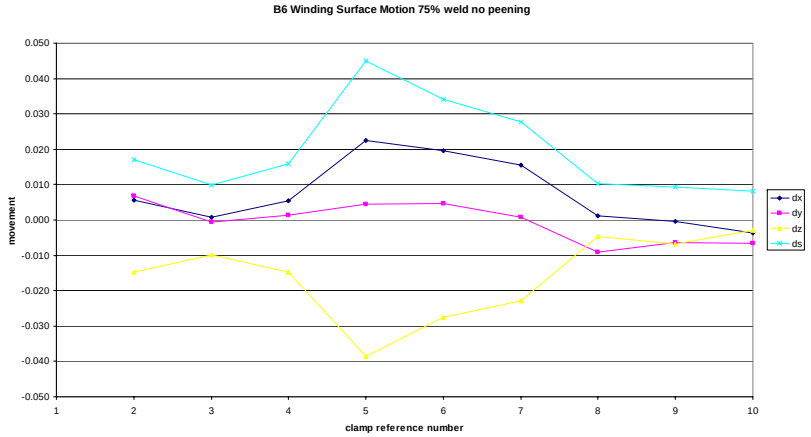
Distortions are Unacceptable, and B6 Moves more than A6

- After the third weld pass, B6 moves .045”; back to .034” after peening.
- A6 moves significantly less.



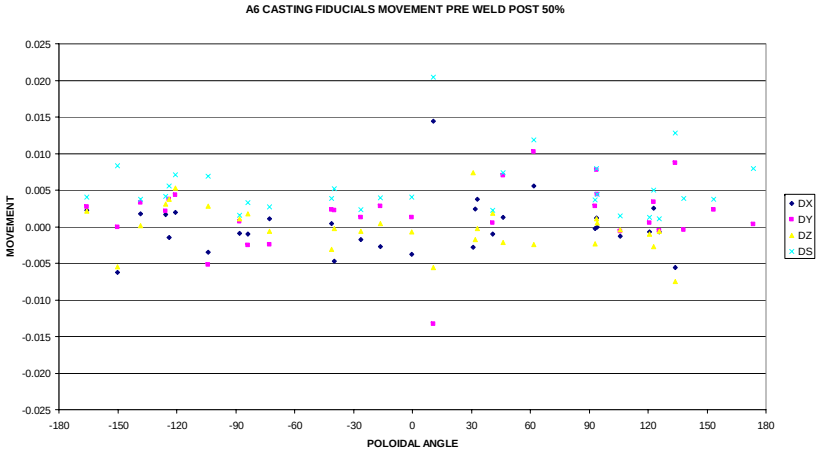


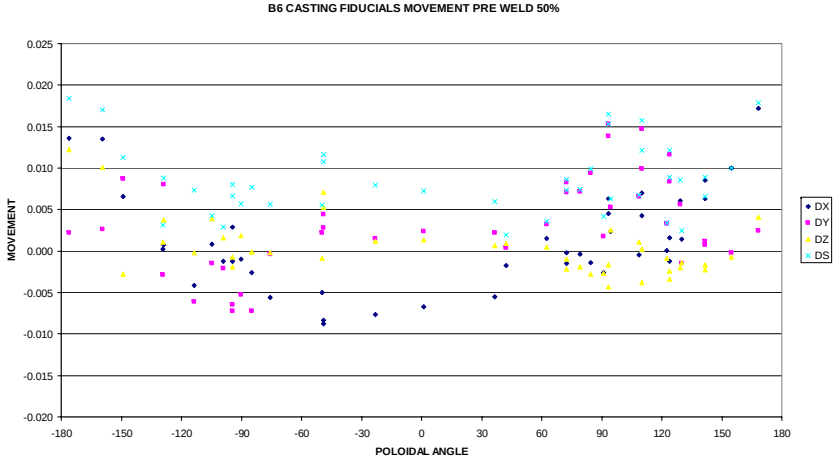




The Movement of External Fiducials on Each Coil, Measured After 2nd Weld Pass, Follows this Trend

- More motion on B6 than A6.
- B6 is probably distorted beyond our ability to get a good alignment.
- More analysis is required to separate rigid body movement, if any, from warping.





- It is reasonable to assume that the B6 coil acts as a restraint on A6. B6 has no upper restraint, and thus deforms more.
- An assembly sequence that maximizes the restraints on the coils being welded will minimize distortions.

A Revised Assembly Sequence can Minimize the Weld Distortions

- Place “A” coil on top of 20deg wedge.
- Rack coil into proper shape.
- Align laser to part geometry, measure global fiducials.
- Place 9 precalculated shims on datum E flange of “A” coil.
- Lower the “B” coil on top of “A” coil.
- Position “B” coil laterally, install full set of precalculated shims (including nose region), Fujipaper, bolts, bushings, torque to 50%, measure both coils, release torque and check Fujipaper, adjust shims as necessary, retorque to 50%, remeasure. [this is from the existing assembly sequence]
- Measure datum E flange of “B” coil.
- Pick up the two coils, still attached to the fixture [bolt the “A” to the fixture], and place the wedge on another wedge so that the top flange of “B” is horizontal.
- Align to the “A” coil, measure global fiducials.
- Place 9 precalculated shims on datum E flange of “B” coil.
- Lower the “C” coil on top of “B” coil.
- Adjust position and torque bolts as before.
- Put the weld shims in the A-B nose region. Fill gaps per weld procedure.
- Weld the nose region between “A” and “B”.
  - Install additional straps between winding surfaces as needed prior to welding.

The A-B Nose Region Has Now Been Welded, with “C” Acting as a Restraint on “B”

- Remove the “C” coil from the A-B pair, and place it on a wedge inclined at 20deg, with datum E facing down.
- Re-align to the “A” coil if necessary [it shouldn’t be] and measure the external fiducials on the “A” and “B” coils, plus the datum E flange of the “B” coil.
  - Use this opportunity to have the back office compute a rigid body “realignment” if necessary.
- We now have an undeformed “C” coil to align to, preserving our measurement accuracy. The “A” coil at the other end of the half period should be minimally distorted, since it had the weight of two coils sitting on it during welding.
- Rack the “C” coil into shape and align to it, measure global fiducials and the datum “D” flange of the “C” coil.
- Place 9 precalculated shims on the datum D flange of the “C” coil.
- Lower the A-B pair onto the “C” coil.
- Position, torque and measure as per assembly sequence.
- Put the special weld shims in the B-C nose region.
- Put straps between wing areas as needed.
- Weld B-C nose.
  - We now have, again, the weight of two coils across the weld region. The “C” coils are the stiffest of the three types, so we can expect to end up with a “C” coil that we can align to.
- Align to “C” coil, measure everything including datum E flange of “A”.

We Now Have a Welded 3-pack With Minimal Distortion

- After measurements have been taken, the back office can compute a set of “realigned fiducials” if necessary.
  - Because of this step, the precise A-A fitup that was previously in the assembly sequence is no longer relevant, and can be omitted. The gross interference check remains.
- The surfaces of the feet on each MCWF should be scanned after all of the welds are complete. When we go to full period assembly, the fixture should have its contact points with the MCWF feet shimmed to match the surfaces as measured after welding.
- Note that all welds are performed with the weight of two coils across the weld, as opposed to the weight of just one coil as in the test now being performed. Also, all three coils are bolted together during welding, maximizing the stiffness of the unit. And the procedure gives the back office the opportunity to compute realigned fiducials, if necessary, after the first weld.
- My expectation…+/-.025” for the 3-pack.