

# Ball Clamp Foot Restraint

SEG39138903

Design Schools: Cypress Woods H.S. Texas,,

Machining School: Austin H.S. Alabama, Colton Sandlin

3D printing Schools: Grissom H.S., Jemison H.S. Alabama

Sewing School: TBD

Teachers: Mike Bennett, Bill Gibson, Kyle Brakke, Chris Faust

Mentors: Glenn Johnson, Alli Westover, Bob Zeek, Marcie Dickson

Engineers: Bruce Blazine, Tom Marshburn

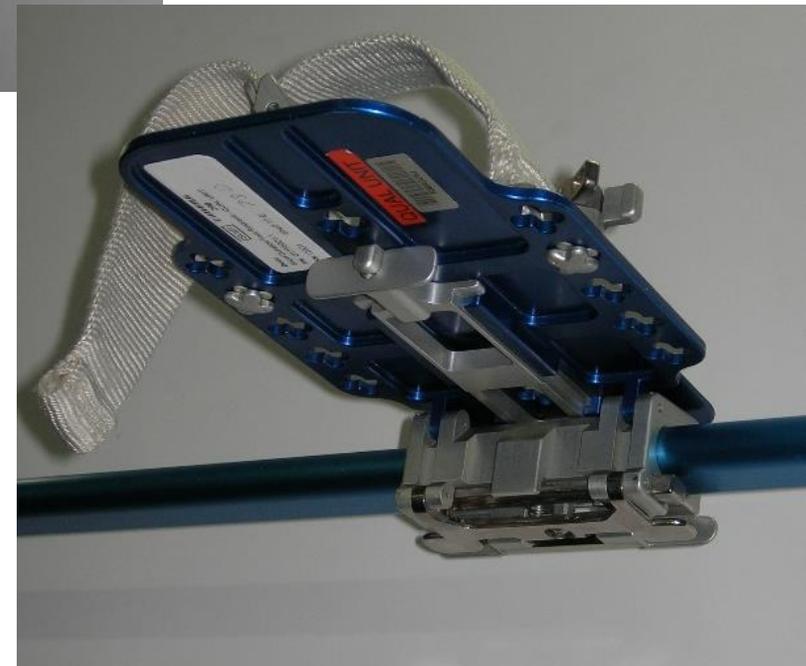
The Ball Clamp Foot Restraint is a variable, friction based restraint that attaches to a Station handrail and is designed to allow a crew member's foot to pivot and swivel several degrees. The clamp can be tightened to increase the friction on the ball, making the restraint more rigid.

# Problem:

- When astronauts work all day at a work site using the current Short Duration Foot Restraints, they sometimes get knee pains. The main difficulty is that the foot restraints are very rigid and don't allow for swiveling between the laptop and the payload near by.
- Crew asked if the Double Ball Clamp could be modified into a foot restraint that would allow for swiveling.
- Students worked with NASA mentors, engineers and astronauts to come up with a new foot restraint to satisfy their needs.



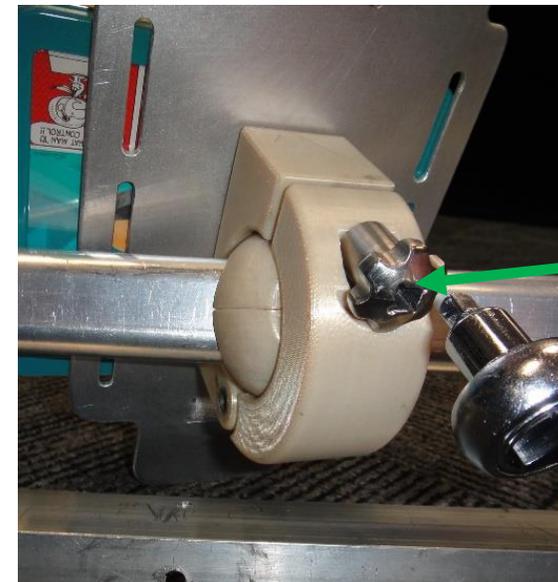
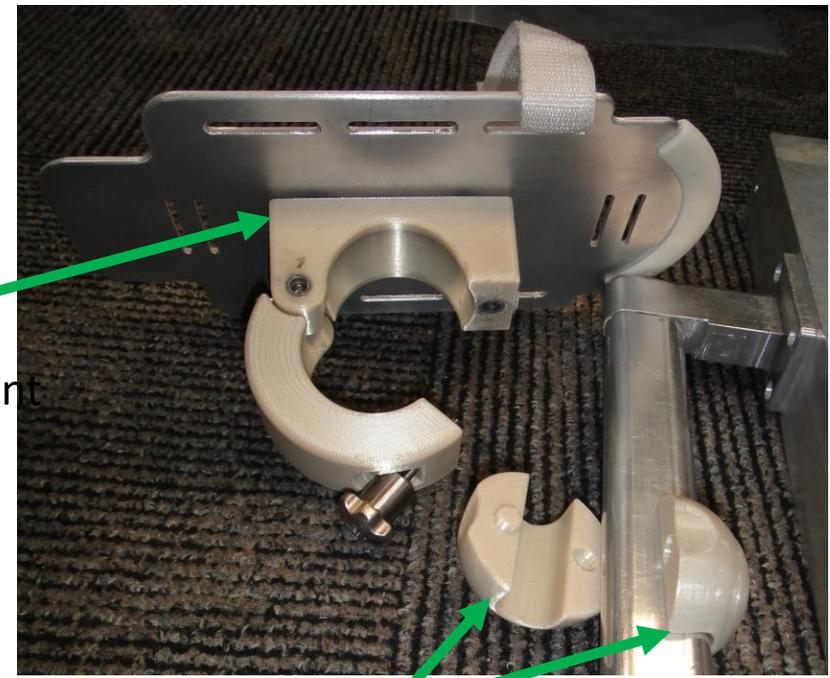
Short Duration Foot Restraint has 2 perpendicular configurations but no swiveling or pivoting capability.



# Functionality

- Ball Clamp Foot Restraints are made of certified ULTEM plastic from a 3D printer with stainless steel shoulder bolts, inserts, thumbscrew, an aluminum foot plate with a nomex and Velcro foot strap.
- Each Ball Clamp Foot Restraint is composed of 4 pieces: a Ball Clamp with attached Foot Plate bolted into place, 2 identical half spheres that are removable and a foot strap that is also removable.
- Two identical Ball Hemispheres attach around a handrail and are the bearing surface for the clamps to rotate around. (Ball Hemispheres stay together by friction fit on or off the handrail)
- The clamp can rotate about 90 degrees around an attached handrail The tightness of the thumbscrew determines the amount of friction applied to the ball. Tighter= more friction
- The thumbscrew is intended to be tightened by hand but if too tight by one person, another person can use a 1/4" wrench to loosen. (it could also be tightened by wrench if needed)
- The stainless steel Thumb screw is captive to the clamp by way of threaded inserts in the arm of the clamp

Ball Clamp Foot Restraint with balls being positioned on handrail for attachment

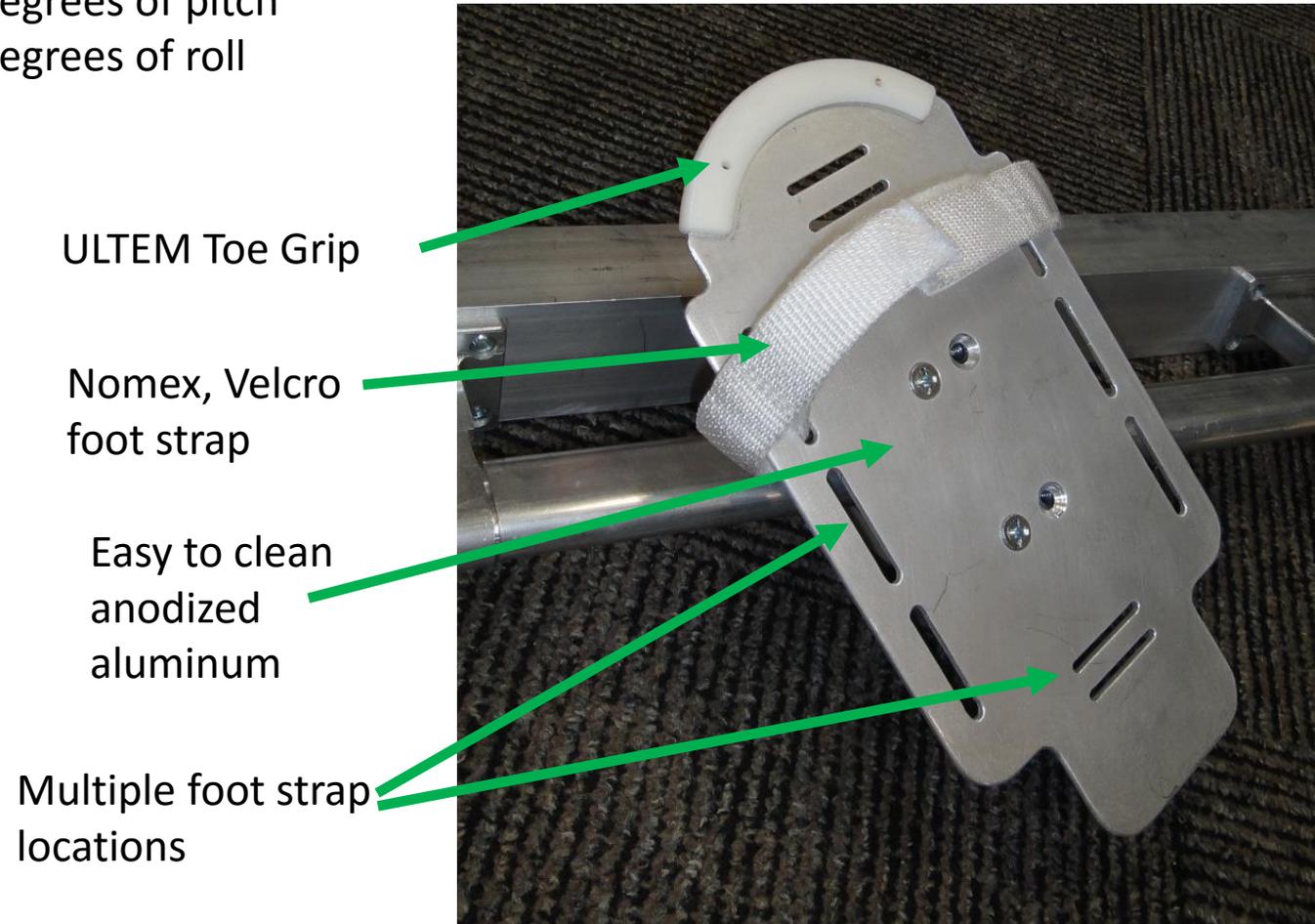


Thumbscrew includes built in socket for 1/4" tool.

# Features

Allows for about:

- 35 degrees of yaw
- 90 degrees of pitch
- 20 degrees of roll



Upgrades for flight unit:

- All the strap holes will be the larger size.
- Green anodized foot plate
- Toe Grip on the smaller side of the plate

Multiple positions for the straps allows for variable placement of the restraint to fit the need, foot, and location. This is similar to the current Short Duration Foot Restraint but the Ball Clamp Foot Restraint allows for pivoting for comfort or improved positioning.



Repositioned Foot Strap



If used for hardware or experiments (like BCAT) pivoting allows for repositioning to fit the location or getting it out of the way quickly.