

## Lead Preparation, Cutting and Swaging Instructions

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The lead for the construction of the BCAL production modules will be received from Vulcan Resources in four shipments, each consisting of eight (8) 1500-pound crates. The lead comes in coils (rolls), each packaged in a clear plastic bag inside a cardboard box. Coils are cut to width by the vendor: 10-cm, 11-cm, 12-cm and 13-cm wide, and weigh 50-70 lbs each. As soon as each shipment is received, the coils (still in their cardboard box) are extracted from the crates and arranged on shelving in LB113.1 and LB113.2.

Each coil yields on average ten 396-cm-long cuts, and cutting proceeds according to the planned schedule. Unrolling the lead on the cutter-side of the fibre sorting table requires care, particularly for the first few cuts, while the coil is still heavy and hard to maneuver and tends to telescope (in a helical manner) from the inside out. The effect is most severe for the narrowest (10-cm) wide coils. Each cut is then wrapped around a 3" diameter PVC tubing, 13" long, and then returned to shelving. As swaging progresses, the cuts are processed, inspected for acceptance and returned to dedicated shelving in LB113 (main) to be used towards construction.

### Preparing and Cutting

1. Unroll lead such that its loose end is lined up with the mark on the cutting table and its length runs along the edge of the green cutting mat.
2. Inspect the lead, smoothing out any wrinkles or blemishes on its surface and noting any irregularities. If there are irregularities notify the Construction Manager. He will decide if a portion of the sheet should be cut, or in an extreme case the entire coil is discarded. Cut the lead from the roll along the 396-cm mark on the table, being sure to cut slowly and not too deeply so as to not stretch the lead or gouge the cutting surface; do so on top of a piece of board thus using a carpenter's square.
3. Clean the top surface of the lead using ethanol and wipe-all lint free cloths.
4. Two or more people flip the lead over and clean the other side.
5. Roll/wrap the lead around a pre-cut section of 3" PVC tubing (shell) ensuring that it is not loose and that the edges remain lined up.
6. Write the labelling code on an adhesive label that is affixed to the inner shell of the tubing; the code records the coil and cut numbers: ROLL # - CUT #.
7. Record this information in the logbook.
8. Record the information for all cuts in the Elog at the end of each shift.

### Swaging

1. Lay an un-swaged roll of lead on the in-feed table surface (right side) of the swager, noting the labelling code written on it.
2. Push the lead up along the high-density polyethylene guide wall along its entire length working out ("massaging") any banana-type curvatures or any ripples. If

- the lead sheet does not align with the guide or there are defects (e.g. folds, creases) that could affect swaging or the build-up, the lead needs to be discarded.
3. One person mans the in-feed station of the swager and one mans the out-feed one.
  4. The 'out-feed station' person turns the swager on in the forward direction (controlled by a switch which should be in the up position), with the speed setting being around 1 (controlled by a dial).
  5. The lead and swager rollers must then be sprayed down with a generous amount of ethanol to prevent the lead from sticking to the rollers.
  6. The 'in-feed' person guides the lead into the swager being sure to keep the lead firmly against the guide as well as spraying ethanol down the length of the lead.
  7. The 'out-feed' person is ready to peel the lead off the rollers if it becomes stuck and/or to ensure that the lead comes off the rollers and onto the out-feed table surface (left side). Slow speed (dial at 1 or 2) on the motor and attention are the keys to this crucial step. If the sheet is stuck too firmly onto the top roller or catches the edge of the out-feed table and thus rips or bends, the swager needs to be turned off (by moving the switch to the middle position) and the lead is peeled off and any damage done should be assessed and repaired accordingly. Examples include trimming off the damaged length as long as it does not bring the sheet below 392cm, or flattening the lead end and reversing it back through the swager to try again.
  8. When the lead is lying flat on the out-feed table the swager should be turned back on (if it had been turned off before) and the lead is feed through continuously with the speed dial at position 2 or 3.
  9. The 'in-feed' person should keep the lead against the guide as it is being fed into the swager, while avoiding the creation of folds or wrinkles.
  10. The 'out-feed' person should keep the lead flat on the out-feed table (it tends to 'hill up' as it comes out of the swager) and be ready to stop the motor if any irregularity occurs.
  11. The two lead sheet corners against the guide are then clipped at a 45 degree angle, so as to always identify which edge came out of the guide side; the swager tends to produce swaged sheets that are slightly thinner on that side. This is done once the sheet is completely out of the swager.
  12. The lead is pushed up against the out-feed guide and any "banana" effects are worked out if possible. If not possible the lead is marked with a tag inside the PVC tubing and set aside for prototyping use or as scrap.
  13. The long side of the lead is compared to the guide for straightness (parallel and square to the guide). A toothpick is then run along the two outermost grooves. If none or one grooves are lost (and appear on the other side at that point) the lead is marked as such ('P' or '1-off') and stored. Two grooves or more result in marking and eventually discarding the sheet, or using it in tests.
  14. If all is ok, the lead sheet is re-rolled around its PVC tubing always from right to left on the out-feed table, and stored until it is time to be used in the build.
  15. Always roll the sheet insuring that the groves lock into place such that it forms a tight, compact roll.
  16. Record information on every swaged sheet in the logbook.
  17. Record information on all swaged sheets in the Elog at the end of the shift.

18. Immediately prior to using a lead sheet in the matrix build, the sheet is unrolled on the out-feed table and re-inspected against the guide and by using a toothpick to verify the grooves. This outcome is checked versus the recording on the inner tag and the logbook for agreement. If not, the final check is the only one that determines the outcome for that lead sheet.
19. The sheet is then re-rolled around the PVC tubing in two alternating ways:
  - a. Type 1: The sheet is rolled up starting at the end closest to the swager, in a right-to-left manner.
  - b. Type 2: Two or more people flip the sheet over along its long axis and roll it left to right.
20. The sheet is then re-rolled around the PVC tubing and set aside on the lab bench for use in the ongoing build process.
21. The rolled sheets are dispensed on the build always left to right, so that precise alignment of the left edges can be accomplished and the differences in sheet length are manifested on the right side. This ensures accurate tracking of the length so that after machining the final, cleaned-up length of 390 cm can be achieved.