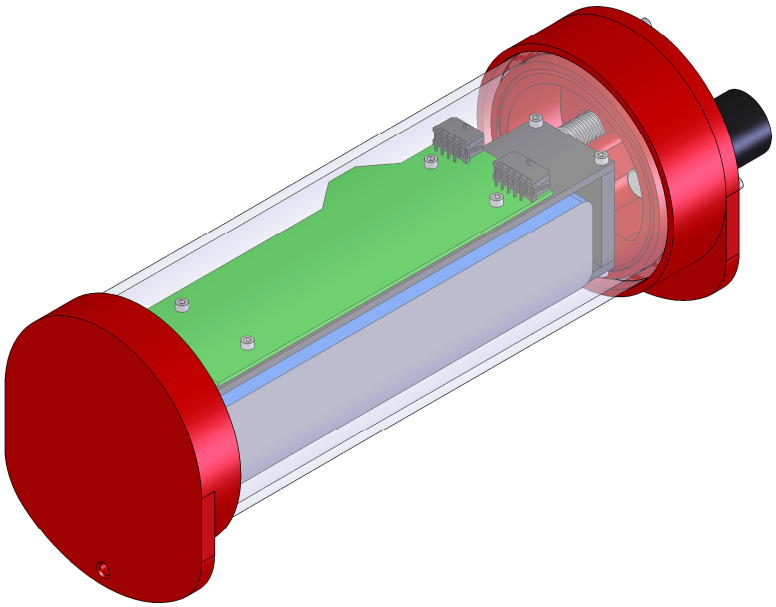
Kraken

Battery Pod Technical Documentation



Bradley Factor – bef23

December 10, 2007

Requirements

The battery pods…

- shall provide a bus voltage between 18-36V.
- shall provide 2-3 hours of vehicle runtime under typical pool test operation.
- shall be smaller and lighter than Proteus's battery pods.
- shall operate in air and underwater without overheating, that is without exceeding the operating temperature range of the most temperature sensitive component, while being exposed to full sun.
- shall be able to be mounted and removed from the vehicle toollessly in under 15 seconds.
- shall be charged without requiring disassembly.
- shall remain waterproof to a depth of 25 feet with a safety factor of 2.
- shall remain intact and undamaged assuming typical handling conditions.
- shall comply with the competition charging condition rule.
- shall mount the battery management board such that the board will remain unexposed to water until at least half of the pod contains water, assuming that the vehicle is oriented normally.
- shall be constructed such that the battery (or batteries) and battery management board can be accessed by opening only one end of the battery pod.
- shall support the external connections necessary to facilitate charging and discharging functions.

Previous Designs

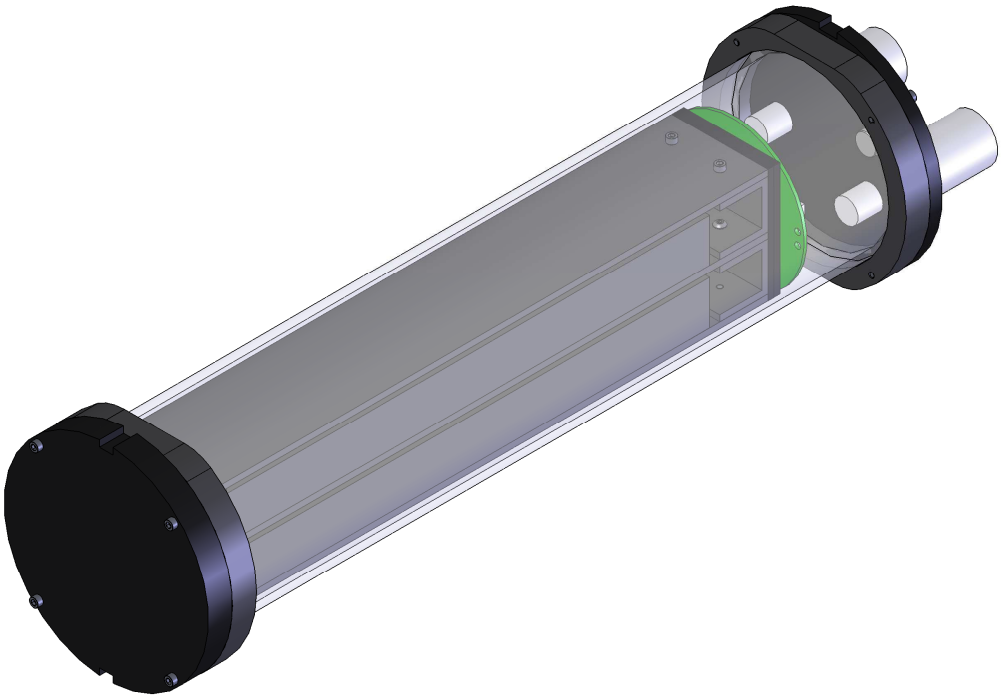


Figure 1: Proteus battery pod

The final design of the Proteus' battery pods was mechanically sound overall. However, several design and usage issues in the final design were addressed in the design of the Kraken's battery pods.

Once assembled correctly, the Proteus' battery pods sealed successfully within their required operating range, however due to the use of face sealing o-rings, minor mistakes in assembly could easily result in a catastrophic failure of the seals.

The positioning of the pod board was occasionally problematic in that water entering the pod due to a sealing failure would always damage the board.

Assembly and disassembly of the pods is a relatively long and tedious process as both ends of the battery pod are involved in the process due to positioning the battery pod rack and underwater connectors on separate end caps.

Attaching the pods to Proteus can be difficult, as they need to be guided through two rings on a system of two rails and then latched into place.

High Level Description

The high level design of the battery pod is fairly simple. A mechanical structure physically supports a battery (or batteries) and protects the battery from water. Electrical connections to the rest of the vehicle are handled through some form of waterproof connector. An additional mechanical structure attaches the battery pod to the rest of Kraken.

Design Implementation

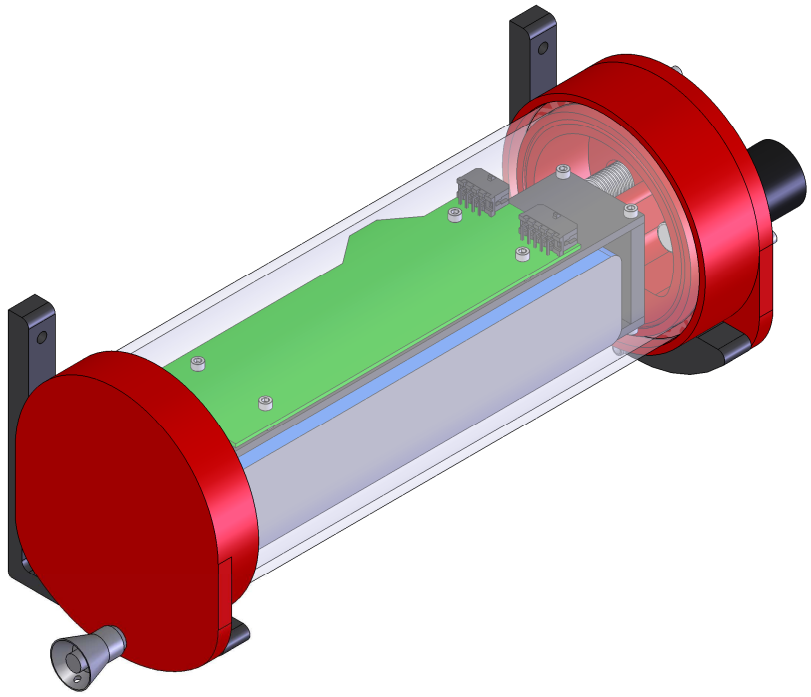


Figure 2: Mounted battery pod

The Kraken's battery pods are designed such that they will be cradled by two supports into which they are pinned. These supports are bolted directly to the frame. This alleviates the mounting difficult issue.

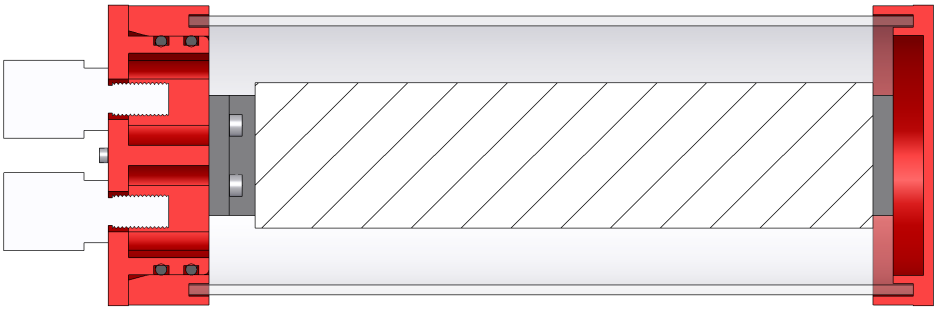


Figure 3: Battery pod section view

The section view above illustrates the pressure vessel design. The front cap has a slot in it so that it can be epoxied directly onto the hull. The back of the hull is epoxied directly onto a collar with a bevel designed to accommodate a double bore o-ring seal which should be more reliable in sealing than the prior face seal design.

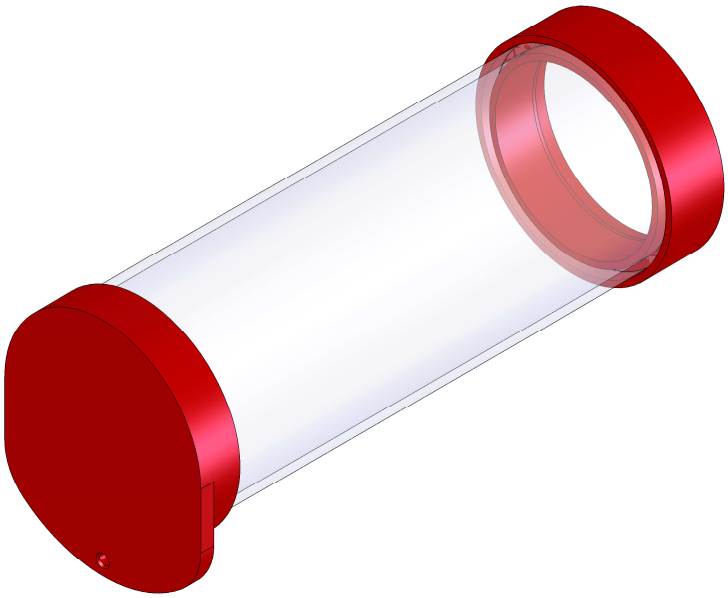


Figure 4: Battery pod hull assembly

Kraken's battery pods are designed to come apart into two main assemblies. Above is shown the hull assembly which consists of a front cap, plastic hull, and rear sealing collar. It can be seen that no electronics or external connections are integrated into this assembly. Additionally, there is nothing mounted to the front cap so that the battery pods can be stood on end for temporary storage; with lesser length, they will be less likely to tip over once at rest.

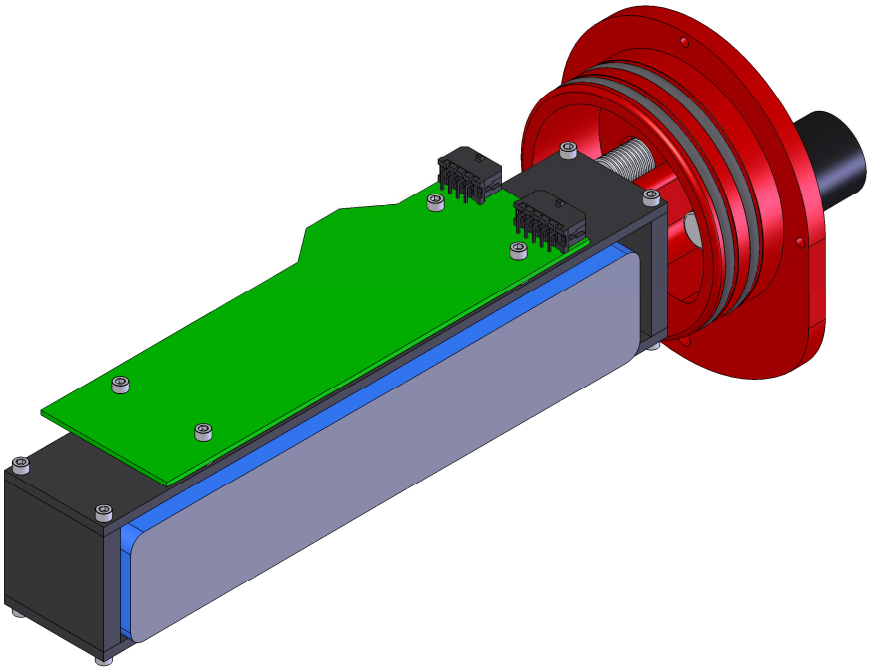


Figure 5: Battery pod equipped rack assembly

This is the second main assembly which consists of the rear end cap with connectors, pressure relief valve, and o-rings as well as the battery pod rack with battery and pod board. By positioning the pod board on top of the rack, a significant amount of the pod must fill with water before the pod board will be damaged. The battery will be zip-tied in place. All of the electronics and external connections are in this assembly, which alleviates the assembly/disassembly time and complexity problem.

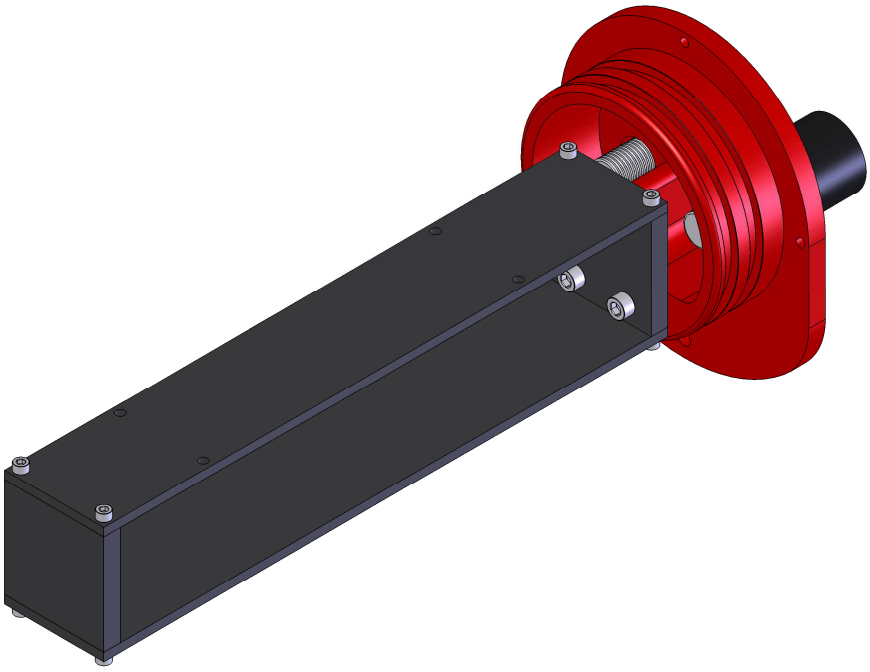


Figure 6: Battery pod bare rack assembly

From the diagram above it can be seen how simply the battery pod rack is designed. It consists of two flat beams and two thicker plates, beams and bulkheads respectively. There are a total of 7 clearance holes and 8 tapped holes. The diagram also illustrates how the battery pod rack is cantilevered from the rear end cap, utilizing three screws and a shelf built in to the rear end cap.

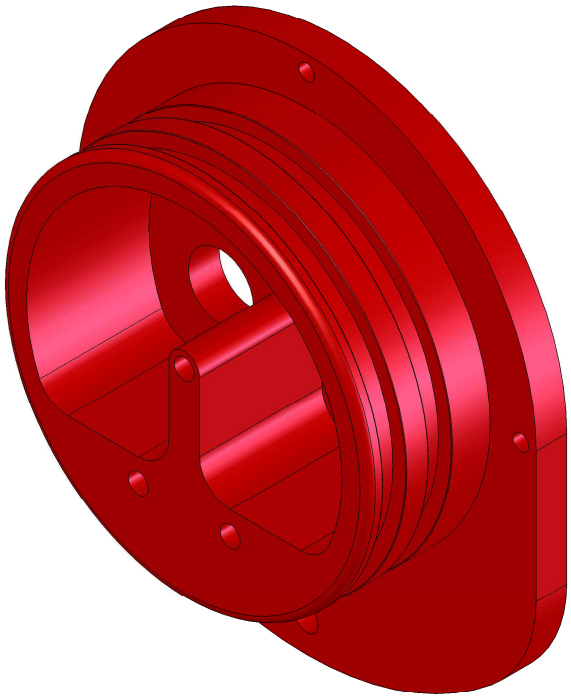


Figure 7: Battery pod rear end cap

The rear end cap is a fairly complicated piece. It includes two bore o-ring glands for sealing, a flange for mounting the pod to the support, and a three point shelf for supporting the battery pod rack. The rest of the front of the connector is machined out to allow for installation of the Seacon connectors and Deep Sea pressure relief valve.

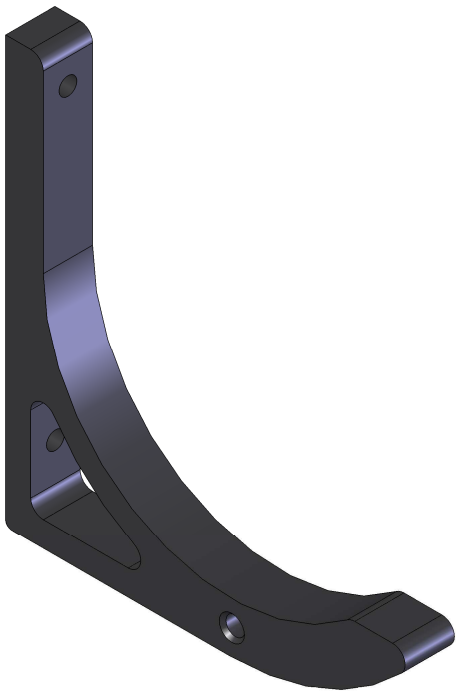


Figure 8: Battery pod support

The battery pod support is separate from the battery pod. Two supports are required to mount each pod to the vehicle. The length and final angle of the curved portion was designed to allow the battery pods to be placed on the supports without being concerned about the pods falling off, to put less stress on the fastening pin during sideways applied torque, and to not require too much vertical motion to remove the pod from the supports. The cutout is provided to reduce weight and to allow for support mounting using a bolt and a nut rather than a screw into a tapped hole. The pin holes are countersunk to make pin insertion easier.

Known Problems

The only possible problem currently known is that the countersunk pin holes in the supports may lower the pin removal force.

Current Status

All of the battery pod racks are machined and ready for finishing and anodization. The outsourced part files are ready to be sent out but require drawings.

Future Improvements

No currently planned future improvements.