

# Leak Testing the Module External Center Seal

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A new center seal has been designed and tested to remove a possible impediment to oil flow through the end plate of the module and avoid bubble formation. The purpose of the center seal is to solve the sealing problem caused by the smaller radius of curvature of the outer cells of extrusions. Two of these outer cells are glued together when two extrusions are combined to make a 32 cell module. The increased curvature of what now becomes the center scallop of the module extends beyond the sealing surface of the end plate or manifold covers and snouts. This problem is solved without blocking any of the liquid flowing when the module is filled by putting an extruded external center seal into the center scallop. This center seal, shown in figure 1, partially fills the scallop forming a seal with the extrusion. Figure 2 shows an external center seal laying on an extrusion just before it is glued into the center scallop. Figure 3 shows the external center seal glued into the center scallop before the end of the module is cut off so that the center seal is flush with the end of the module. Figure 4 shows the end of the module after it has been cut to size.

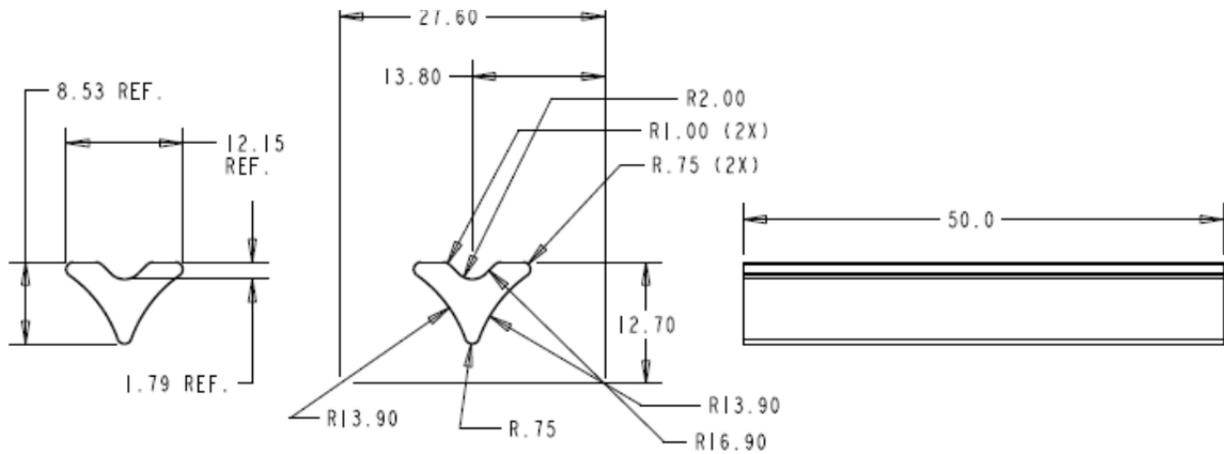


Figure 1: External center seal. All dimensions are in cm. docdb 6019

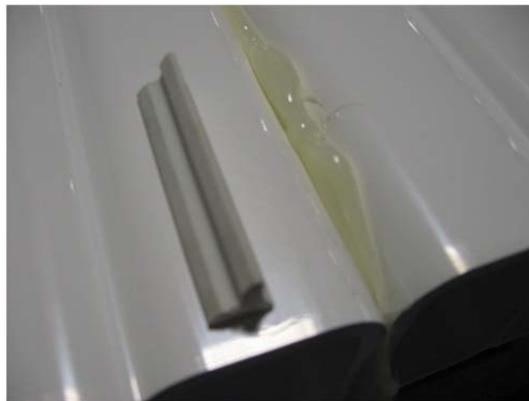


Figure 2: External center seal just before being glued into the center scallop of a module. The center seal will be pressed into the glue visible in the center scallop.



Figure 3: External center seal glued into the center scallop of a module before the module end is cut off.

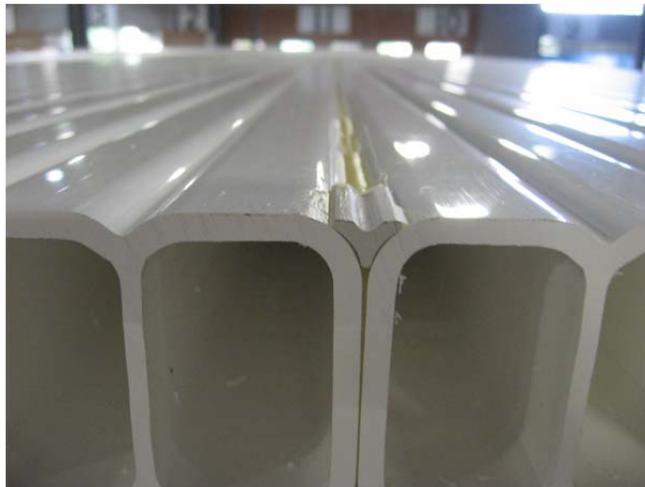


Figure 4: External center seal glued in place after the module end has been cut to size. Note that the center seal is always below the level of flat region of the module cells.

Test modules were assembled and pressure tested to show that the external center seal forms a reliable and easily installed seal. To test the concept, a plastic part was machined fill the scallop to simulate the extruded part. Eight short, 2 foot long, modules were constructed using existing end plate and manifold parts. The usual process was followed to seal the module with an inner glue of 3M2216 applied and leak tested at 10 psi followed by an outer glue of Devcon Plastic Welder leak tested at 20 psi. No leaks were seen. For small modules of this size, the leak checking procedure will find leaks down to 1 $\mu$ m.

Next 32 full sized horizontal modules were prepared as reference pressure tanks for a new bubbler leak tester. These modules were sealed at both ends with end plates and glued with Plastic Welder only. The external center seal was simulated by filling the center scallop with plastic welder. None of these modules leaked when pressure tested at 20 psi. This gave a sensitivity of the equivalent of a 9  $\mu\text{m}$  leak.

Finally the extruded external center seal, shown in Figure 1 was ordered. When it was delivered it was tested on 7 full sized vertical modules being used for reference pressure tanks. These modules had end plates and their external center seals on both ends. The modules were tested at 20 psi and no leaks were observed.

Based on these tests, we conclude the external center seal is a reliable and robust solution to the problem of sealing the joint between the two extrusions that form a module.