UWROV NanoFloat Design & Safety Compliance

***NanoFloat* 1.1**, UWROV's profiling float for 2025 was designed with the 2025 MATE RFP in mind.

NanoFloat excels at **efficient profiling and remote transmission of data** as part of ***Task 3: MATE Floats!***, and its design revolves around its operational simplicity, affordability of components and task execution consistency.

NanoFloat's buoyancy engine consists of a brushed DC motor with an M3 threaded final drive shaft. This threaded shaft interfaces with the inner threads of the **piston on the underside of the float**. A DC motor driver on the main electronics board takes digital input and drives the motor forwards and backwards to extend and retract the piston, changing the buoyancy of the float. NanoFloat's endcaps measure 38.1mm in diameter and the float is 270mm long at full extension, giving it impressively small dimensions. Its uniquely small size enables an excellent buoyancy differential due to its **displacement-volume ratio of 0.003:1**, and allows NanoFloat to accelerate quickly during profiles .

An **ESP32** microcontroller was chosen to communicate with the pressure sensor and interface with the motor driver. During surfacing, the ESP32 connects to the **surface-side WiFi router** and transmits all logged pressure data to the surface-station laptop. Once the first vertical profile is completed, the float will transmit data back to the surface and, upon receiving acknowledgement of transmission, will wait for 5 seconds before automatically beginning the next vertical profile. If a Quit signal is sent in the 5 seconds following data transmission, the float will stop autonomously profiling.

Depth control is accomplished by combining the data stream from an **analog encoder on the motor shaft** and a **pressure sensor**, both of which connect back to the ESP32. These provide precise information on piston extension and descent rate, allowing for intelligent depth control during profiling.

As part of safety considerations, a **single 500mA fuse** is placed 2.2cm from the battery pack to prevent excess current draw. All systems are powered by a **6V battery pack** consisting of **four 1.5V alkaline AAA batteries in series.** This battery pack design strikes a perfect balance between capacity, performance, and weight while adhering to the strict size constraints of the 1-inch PVC hull. The batteries are insulated using electrical tape, are hard-mounted in a 3D printed housing inside the float to ensure they remain constrained, and remain under the 12 VDC and 5A maximum restrictions.

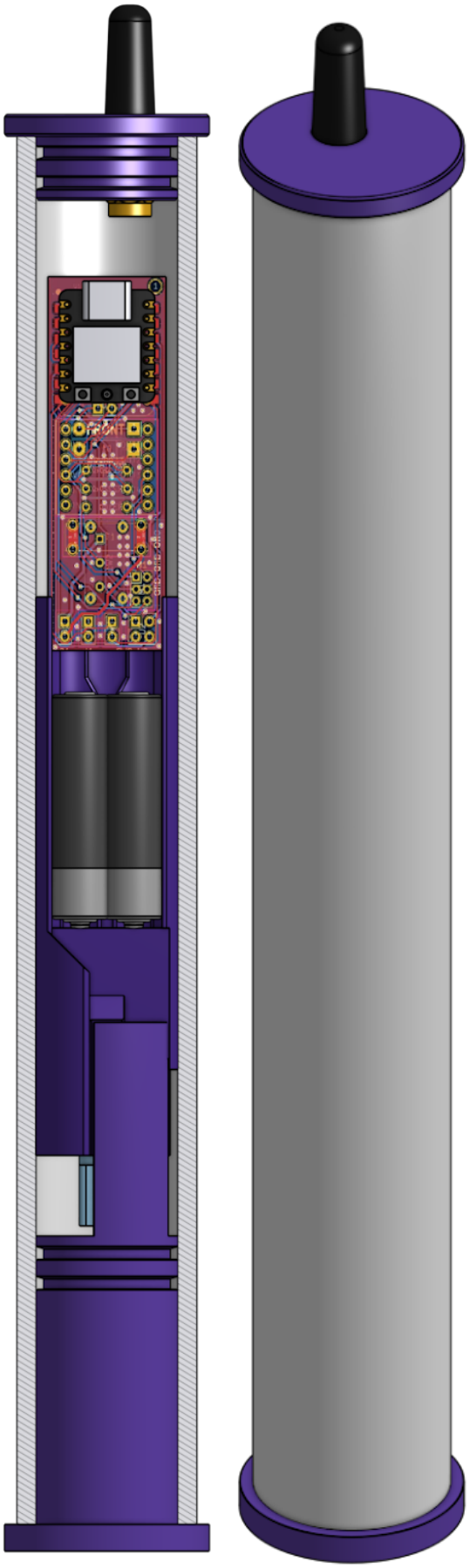

Figure 1. *NanoFloat 1.1* Section View (Left) and Isometric View (Right)

Safety Requirements Verification:

ELEC-NRD-001: NanoFloat is powered entirely from a 6V DC internal battery pack paired with a 500mA fuse. These specifications remain under the 12 VDC and 5A maximum restrictions (Fig. 2) in addition to satisfying the requirements for AAA batteries.

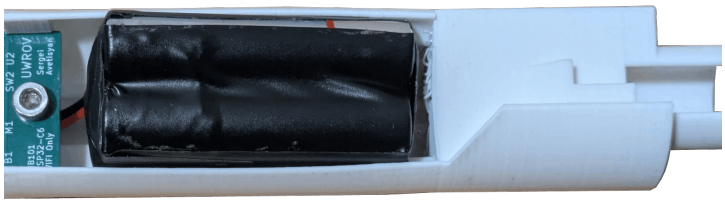

Figure 2. Battery pack of *NanoFloat 1.1.*

ELEC-NRD-002: NanoFloat does not utilize any thrusters or cameras. All motion is accomplished via the integrated piston-driven buoyancy engine.

ELEC-NRD-003: NanoFloat contains 4 AAA batteries securely enclosed in a 3D printed electronics carriage

ELEC-NRD-004: NanoFloat has a single 500mA fuse 2.2cm away from the battery pack, connected by a 3cm wire to the positive terminal which is less than the 5cm requirement. A fuse of 500mA satisfies the maximum fuse size constraint for AAA batteries.

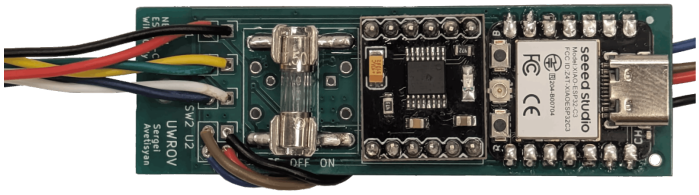

Figure 3. Fuse of *NanoFloat 1.1*

ELEC-NRD-005: The full load amps value was measured and is summarized in Table 1 below.

Mode	Full Load Amps (mA)
Waiting Mode (Motors off)	<80
Buoyancy Change Mode (Motors on)	400

Table 1. Full Load Amps Values for NanoFloat 1.1

ELEC-NRD-006: NanoFloat's design allows it to open its enclosure when internal pressure is larger than the external pressure. A 2.6 cm diameter end cap acts as a pressure relief plug, satisfying safety requirements.

ELEC-NRD-007: The NanoFloat SID is located in the SID section of the technical documentation (Page 14).