# Technical Report

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## INSIDE THE AC75 PART 2: THE ROTARY PUMP

Harken currently offers three sizes of multi-speed, pedestal-driven rotary pumps for Grand-Prix race boats 13.7 - 30.5 m (45 - 100'). They deliver oil faster, more efficiently, and with higher shift points than other pumps of comparable sizes. The 10 and 20 cc pumps shift from 1st to 2nd gear both automatically and manually, with automatic shift points determined by the maximum output of the grinders. If fewer crew are grinding, and not enough power is generated to reach the automatic shift point, pumps can be shifted manually—the 20-cc pump by simply reversing the pedestal handles; the 10-cc pump by using a pull-cord attached to a lever. Pumps are made of corrosion-resistant Hard Lube-anodized aluminium, with aluminium, titanium, and stainless-steel components. All pumps include a non-return valve on the outlet to prevent backflow.

10cc

20cc

26cc

## PUMP TESTING

We test all pumps leaving Harken on our Rotary Pump Test Stand. It has a 20 HP motor that can operate at very low speeds (Human speed is between 30-180 rpm) and still supply maximum torque. We use the test stand to measure flow in and out of the pump, torque in, pressure out, and rpm. This gives us a complete picture of all the efficiencies of the pump:

- **Hydraulic efficiency;** The recorded flow out vs recorded flow in.
- **Volumetric Efficiency; T**he ratio of recorded flow out vs theoretical flow out.
- **Total Efficiency;** The torque in x RPM vs flow out x pressure.

Every pump is put to the test against up to three accumulators to provide a hydraulic resistance load. We have the ability to save all this recorded data and share this with our customers upon request.

The Rotary Pump Test Stand is also setup with a full pedestal unit allowing us to test for how the pump performs under actual human power. This allows the Teams to test and develop the pump before it is installed onto the boat. We have this facility in both our Italy and USA. Test facility. Several customers have taken us up on the offer in the past and feel it really helps develop the product.

The evolution of the latest AC36 pump has demanded a much more rigorous test schedule to what has been carried out in the past. We were asked by the Teams to provide data for and analysis of a 50-hour continuous run test. This was designed to test long term efficiency and wear trends, meaning they can iron out any issues giving total trust I the unit while competing.

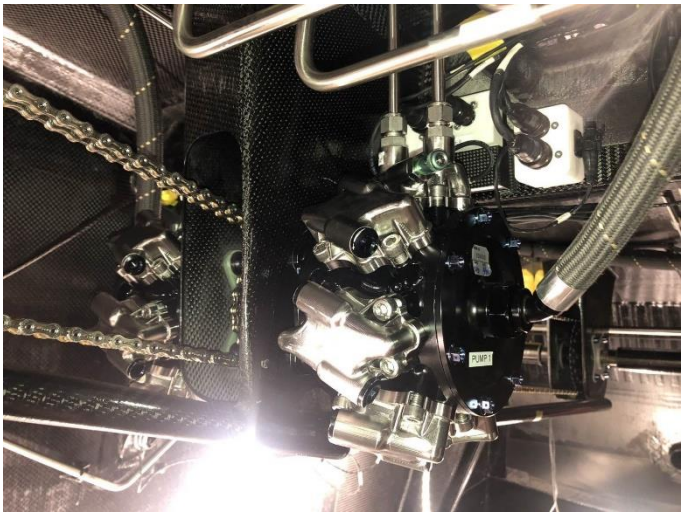
With this in mind we set out to maximize efficiency and reliability with different material choices for the internal components of the pump. The 50-hour test proved to both Harken and the Teams that the design was solid and could be counted on for competition at the highest level with a very good level of reliability.

Test Bench Harken US

## THE AC 75 PUMP

Our latest design offers a very efficient hydraulic power plant that has more flexibility than any other pump we have offered in the past. The design allows for the end user to specify their desired output per revolution of each of the two independent piston banks. This is achieved through a variable fixed stroke mechanism and different size pistons that can be swapped out with minimal effort using all the pieces sold with a single pump. Much like our Harken Air Winch can change out Gear's ratios. Combined with an electro-mechanical shift valve the pump can supply three different displacements per revolution depending on the end user's needs. It also has the ability to operate at two different pressure ranges simultaneously if more than one functions is needed to be moved at the same time.

A smooth output and efficient action were the paramount criteria within every design loop we made. This pump has proven to be one of the most flexible and reliable versions we have made to date. The unique features and layouts will spawn future versions as we grow to understand our customer's needs more and more.



AC75 Rotary Pump onboard the AC75


AC75 Pump