

PCAL assembly – Module-I

Box assembly

The PCAL box consists of two composite windows (2'' ROHACELL structural foam core sandwiched between two 2mm thick stainless steel sheets, the set is kept together by a stainless steel "L" frame welded around the perimeter) and three aluminum (~2'') sidewalls attached to the window's frame. There is a retaining assembly inside the box to keep the lead and scintillator layers in place and to allow enough space for the fibers to be routed out of the box. The retaining assembly consists of a stack of aluminum bars and machined aluminum channels that provides lateral support to the stack as well as a gap between the retaining bars at the readout end of the scintillator bars as space for the fibers to pass through the bars assembly.

Three sidewalls and retaining assembly for the first module were received in February and the machined pieces were within design tolerances except for the position of the window screw holes used to attach the sidewalls to the window frame, they were out of alignment with the threaded holes in the sidewalls by a few millimeters. Survey showed



that the incorrect holes corresponded to the window's frame.

Another issue that required special attention was the perpendicularity of the sidewalls to the plane of the window. Due to wiggles of the window's perimeter support angles, the window sidewalls were not perpendicular to the window surface (possibly as a consequence of the temperature involved in the welding process). Epoxy with glass fibers was used to fill-up gaps (like shims) in order to suppress the wiggles. The two aforementioned problems were communicated and discussed with the vendor, reaching the agreement that they will change the construction techniques in order to keep the parts within specified shapes and tolerances. For the parts of the first box already at Jefferson

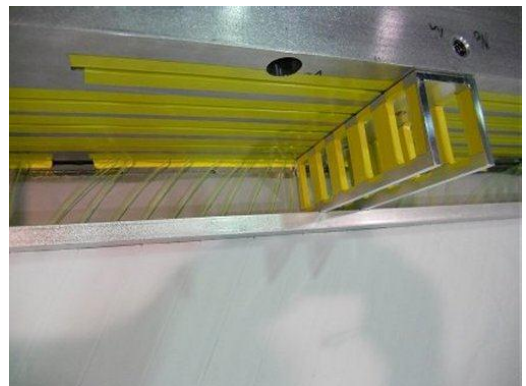
lab it was decided to rework them in situ in order to avoid long delays and transport complications.

Stacking – started May 3rd, 2011

- It took a few hours to accommodate the 84 scintillator strips of the first U-layer. Overall looked good, but the springs for about 20 scintillator bars in the middle were too tight. It was decided to “shave” 1 mm off of the retainer on the readout end of the retaining bar.

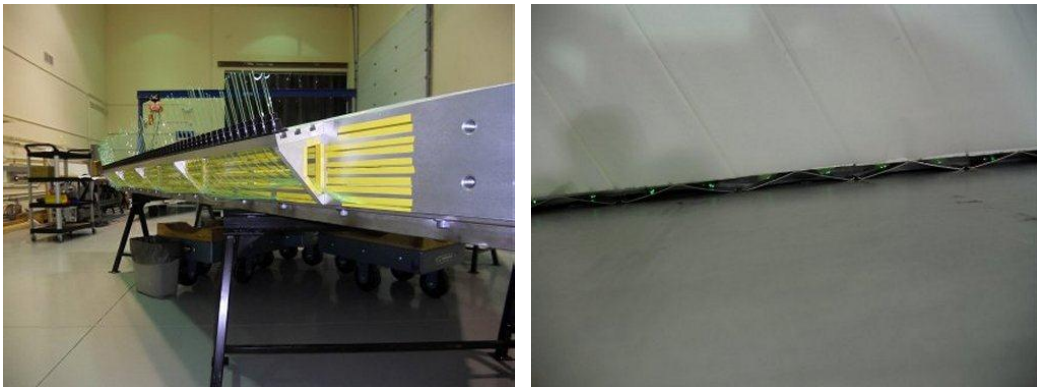


- May 4, the first retainer for the U-layer bars was replaced after the removal of 1mm. It was decided that instead of one long aluminum retainer strip, to make machining easier it was decided for the remaining bars to cut them into 4 pieces of equal thickness as specified but with a width 1mm smaller than the original retainer. In order to make sure that 4-piece retainer will not move or “fall apart”, they were spot glued to the window with two-component epoxy (DP-120). Most of springs were installed to see how they fit with the new retainer (they were removed for fiber installation afterwards).
- May 5, fiber installation started, being finished for this layer on Saturday, May 7. In the meantime the second retainer bar was sent to the machine shop to machine 1 mm deep grooves on the opposite side to the scintillator where the retainer bars sits on the retaining support channels. (A mistake was made on the drawing for the location of



the grooves. It turns out that on the PCAL drawings the retaining assembly location of the channels was given from the edge, not from the center. Hakob removed a few mm from the end of the retaining bar in order to make it fit.)

- May 8, the ends of the fibers were glued to the scintillator. Two component epoxy, DP-190, was used. A new gluing technique was developed, Teflon wrapped aluminum shim supports were used underneath the fibers where they come out of the scintillator strip (at the opposite end to the readout side), to glue the fibers near the top of the hole to the scintillator strip. In this way the hole is not fully closed, allowing the flow of nitrogen. The method is quick, for each fiber just a drop of glue



is needed.



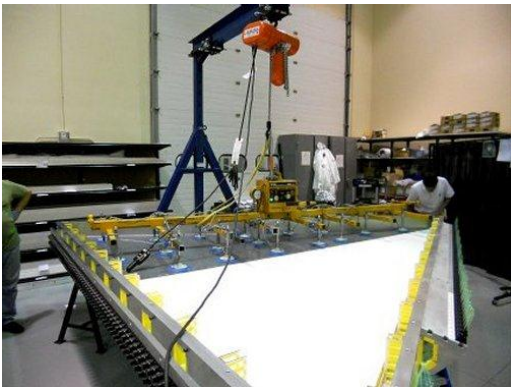
- May 9, after the glue curing period (24 hours for full curing), the ends of the glued fibers were trimmed and then the shims and springs were installed. Everything looked good. A Teflon layer (50 micron thick) was then laid over the scintillator layer.

In the meantime, Danny, Dave and Calvin worked on the lead lifting fixture. The springs on the suction caps were replaced and a spacer (a tube) was added to each suction cap in order to move the frame higher. Otherwise it interfered with the box's sidewalls.



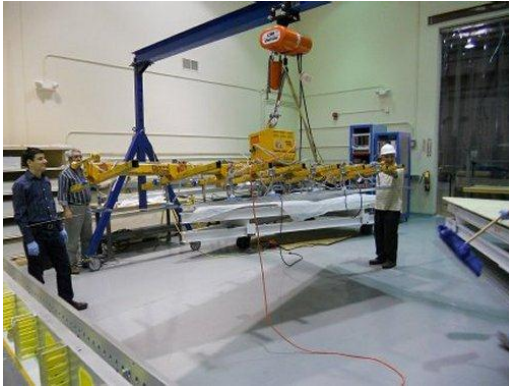
The thickness of the lead sheets was measured using an ultrasonic thickness gage. 38 points on each triangular piece were measured; the measurements were saved to the correspondent file.

- May 10, the first test to verify the fit of the lead sheet in the box was performed. It did not fit. Several problems were found: the lifting fixture was out of balance, the suction cups were not well distributed, the Lead sheet and one corner sagged too much, on one side the frame touched the side wall (the fibers actually), and last but not least the hoist motion was too fast.

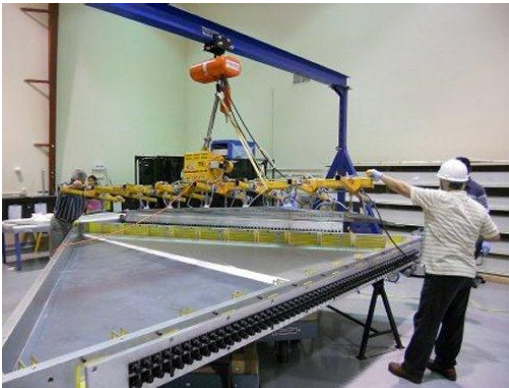


- Checking the Lead sides again, it was found that the hypotenuse of the triangle was not a straight line. It looked like the knife (or blade) used to cut the Lead followed a wavy path. Using a straight edge (a long steel ruler) and a box cutter, the edge of the left piece (looking from the back sidewall towards the tip of the PCAL triangle) were cut straight. Also, the suction caps of the lifting fixture were moved to the right side of the frame to solve the issue of interference of the frame with the fibers. On the

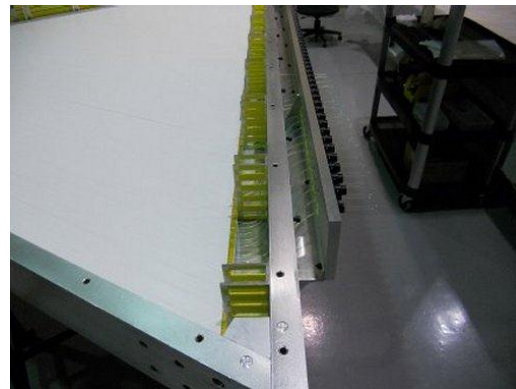
back side suction cups redistribution was done to solve the issue of the imbalance along the axis.



- May 11, the first (left) Lead sheet was set on top of the scintillators just before the “Run a round”. The trial fit of the second piece was again unsuccessful. There was about 2mm overlap, and again hypotenuse was not a straight line. Had to be re-cut straight as the previous one.
- May 12, after a few iterations the second piece was successfully installed.



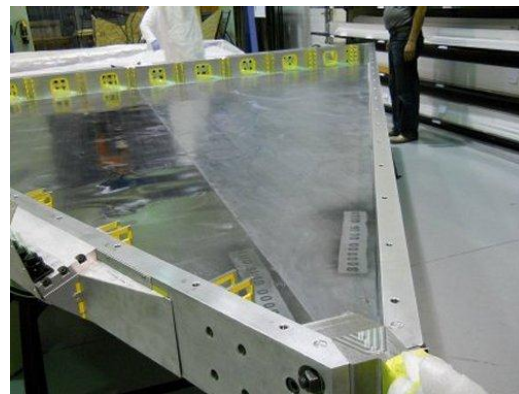
- May 13, start stacking the second layer of scintillator. By the end of the day all the scintillators were laid and a few fibers were inserted.



- May 18, the assembly of scintillators and fibers of the second layer was finished at 2pm. For spot gluing the ends of fibers, newly purchased rectangular Teflon bars, 0.25''x0.5''x 4' long, were used, this made things even simpler.



- May 18, the thicknesses of both lead sheets were measured on Tuesday. First piece (right piece) was prepared for installation by end of Wednesday (sides were measured and a cut was made to straighten the hypotenuse).
- May 18, in the early afternoon, the first Lead piece was installed; the second (left) piece did not fit. Trimming in a few places along the hypotenuse was required. After cutting three wiggles, the second sheet fitted well.



- It was decided to increase the number for support shims under the retaining bar on the V/W side. It is too thin and it sags between 5 supports. 4 more shims were added between each pair of original supports.