CLAS12 Lead Stabilization Note

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Through successive refining steps the Lead Stabilization process has been perfected for good bonding, bending and twisting to allow for the required shaping of the coil power leads.

Herein some details of the procedure that has been used are outlined. In preparation the high step on the ∪ channel of the conductor is on the bottom of the coil cable (this is one of the requirements of the CLAS12 Torus Coil Winding traveler # 464111).

The Copper Stabilizer bar has been machined with an equivalent step on the bottom side (see Figure 1) to match the step and allow for better contact of the superconductor wire to the bar itself. This precaution also limits the flow-out of the liquid solder present in the region during the process.
The soldering process of the stabilizer bar for the CLAS12 Coils must happen with the cable in the vertical position.

Procedure

1. The Copper Stabilizer Bar needs to be properly machined annealed and clean thoroughly (scotch-brite plus alcohol).

2. Pretin the whole length of the Copper Stabilizer Bar. This utilizing a very small amount of Chipquik Solder Paste SMD291AX250T3 which is the same paste used for the soldering process. The pretinning of the bar must be executed with care. The process require a very thin layer of solder, and particular attention must be payed to the machined grooved area of bar to avoid solder buildups that can jeopardize the contact of the superconductor wire to the copper bar. The tinning of the step-down may be executed after the tinning of the bar surface.
   An example of accurate tinning is shown in Figure 2.

3. Distribute a thin layer of the soldering paste on all mating surfaces, assuring complete coverage, yet avoiding material overbuilding. Do not add solder wire.
   For the application of the solder paste use fingers (wearing nitrile gloves) which allows for the tactile sensation. (see Figure 6).

4. Close the surfaces with the applied soldering paste into the soldering fixture. The cable goes in first then the stabilizer with its proper orientation (the groove to mate with the step at the bottom of the cable) – The closing of the fixture requires assembly of all the springs and washers. – Include the proper aluminum spacer to assure the complete contact of the superconductor cable and the mating Stabilizer Bar. The tapered spacer for the first soldering needs to be inserted leaving about a1/4" out (see Figure 5 for reference).

5. Attach all the thermocouples for the monitoring of the temperatures along the soldering fixture (see Figure 7 and 8 for reference) and turn the monitoring temperature controller on. Assure proper readout by first reading the ambient temperatures thereafter the six temperatures of the thermocouple points along the fixture shall closely follow a gradual increase.
   Note that the heated part of the soldering fixture is on the opposite side of the power cables connection.

6. Compress to the final dimensions the soldering fixture utilizing **four** clamps located along the centerline plus two smaller ones at the far end and onto the cable (see Figure 3 and 8). The four clamps applied along the soldering fixture must be tightened applying <u>maximum</u> force.

7. Cover the fixture (e.g. utilizing aluminum foil as it is shown in Figure 4) to prevent air drafts directly effecting the heating of the fixture.

8. Set both Variacs to 80%, assure all the plugs are properly and fully inserted and power-on.

9. Wait until the temperature along the block (i.e. the readout of the thermocouples 3, 4, 5, 6, 7, 8) is about 160°C then trim down both Variacs to 70%.

10. Wait until the lowest reading thermocouple along the block (i.e. the readout of the thermocouples 3, 4, 5, 6, 7, 8) reaches 187°C. Wait additional 90 seconds then ramp the Variacs to '0' and turn the power off. The heating cycle requires, for reference, about 45 minutes.

11. Allow cooldown, unplug the system.

12. Remove the soldering fixture, clean up the fixture the aluminum filler and all the other small parts, organize all the components ready for future use.

13. Clean-up the conductor by filing out eventual solder drippings, scotch-brite and alcohol along the conductor and the stabilizer.

14. Inspect. There shall not be voids along the upper side of the conductor.

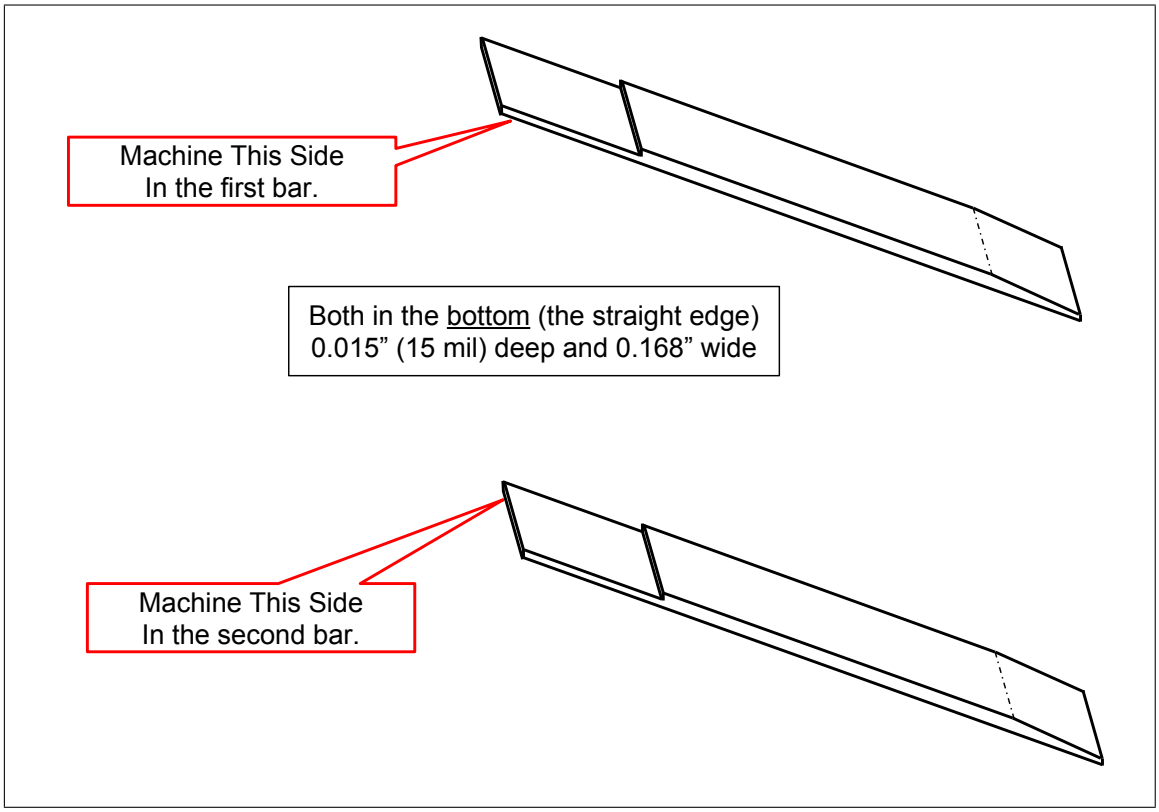

Figure 1: Copper Machining (Sketch)

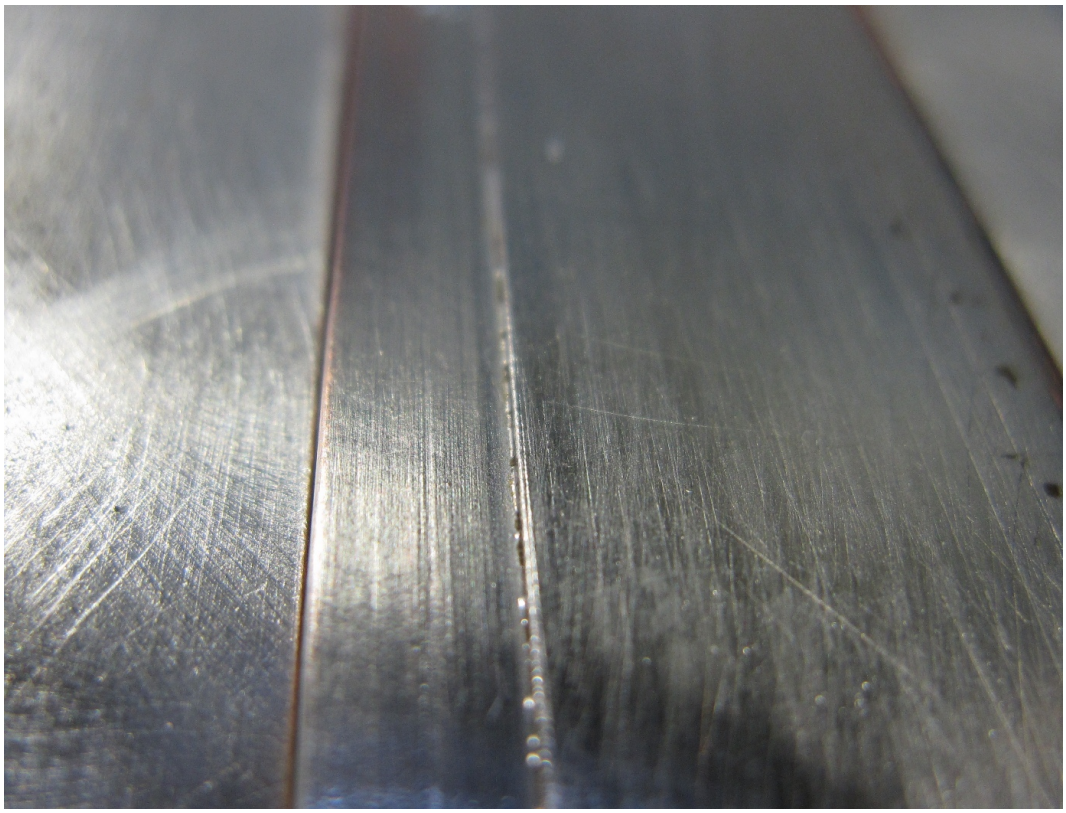

Figure 2: Stabilizer Copper Bar, machined and pretinned

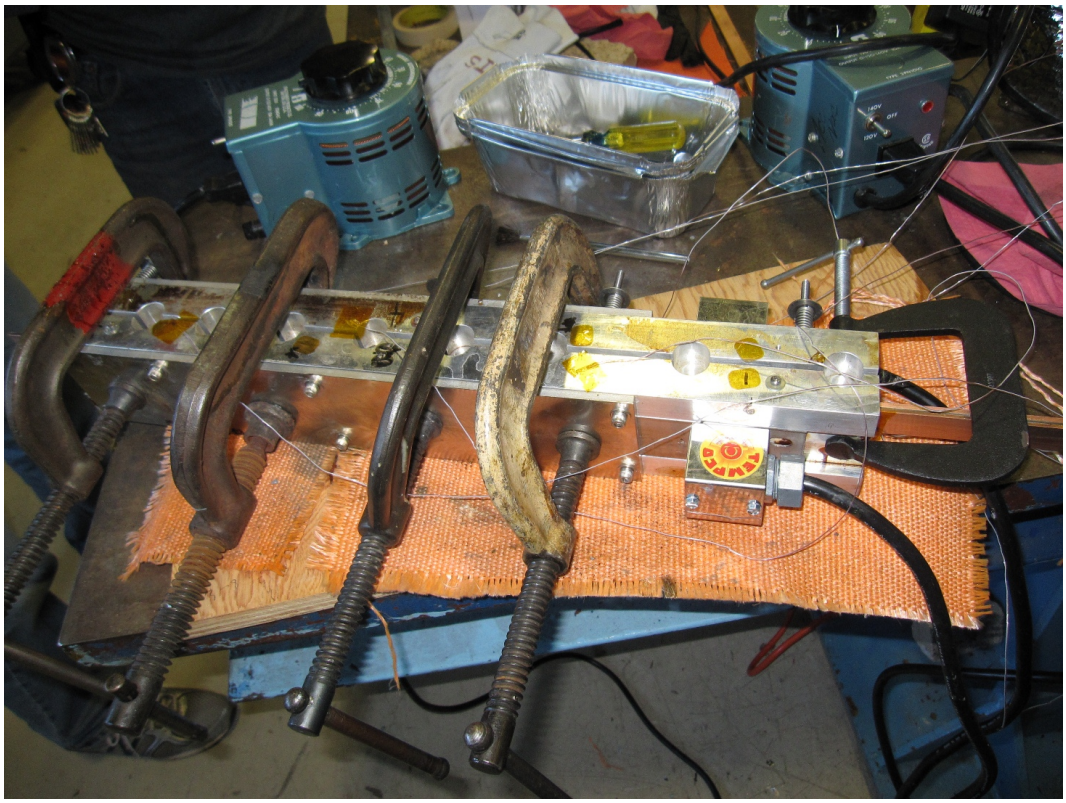

Figure 3: Fixture clamped and ready for soldering

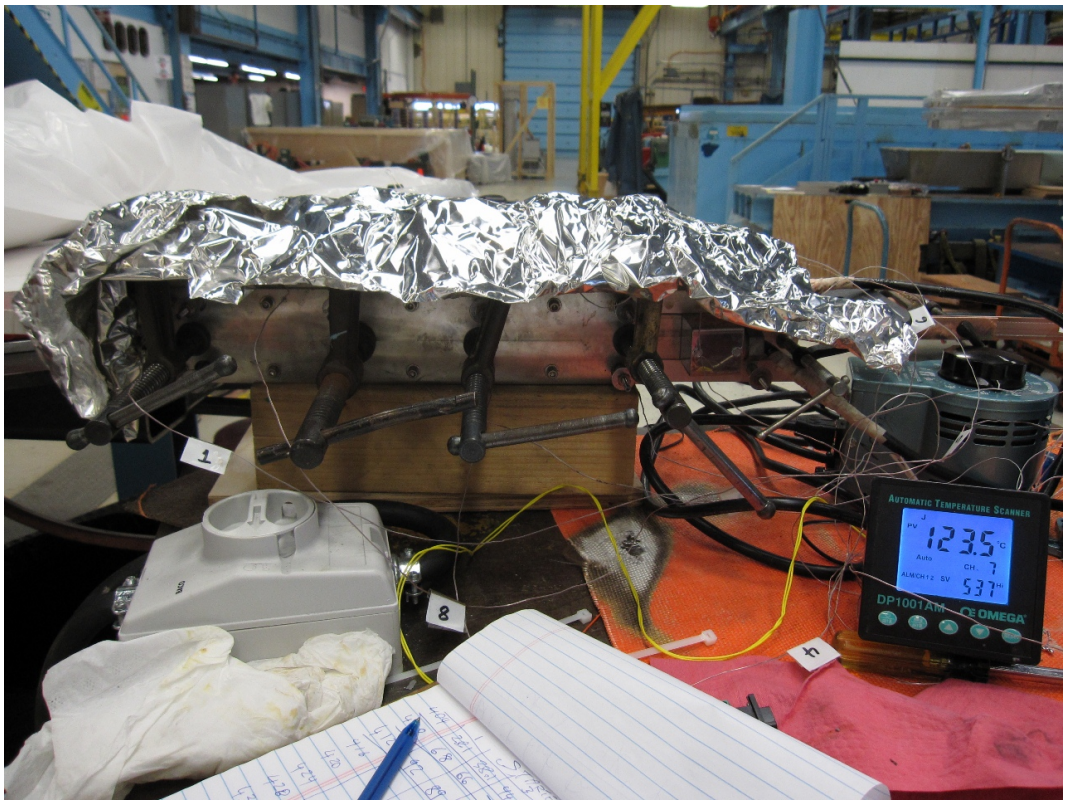

Figure 4: Stabilizer soldering area has been covered to prevent irregular cooling due to air drafts

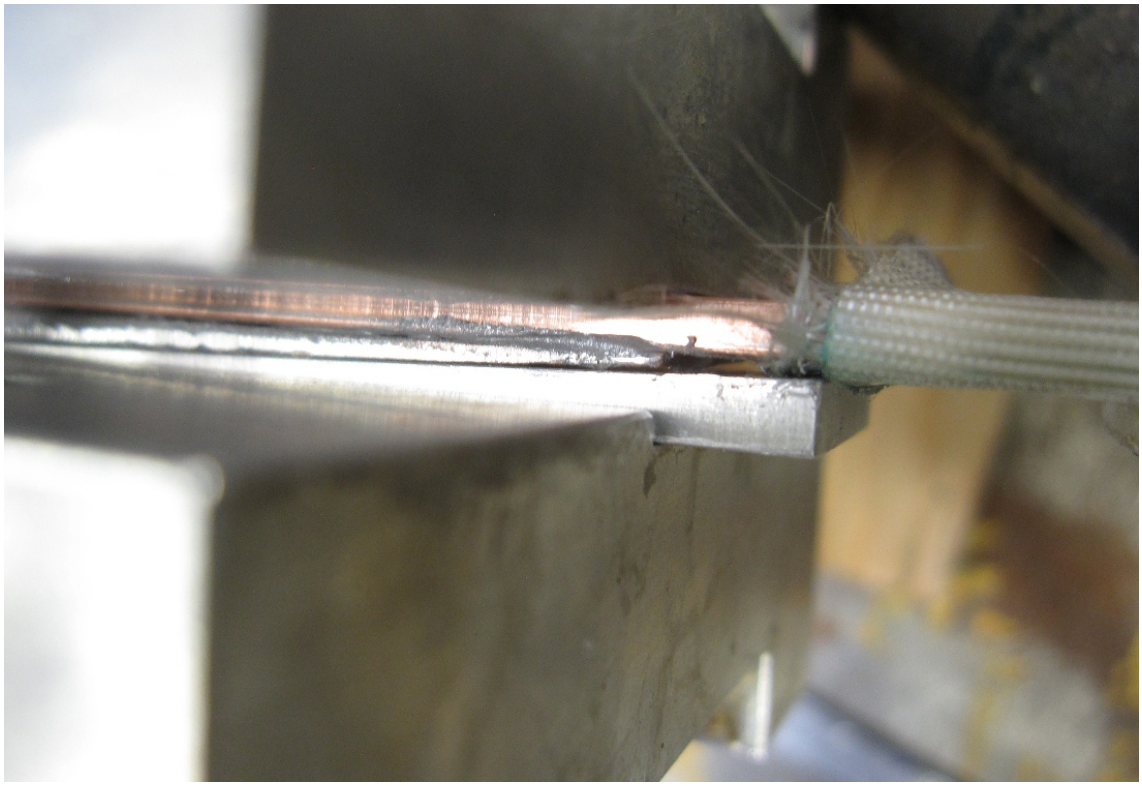

Figure 5: Tip of the aluminum spacer sticks out about 1/4”

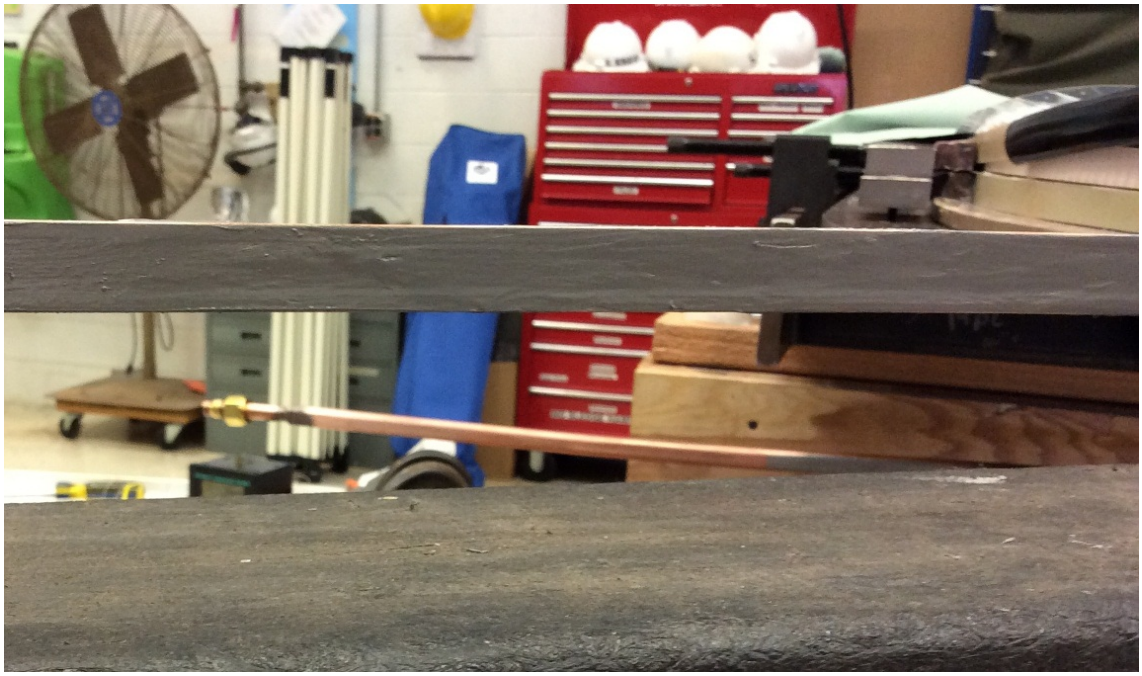

Figure 6: Superconductive cable and stabilizer, held at the bottom, appropriately pasted with ChipQuik. The cable must be inserted in the soldering fixture before the stabilizer

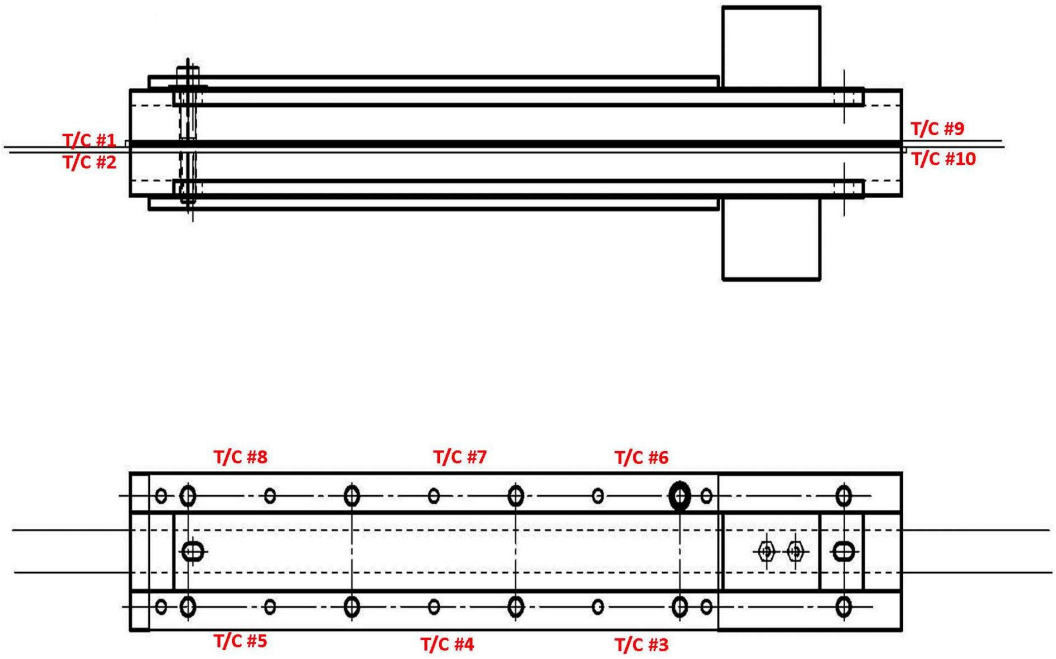

Figure 7: Thermocouple positioning schematic

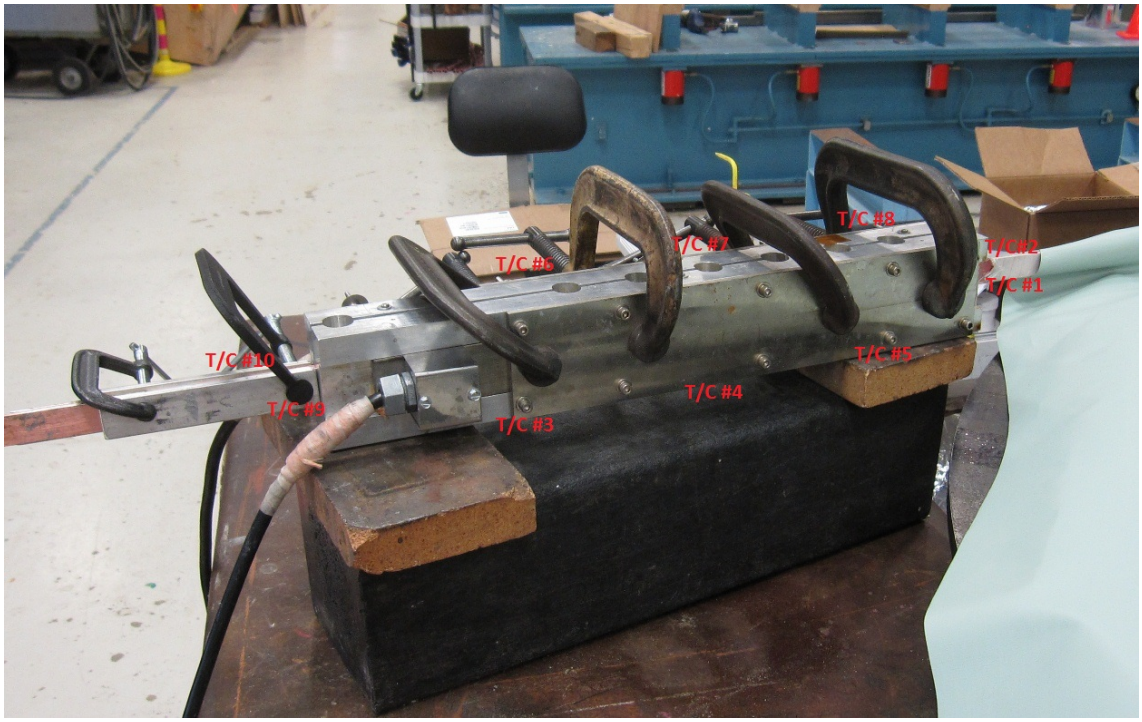

Figure 8: Thermocouple and clamps positioning, picture