

System Validation Testing Report – Ingress Protection Test

Team: P15001: Active Ankle Foot Orthotic

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Test Date: 04/07/2015

Related System: AB: Use AFO

The test is being completed to determine if AFO will meet our Ingress Protection requirements, as specified by our engineering requirements. Our Ingress Protection code (IP) is “54”. There are 2 components of the IP code; the first number is the solid object protection code, while the second number is the water protection code. This test was to verify our water component of the IP code. A 4 in the IP code indicated that the AFO must be protected against the “splashing of water”, by testing for water splashing against the enclosure from any direction having no harmful effect.

This IP test was completed specifically on the lower component housing. Over a full day’s use, the AFO could see splashes of water contacting the AFO if it being worn outside, whether it is from rainwater or splashing from other sources. Most of the AFO is washable and therefore could withstand the splashing without any problem. However, the lower component housing must be tested against this water requirement because it contains electronic components, some of which that cannot contact water, was well as being 3D printed. This test is to verify the fact that the LCH was designed to meet these IP requirements, taking into account the O-Rings and tight press fits.

Supplies:

- 1.) Lower Component Housing
 - a. LCH base
 - b. IR cavity Lid
 - c. PCB board cavity lid
 - d. O-Rings
 - e. Socket head cap screws
- 2.) Sink with tap water
- 3.) Paper towels
- 4.) Allen wrench

Setup:

The lower component housing must be assembled, as required by the final prototype, to test to see if the final assembly meets our requirements. However, the LCH was assembled without the electronic components, instead using paper towels to fill the cavities. These paper towels can then be analyzed at the end of the test to determine if any water has entered the cavities.

- However, because the IR sensor will not be used in the test, there will be 2 holes in the IR lid where the “eyes” of the IR sensor would be located. The “eyes” of the sensor can get wet, though, so that is not a concern of the test. An outline of the holes was drawn on the paper towels in that cavity, and any water contact with that surface would not determine a test failure.

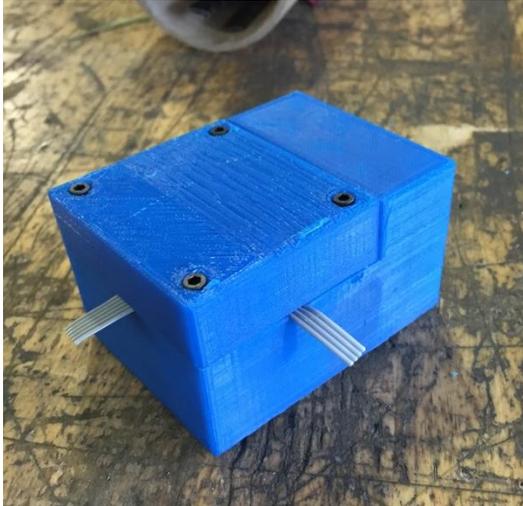
Procedure(s):

Test:

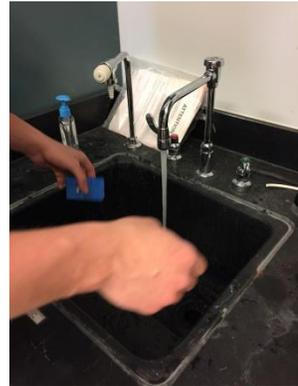
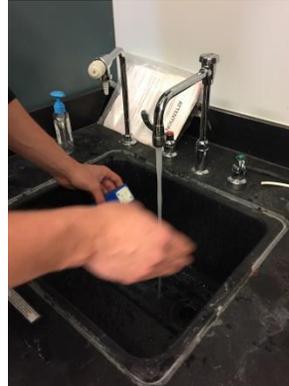
1. Assemble Lower Component Housing
 1. Place sample ribbon wires in ribbon wire channels to simulate actual ribbon wires in final assembly
 2. Stuff both cavities with paper towels so water entry can be analyzed



3. Place O-Rings in PCB cavity lid and IR cavity lid
4. Assemble lids with socket head cap screws with Allen wrench as required



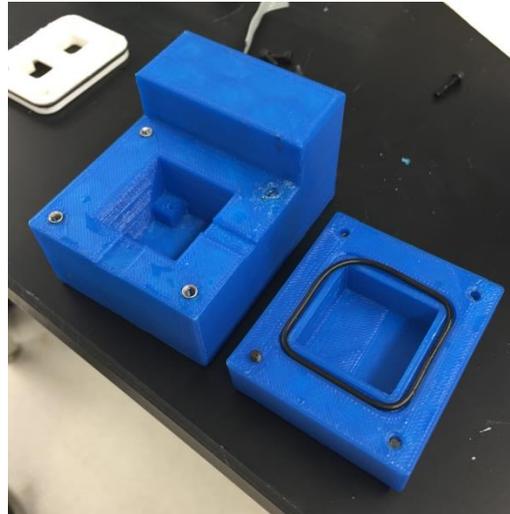
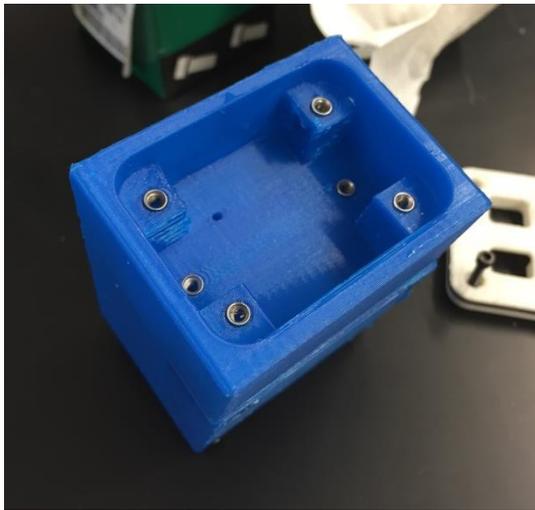
2. Turn on tap water with sink and hold LCH near water stream
3. Perform splash test
 1. Run had through running water, splashing water toward LCH
 2. Be sure water is making contact with LCH, especially on mating surfaces
 3. Continually rotate LCH so all surfaces are contact
 4. Perform test for 2 minutes, fully covering LCH
 5. MAKE SURE LCH DOES NOT MAKE CONTACT WITH RUNNING STREAM OF WATER---- THIS IS BEYOND OUR INGRESS PROTECTION CODE AND ENGINEERING REQUIREMENTS



4. Dry LCH outside surface with paper towels
5. Disassemble LCH assembly
6. Remove lids
7. Analyze both paper towels and cavities, looking for water evidence
 1. Do not analyze section of paper towels where IR sensor “eyes” will be located- do not count water on this surface as a failure

Results:

After disassembling the LCH and analyzing both the cavities and the paper towels, it was determined that our LCH passes our Ingress Protection code and meets our engineering requirements. The paper towels were completely dry, especially around the mating edges, where the O-Rings were present. Also, the cavity walls were dry and there was no noticeable water entry, proving both O-Ring functionality as well as the fact that the 3D printed part was not porous to the water contact on the outside edges. One interesting thing was to look at the mating surface of the PCB cavity; there was some water evidence on the surface up until the O-Ring seal, but none at the location of the O-Ring or beyond.



Conclusion:

- a.) Our AFO, and specifically the lower component housing assembly, passed the waterproof test and meet our Ingress Protection Code requirements.