

Open Source Manipulator

This design describes the manipulator arm on the personal submersible Shackleton. It is a slightly modified version of the manipulator designs developed by Hank Pronk. The idea is to provide an open source design for a basic manipulator that can be built at home using only basic tools, and which does not require any sophisticated electronics. The design is provided for free, but also without any assurances of performance.

The documentation concentrates on the arm itself, only touching lightly on two components that are likely to be adapted in each instance:

- The hull mount will be different for each sub, as it depends on hull geometry. But whatever your hull mount design, I strongly encourage you incorporate the ability to jettison. The arm may become entangled, or could fail just after you grabbed hold of a heavy object.
- The controls may reflect each pilot's preferences. Hank and I use a variable DC-DC voltage regulator that allows us to reduce the speed of the actuators to a crawl if desired. The reduced voltage is supplied to four on-off-on momentary switches, one per actuator. We prioritize simplicity, but controls are an area where others may opt to go wild.

The Lenco actuators used in this design come in two stroke lengths, and this design uses two of each. However, there are a number of sub-variants of these actuators. Any can be used, with the caveat that because the variants are of slightly different lengths, the actuator pivot points will need to be adjusted correspondingly. See the file "Lenco actuator dimensions" for specifics. The actuators will need to be modified slightly for underwater use. This has been documented by Hank in the following Youtube video: <https://www.youtube.com/watch?v=LyLMAXL09pg>

Once you have built your arm, you will need to route the actuator cables to a junction box mounted somewhere on the arm or its hull mount. The cables are led through 5/16" ID automotive fuel line, attached to both actuators and junction box using 1/4" NPT barbed fittings and hose clamps. The junction box will also have a cable leading to a hull penetrator. Finally, the junction box should have a fitting for pressure compensation with either air or oil. The Bill of Materials file documents all parts needed.

This arm was fabricated using only a drill press and a small angle grinder, except for a few simple bushings and spacers made on a lathe. If you do not have the fabrication capabilities for the project, either in whole or just for specific components, I'm glad to help with fabrication. Please contact me at if you have any questions at all, if you spot any errors, or of course if you have any suggested improvements.

Best,

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