# SECONDARY LOCK MECHANISM for SEA-Snap™

In Partner with: enginuity

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## THE PROJECT

### ENGINUITY:

- Designed and currently manufactures a lifting connector intended for marine/industrial lifting and rigging purposes.
- Their unique design is known as SEA-Snap™, the sister hook design allows for an instant-grab connection.

### PROBLEM:

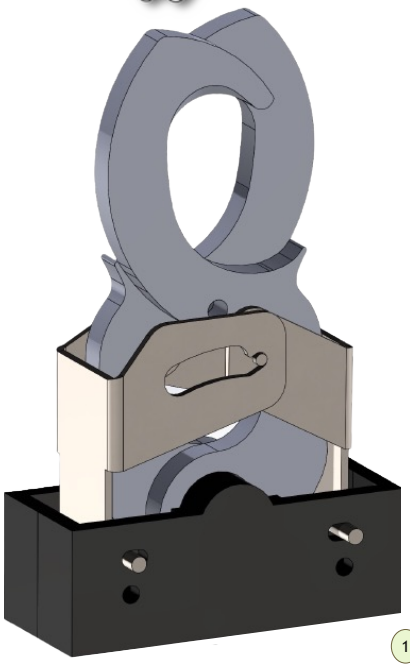
- The goal of this project is to design a secondary lock compliant to CSA standards to obtain reach in the fall arrest and climbing markets.

### REQUIREMENTS:

Must comply with standards:
- CSA Z259.12-16
- BS EN 362:2004
- UIAA 121

Main points:
- Gate side shall withstand 16 kN for 60 seconds with no signs of failure.
- Gate face shall withstand 16 kN for 90 seconds without failure.
- Loaded over an edge shall withstand 8 kN without breaking.

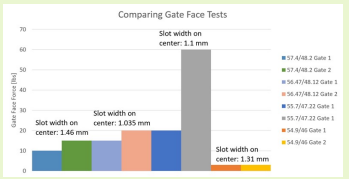
Enginuity Desired:
- Connector should keep manufacturing changes to a minimum.
- Operable with a single gloved hand.
- Retain unique ability to connect by "stab" motion.
- Retain duplicity in manufactured components.



## VERIFICATION

- A saltwater test was performed similarly to CAN/CSA Z259.12-16 (ISO 9227).
- A hook was placed in a saltwater bath for 24 hours. It was then removed and allowed to air dry for 1 hour before being submerged in the bath for another 24 hours.
- The result of the test was a slight bit of tarnishing on the hook which was easily wiped away.

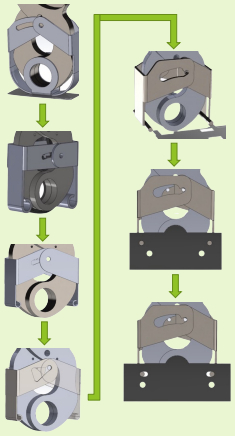
- A gate face test was performed on various versions of the connector casing as per CAN/CSA Z259.12-16 (6.6.1).
- The connector was placed in a vice and the force required to make the lock fail was recorded using a spring scale.




- It is evident from the above graph that there is a correlation between a narrower slot length and a greater load withstood during a gate face test.

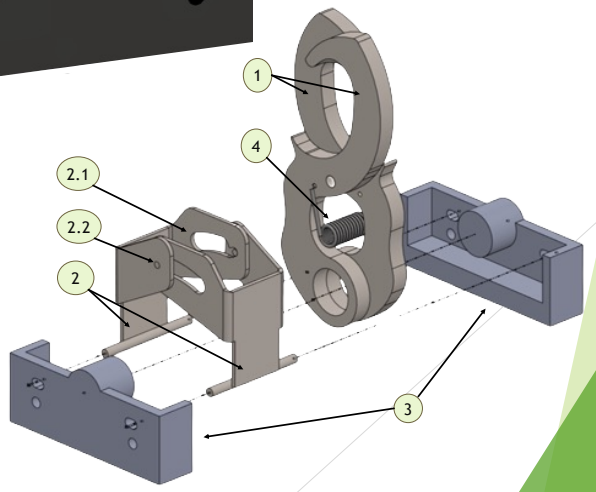
## DETAILED DESIGN PROCESS

- Many different iterations of the chosen design concept were made by using an abrasive water jet cutter to cut 316 stainless steel blanks, bending the sheet metal, and welding various features to the cam covers.
- The original design was a one-piece design that would replace the main connector torsion spring. Spring force, fatigue, and overloading were all issues.
- A two-piece design was the next evolution. After some iteration, the main torsion spring was used to return the two covers to the locked position.
- Finally, a non-quadratic design was implemented for the cam slot. Moving the pivots closer together by way of a slotted pivots in the connector case allowed the covers to be unlocked when both sides were pressed



## COMPONENTS

| | |
|---|---|
| 1 | 2x 316 Stainless steel hooks |
| 2 | 2x 316 Stainless Steel Cam-follower Cover to bind and lock device |
| 2.1 | Slot profile to bind when force applied to a single side |
| 2.2 | Pin to cause binding and withstand corresponding compression forces. |
| 3 | 2x mock casing to secure Cover Pivots |
| 4 | Torsion spring to apply constant closing force. |




## FUTURE CONSIDERATIONS

- Design a new case that fits over or under the cam covers.
- Make a version of the cam covers with improved tolerances and spring clearance.
- Make the cam follower captive to eliminate effects on operation from flex in the plastic casing or the steel cam covers and to reduce manufacturing costs.
- Improve on cam profile design to make it more consistent.
- Design a jig to improve assembly efficiency.
- Continue testing to verify design as well as identify more areas for improvement.

### REFERENCES:

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