# Ocean Networks Canada

**Ferry Maintenance Report – Queen of Alberni**

**Date:** January 23, 2015

**Arrival:** 12:45PM sailing to Tsawwassen. We signed in at terminal supervisor at Duke Point.

**Reporter:** Chris Sundstrom (Servicing), Akash Sastri (Science Analysis)

**Attending Personnel:** Chris Sundstrom (ONC-Operations), Jeremy Krogh (ONC-Science)

**Reason for Visit**

Regular instrument servicing + Calibration/comparison of Optode Instruments measurements
System stopped functioning, suspected pump failure

**Observations**

1. There was extreme moisture in the Instrument Box. The entire lower box was coated in water spray and 3-4 gallons of water were in the catchment box.
2. The AADI optode was slightly dirty with some limited sediment/biofilm growth within the housing. The water inside was stagnant.
3. The BBFL2 was essentially clean, as the housing was mostly dry inside from lack of pressure. Only a little water remained due to an inability to drain this remnant volume due to system geometry.
4. The Seabird 45 CT sensor was mildly dirty, with no mussels found growing within the housing. The water inside was stagnant.
5. The flex tubing was newly replaced and showed little to no signs of sediment or biofilm growth.
6. The sea chest showed no signs of leaks.
7. The inline filter (sea strainer) was checked and was found to be slightly dirty and required cleaning.

**Actions Taken**

1. Opened both boxes and observed function. The system was not functioning normally upon arrival. The pump was not operating, although the pump control board showed a green light. No flow was seen and the flow tubes were empty except for pooled water in the low points.
2. Powered down and disassembled instruments in lower assembly.
3. Restarted the system to check if the system had "lost its head". System did not restart. Attempted the reset button on the pump control board. No response.
4. Disassembled system instruments, checking tubing and connections. No apparent leaks or failures in the instrument tubing. No signs of damage to any connectors. Water had sprayed high enough to pool on the Optode and CT housings, but the BBFL2 was perfectly dry, and there were no signs of spray reaching that level.
5. Removed and inspected the pump control box. Water noted inside the housing and corrosion was found on the bottom edge. Examination showed that the battery had not been fully seated into the housing, possibly because it was slightly large, and this caused the lid to bow away from the seal in the middle. Under extreme leak conditions enough water built up on the top surface of the box for some to find its way into the failed seal, thence dripping onto the battery which was pressed tight against the bottom edge of the circuit board. This caused corrosion on several components on the board. Note that the failure only happened because of extreme leak conditions, combined with a battery that didn't fit right, combined with the battery being pressed against the board, combined with a lack of conformal coating on the board.
6. Removed and replaced pump unit. No immediately obvious signs of damage to the unit, but spray patterns indicated failure in the pump region of the housing. Slight indications of a leak between the motor and pump head.
7. Rebuilt the system.
8. Cleaned and checked over instruments in Engineering room.
9. Ran pre- and post- calibration with standard solutions and with Orange test stick and blue test stick for CDOM fluorescence and Chl fluorescence.
10. Re-assembled the instruments in the lower box.
11. Checked over Sea chest and valves, no leaks apparent.
12. Checked the sea strainer.

13. Turned ON the system. System did not restart the pump, although the pump control board showed green lights. Tried multiple restarts and resets. No success. Turned the main breaker off on the system to preserve instruments (wet instruments should not be operated in the dry condition).
14. Signed out at Engineering room.

**Future Actions**

1. Install replacement Pump Control System. Check for leaks and test system.
2. Purchase extended length Allen keys for the Queen of Alberni. The set we have on board is too short to perform maintenance on the Pump system, and we had to borrow appropriate length Allen keys from the Engine Room (which was almost impossible – they had only a partial set in the small sizes we use).

**Discussion of Test Procedures and Results**

The test procedures used are documented in the supplemental report, which also provides preliminary analysis of the data and its consequences.

**PICTURES**

Figure 1: Water pooled in top recess of Optode


Figure 2: Water Spray on Manifold

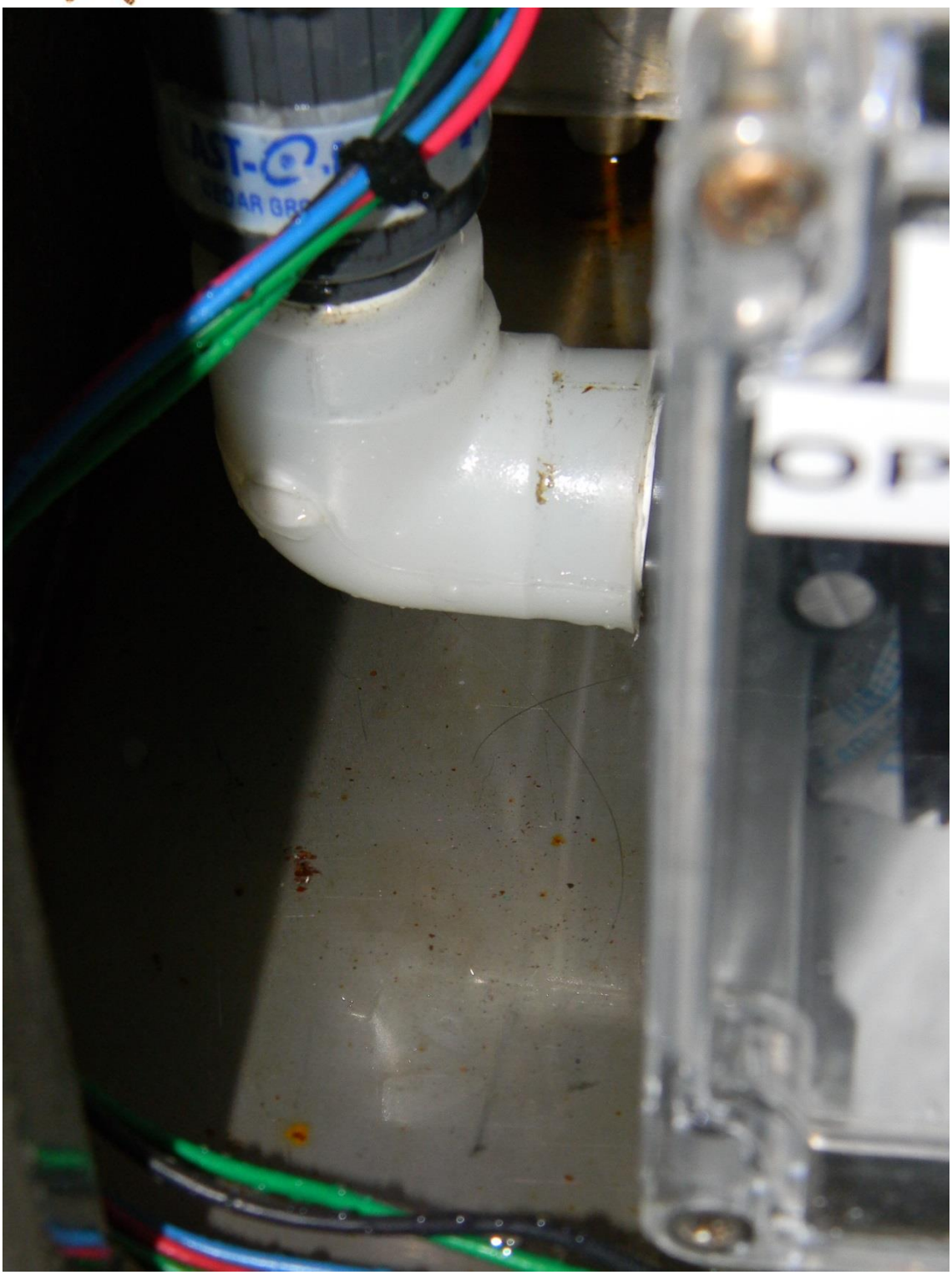

Figure 3: Water pooled in the bottom of the housing


Figure 4: Water spray on pump housing

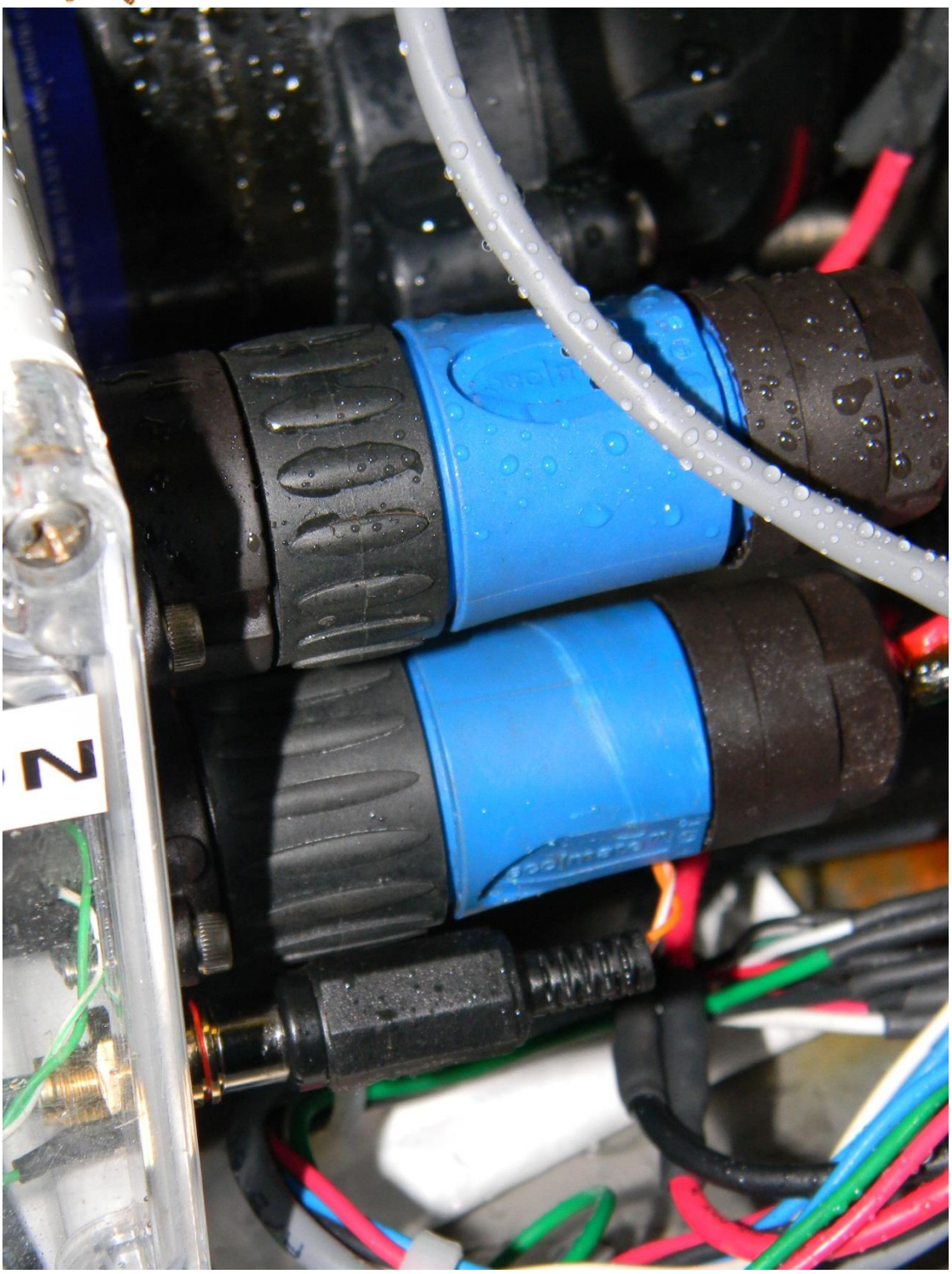

Figure 5: Water Spray on connectors


Figure 6: Pump Control Box. Note water pooled inside front edge of housing, plus visible corrosion products at junction of battery and board. Desiccant package was fully absorbed.

Figure 7: Depth of water within the catchment basin (approximately 4 cm)

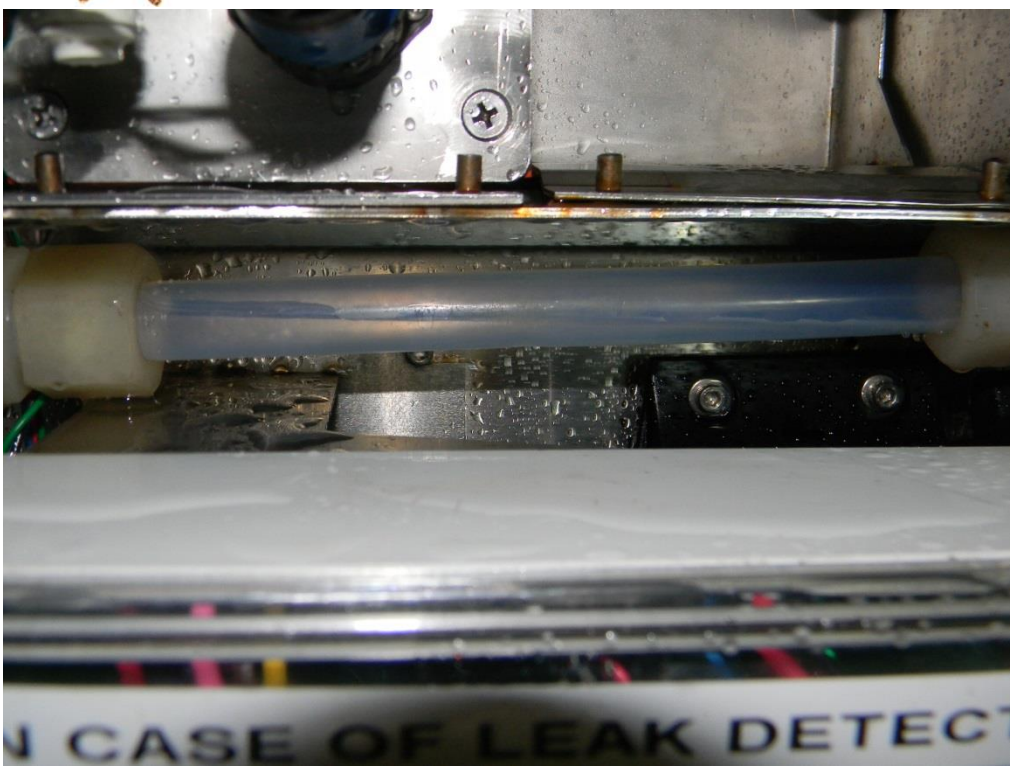


Figure 8: No flow visible within main supply tube. Spray pattern indicates leak within the pump section of the system.

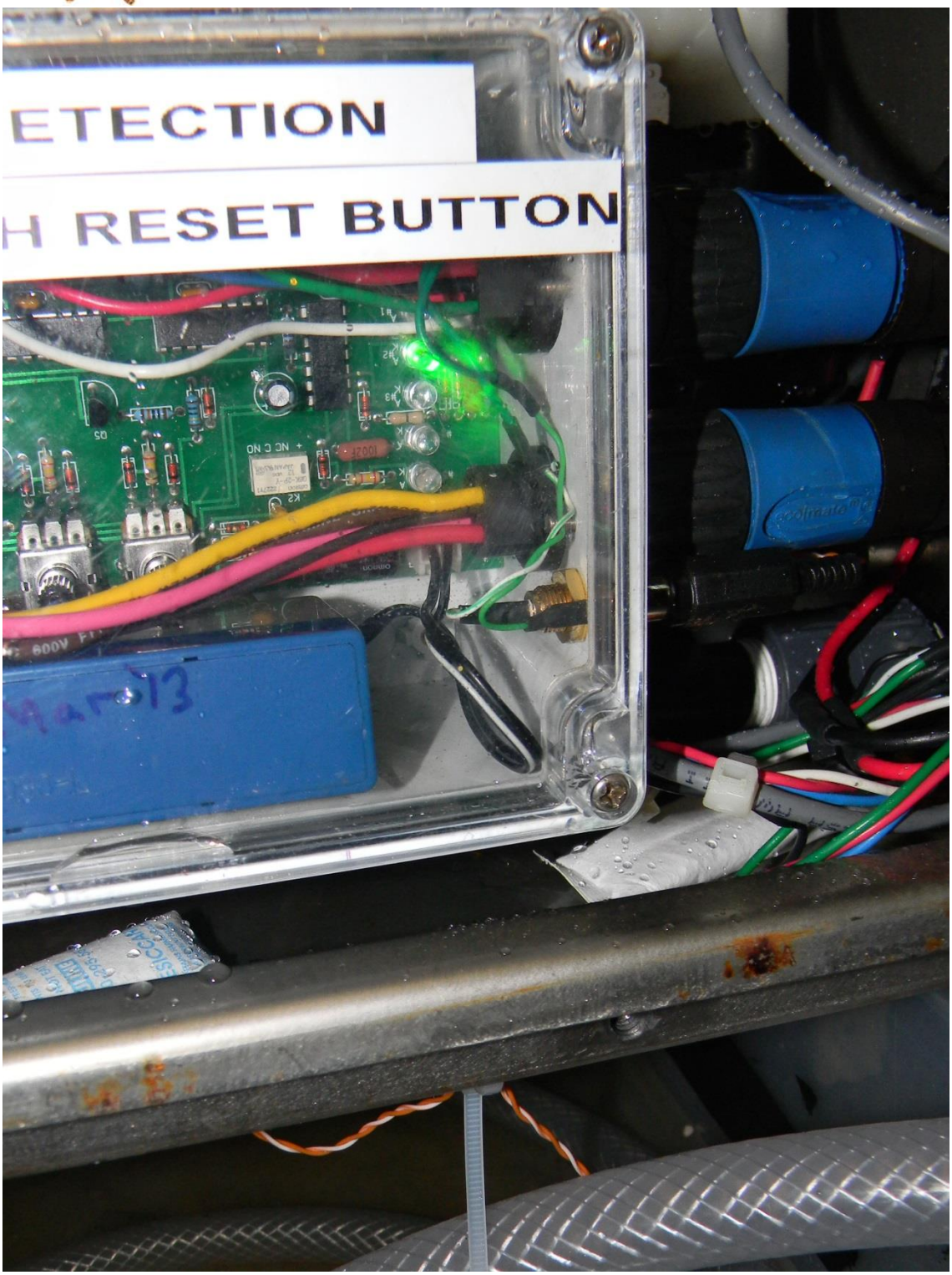


Figure 9: Note Pump Control Box light is on, no pump function


Figure 10: Water inside Pump Control Box

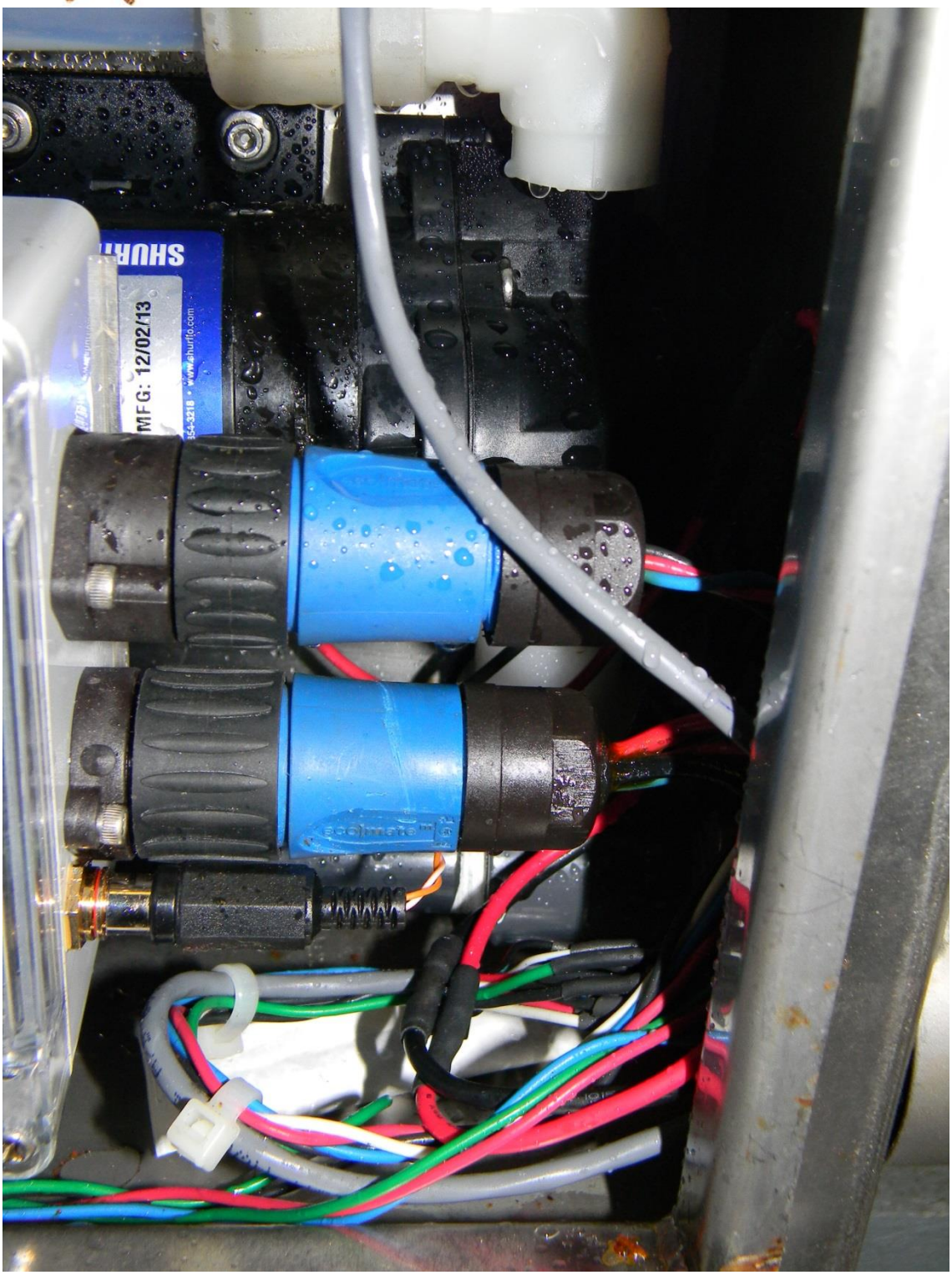


Figure 11: Water Spray within pump region

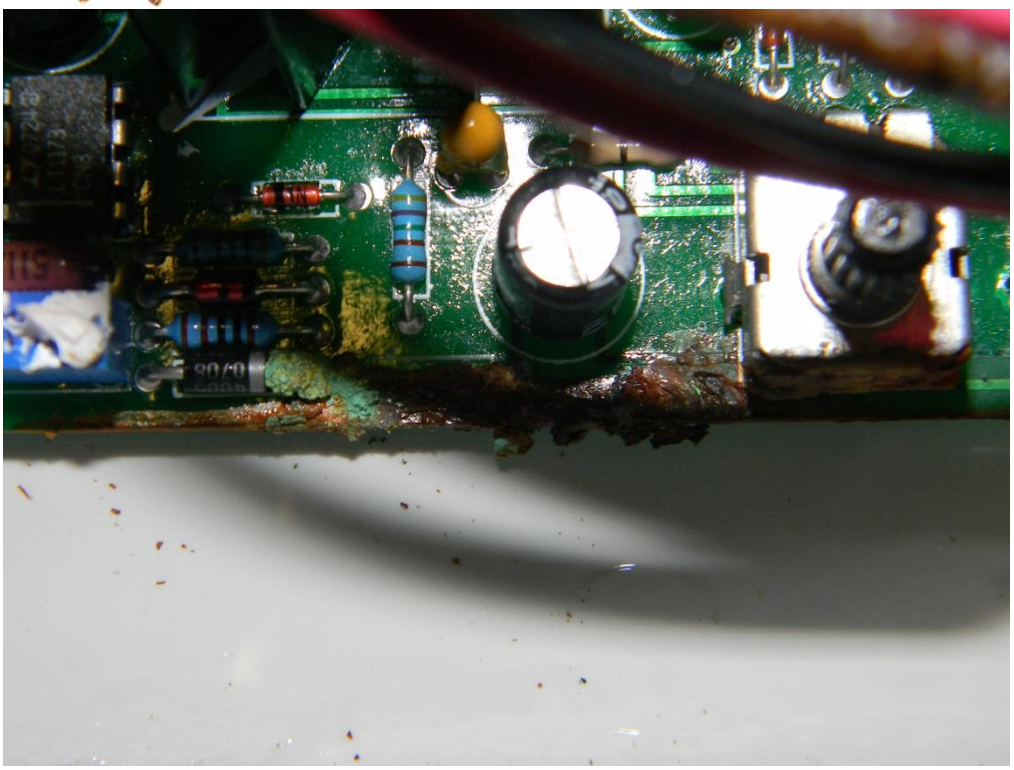

Figure 12: Corrosion on lower edge of board

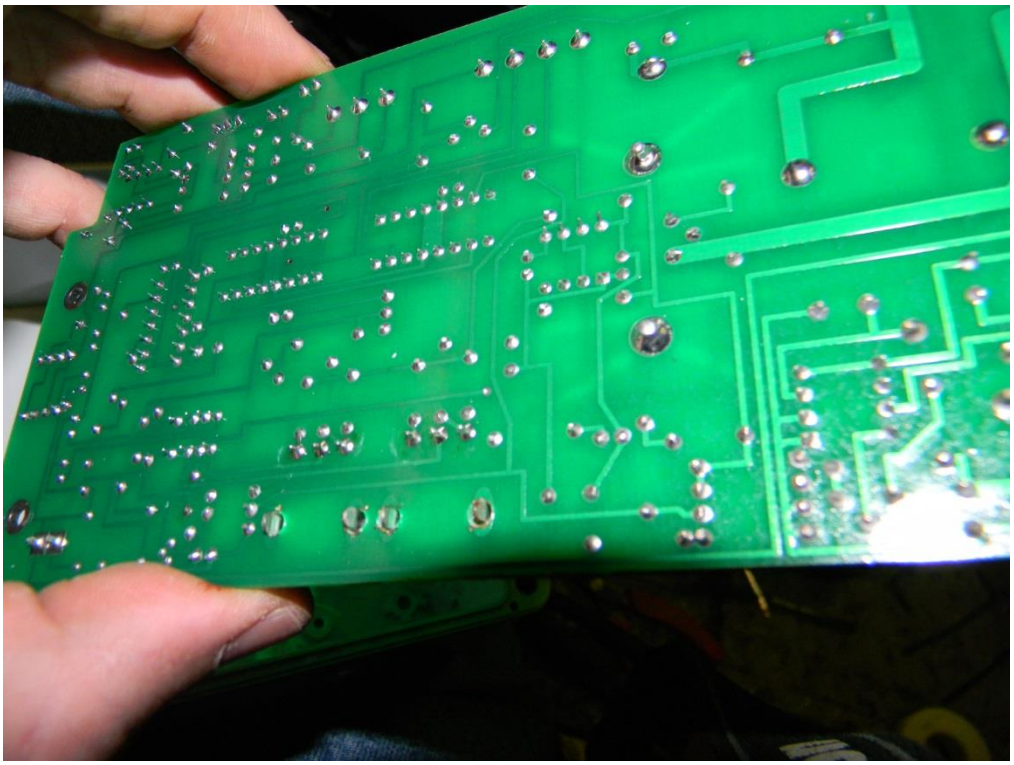

Figure 13: Back of Pump Control Board

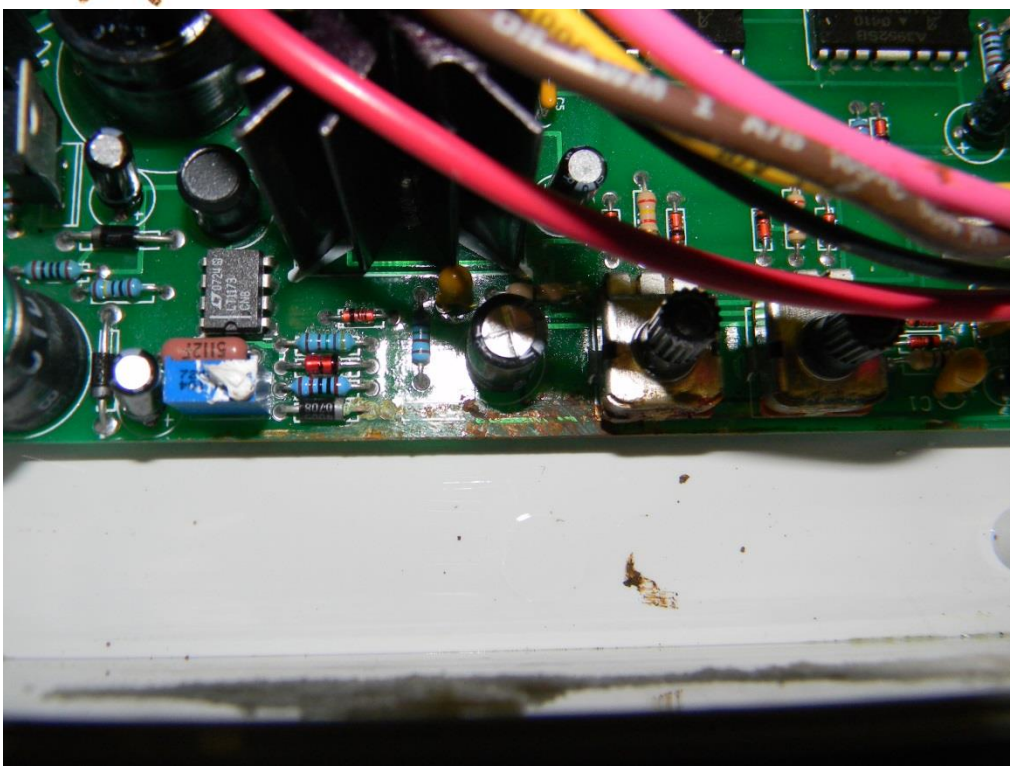

Figure 14: Pump Control board corrosion after rudimentary cleaning

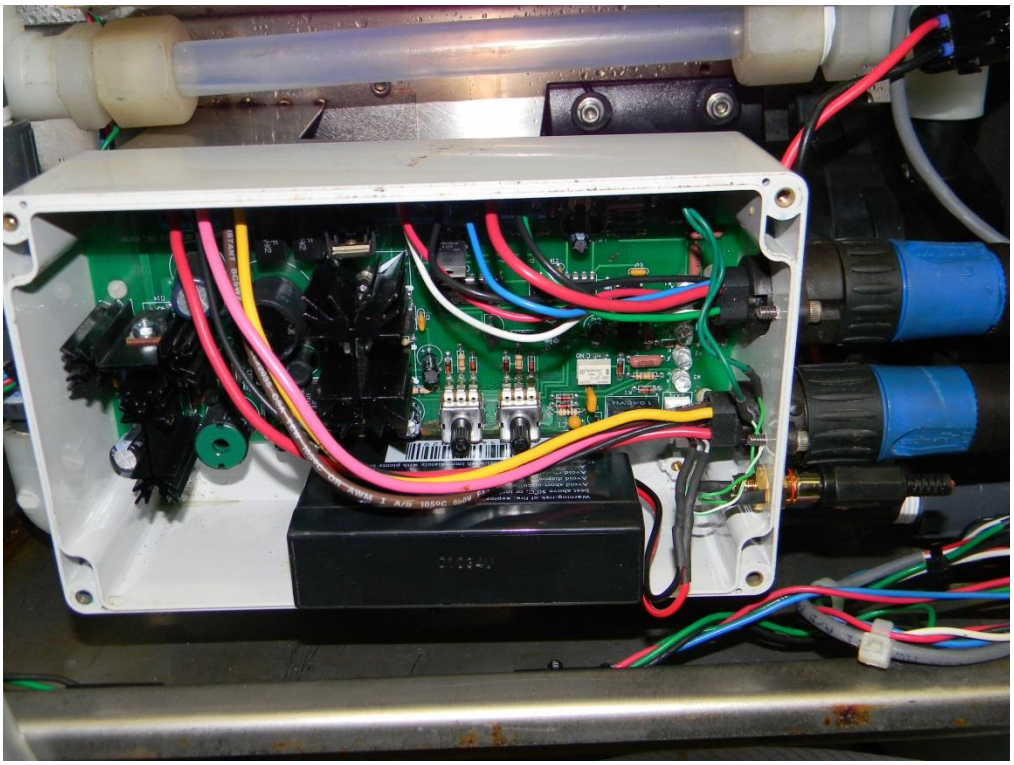

Figure 15: Pump Control Board ready for test

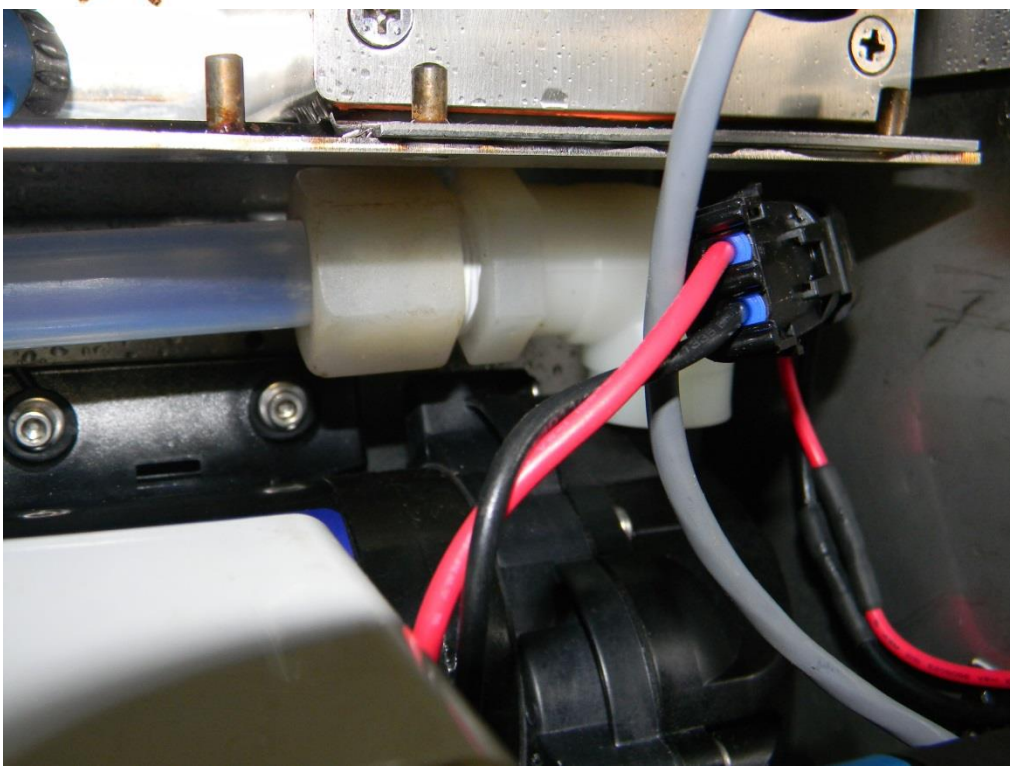

Figure 16: Pump system after reassembly

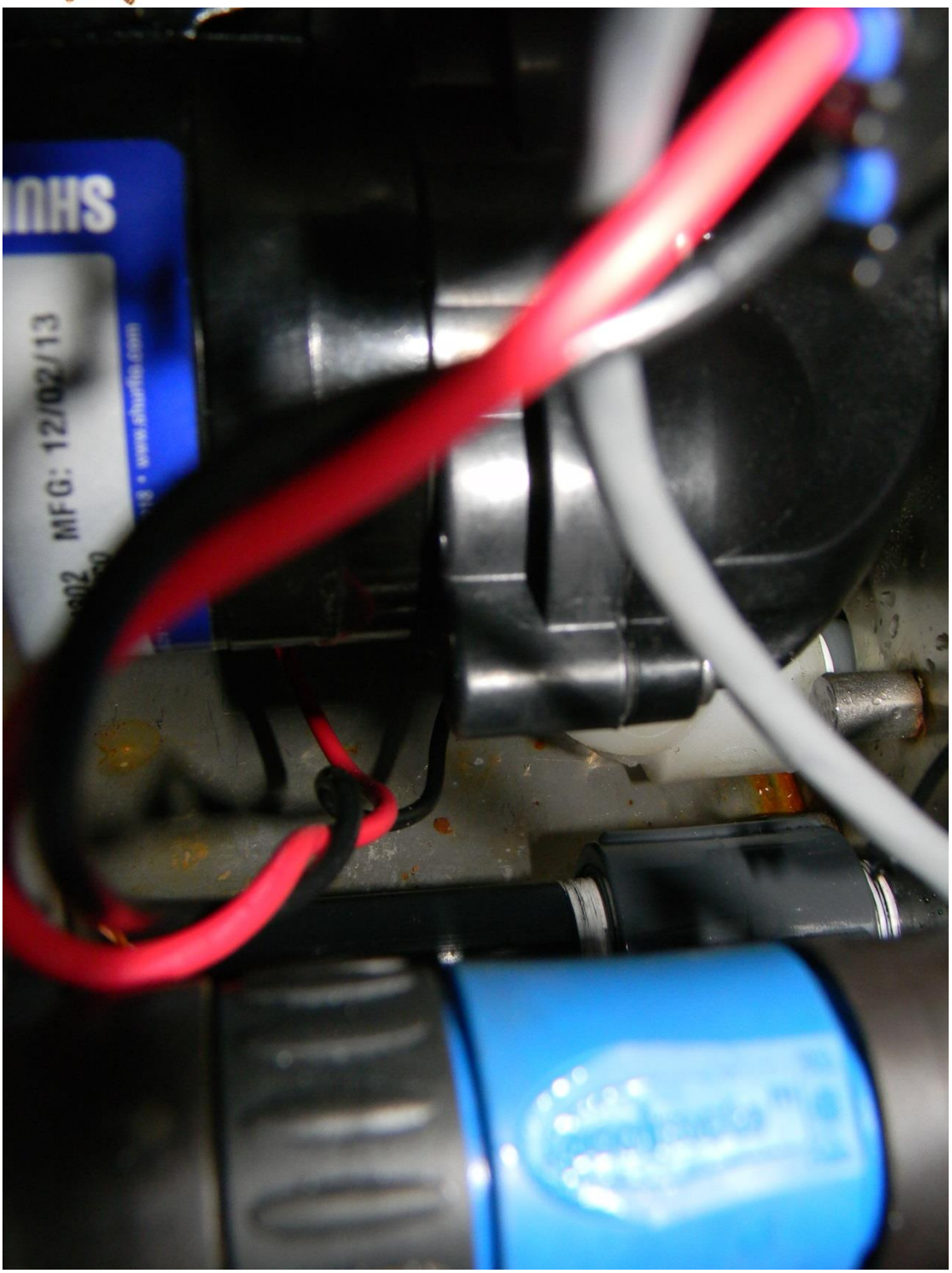


Figure 17: Pump after reassembly


Figure 18: Pump board during testing

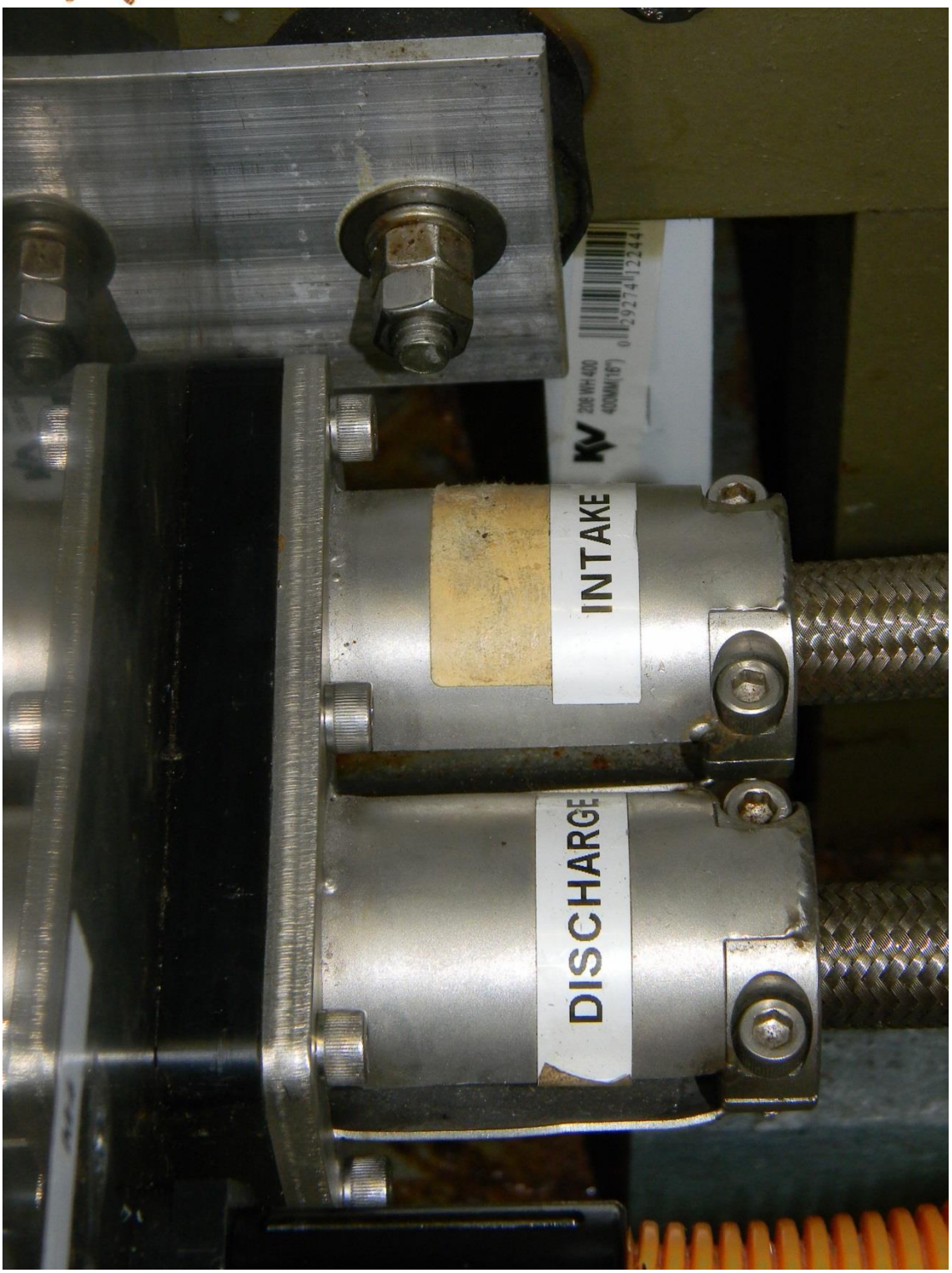


Figure 19: Reassembled intake assembly


Figure 20: Instrument box as left at end of day.

Figure 21: BBFL2 Interior

Table 1. January 23, 2015. Mean (±standard error) values of pre- and post-cleaning fluorescence for solutions/fluorescent sticks specific to CDOM and Chlorophyll fluorescence. '□ fluor' values for Diet Coke (Chl) and diluted tonic water or Sprite Zero (CDOM) have been used at every cleaning since March 14, 2014 to assess the degree of signal decay between cleanings. The post-cleaning fluorescence values for the pink and blue sticks were lower than pre- values, yielding a negative response to cleaning. All other (solution-based) measurements yielded positive responses to cleaning; however moderate, suggesting minimal bio-fouling since the last cleaning which took place during a complete system maintenance on January 9, 2014.

| CDOM/Chl Fluorescence | Method | Pre- (mean± SEM) | Post- (mean± SEM) | Δ fluor (%) |
|---|---|---|---|---|
| CDOM | Diluted tonic water | 224.86± 0.034 | 236.49±0.046 | 0.05 |
| CDOM | Sprite Zero | 45.13±0.018 | 46.27±0.015 | 0.025 |
| CDOM | Blue fluorescent stick | 87.32±0.04 | 32.22± 0.013 | -1.72 |
| Chl | Diet Coke | 6.01±0.002 | 6.02±0.002 | 0.002 |
| Chl | Pink fluorescent stick | 8.36±0.003 | 6.94±0.003 | -0.2.0 |