# Report of the Month

If you look at the pictures, it's not too much of a mystery what happened to this 2001 Tohatsu 4-stroke engine. But take a guess anyway!
To learn more about where the elements are coming from, click here.

| | | | UNIT / LOCATION AVERAGES | | UNIVERSAL AVERAGES |
|---|---|---|---|---|---|
| | MI/HR on Oil | 1 | | | |
| | MI/HR on Unit | | | | |
| | Sample Date | 1/2/2018 | | | |
| | Make Up Oil Added | | | | |
| ELEMENTS IN PARTS PER MILLION | | | | | |
| | ALUMINUM | 9 | 10 | | 6 |
| | CHROMIUM | 0 | 0 | | 1 |
| | IRON | **57** | 64 | | 24 |
| | COPPER | 3 | 3 | | 7 |
| | LEAD | 0 | 1 | | 2 |
| | TIN | 0 | 0 | | 0 |
| | MOLYBDENUM | 133 | 115 | | 95 |
| | NICKEL | 0 | 0 | | 0 |
| | MANGANESE | 0 | 0 | | 0 |
| | SILVER | 0 | 0 | | 0 |
| | TITANIUM | 0 | 0 | | 0 |
| | POTASSIUM | 1 | 1 | | 1 |
| | BORON | 78 | 84 | | 48 |
| | SILICON | 4 | 6 | | 11 |
| | SODIUM | **20** | 17 | | 11 |
| | CALCIUM | 1519 | 1335 | | 1692 |
| | MAGNESIUM | 33 | 248 | | 68 |
| | PHOSPHORUS | 585 | 624 | | 703 |
| | ZINC | 681 | 716 | | 845 |
| | BARIUM | 0 | 0 | | 0 |

| | | | Values Should Be* |
|---|---|---|---|
| PROPERTIES | | | |
| | SUS Viscosity @ 210°F | 70.4 | 65-76 |
| | cSt Viscosity @ 100°C | 13.05 | 11.6-14.8 |
| | Flashpoint in °F | 400 | >375 |
| | Fuel % | <0.5 | <3.0 |
| | Antifreeze % | **?** | 0.0 |
| | Water % | 0.0 | <0.1 |
| | Insolubles % | 0.2 | <0.6 |
| | TBN | | |
| | TAN | | |
| | ISO Code | | |

**Top: Barnacles galore.**
**Bottom: Old zinc plate vs new.**

This engine sat flooded, convered in barnacles, underwater on the bottom of a southern Califonia boat launch for about a year. Here's the story: "I originally found the sunk motor on Craigslist for sale by the marine biologist who recovered it. Judging by the size of some of the barnacles on the motor, I'm guessing it was underwater for up to a year - possibly longer. The clamps were stuck in a wide-open position so I think someone forgot to tighten them before they launched and the motor fell off the boat and sunk.

My plan was to use this as a parts motor for my Tohatsu 5 hp LS. When I bought the engine, it was covered in barnacles with sea water and grit sloshing around in the gear case. It was advertised as not seized, but it very much was. The prop spun in neutral, but that's about it. The condition of the outside of the motor was quite good. The zinc at the bottom of the drive leg was nearly completely dissolved and looked like Swiss cheese. But it had done a good job of protecting the motor. (Story continues on next report.)

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | MI/HR on Oil | 1 | UNIT / LOCATION AVERAGES | | | | | | UNIVERSAL AVERAGES |
| | MI/HR on Unit | | | | | | | | |
| | Sample Date | 1/2/2018 | | | | | | | |
| | Make Up Oil Added | | | | | | | | |
| | | | | | | | | | |
| ELEMENTS IN PARTS PER MILLION | ALUMINUM | **18** | 10 | | | | | | 6 |
| | CHROMIUM | 1 | 0 | | | | | | 1 |
| | IRON | **133** | 64 | | | | | | 24 |
| | COPPER | 4 | 3 | | | | | | 7 |
| | LEAD | 1 | 1 | | | | | | 2 |
| | TIN | 0 | 0 | | | | | | 0 |
| | MOLYBDENUM | 82 | 115 | | | | | | 95 |
| | NICKEL | 1 | 0 | | | | | | 0 |
| | MANGANESE | 1 | 0 | | | | | | 0 |
| | SILVER | 0 | 0 | | | | | | 0 |
| | TITANIUM | 0 | 0 | | | | | | 0 |
| | POTASSIUM | 1 | 1 | | | | | | 1 |
| | BORON | 92 | 84 | | | | | | 48 |
| | SILICON | 9 | 6 | | | | | | 11 |
| | SODIUM | 11 | 17 | | | | | | 11 |
| | CALCIUM | 998 | 1335 | | | | | | 1692 |
| | MAGNESIUM | 679 | 248 | | | | | | 68 |
| | PHOSPHORUS | 727 | 624 | | | | | | 703 |
| | ZINC | 793 | 716 | | | | | | 845 |
| | BARIUM | 0 | 0 | | | | | | 0 |

Be glad your cylinders don't look like this.

| | | | Values Should Be* | | | | | |
|---|---|---|---|---|---|---|---|---|
| PROPERTIES | SUS Viscosity @ 210°F | 63.6 | 59-65 | | | | | |
| | cSt Viscosity @ 100°C | 11.22 | 9.9-11.9 | | | | | |
| | Flashpoint in °F | 405 | >375 | | | | | |
| | Fuel % | <0.5 | <2.5 | | | | | |
| | Antifreeze % | 0.0 | 0.0 | | | | | |
| | Water % | 0.0 | <0.1 | | | | | |
| | Insolubles % | 0.2 | <0.6 | | | | | |
| | TBN | | | | | | | |
| | TAN | | | | | | | |
| | ISO Code | | | | | | | |

Story continues: I flushed out the power head with kerosene and scrubbed all the grit I could reach out of the valve train. I soaked the cylinder in a mix of SeaFoam and penetrating oil overnight. In the morning I was able to break the cylinder free by gently rocking the flywheel back and forth. After freeing the piston I flushed out the kerosene and put in fresh motor oil. Once the motor was moving freely I decided to put a spark plug onto the boot to see if the ignition system had survived being soaked in seawater for so long. And much to my surprise, it started making spark! The carburetor was in poor shape. It likely had ethanol gas in it when it went under and it had reacted with the salt water to nearly completely fill the interior of the carb and fuel system with a thick, white crystalline deposit. So I swapped on a spare 5 hp carb from my other Tohatsu and plugged a fuel tank directly into the replacement carburetor. I set everything up outside in a barrel full of of water. And after maybe 10 pulls and much coughing and sputtering, the motor started and ran! At that point I hadn't replaced any parts except the temporary carburetor.

The above sample was taken after repairing the broken valve spring (see the next part of the story). Doesn't look great, but most of the metal is from the wear-in process. Sodium has improved a lot.

# Report of the Month

This is the lower unit on the Tohatsu unit that was recovered from a year underwater. No surprises here!

To learn more about where the elements are coming from, click here.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | MI/HR on Oil | | UNIT / LOCATION AVERAGES | | | | | | UNIVERSAL AVERAGES |
| | MI/HR on Unit | | | | | | | | |
| | Sample Date | 1/10/2018 | | | | | | | |
| | Make Up Oil Added | | | | | | | | |
| | | | | | | | | | |
| ELEMENTS IN PARTS PER MILLION | ALUMINUM | **111** | 111 | | | | | | 28 |
| | CHROMIUM | **6** | 6 | | | | | | 2 |
| | IRON | **610** | 610 | | | | | | 187 |
| | COPPER | **38** | 38 | | | | | | 7 |
| | LEAD | 6 | 6 | | | | | | 2 |
| | TIN | 3 | 3 | | | | | | 1 |
| | MOLYBDENUM | 1 | 1 | | | | | | 12 |
| | NICKEL | 5 | 5 | | | | | | 2 |
| | MANGANESE | 4 | 4 | | | | | | 2 |
| | SILVER | 0 | 0 | | | | | | 0 |
| | TITANIUM | 1 | 1 | | | | | | 0 |
| | POTASSIUM | 2 | 2 | | | | | | 1 |
| | BORON | 39 | 39 | | | | | | 26 |
| | SILICON | 5 | 5 | | | | | | 4 |
| | SODIUM | **38** | 38 | | | | | | 11 |
| | CALCIUM | 8 | 8 | | | | | | 130 |
| | MAGNESIUM | 3 | 3 | | | | | | 50 |
| | PHOSPHORUS | 925 | 925 | | | | | | 529 |
| | ZINC | 418 | 418 | | | | | | 131 |
| | BARIUM | 10 | 10 | | | | | | 3 |
| | | | Values Should Be* | | | | | | |
| PROPERTIES | SUS Viscosity @ 210°F | 50.8 | 49-82 | | | | | | |
| | cSt Viscosity @ 100°C | 7.51 | 7.0-16.3 | | | | | | |
| | Flashpoint in °F | 415 | >405 | | | | | | |
| | Fuel % | - | | | | | | | |
| | Antifreeze % | **?** | | | | | | | |
| | Water % | **POS** | <0.5 | | | | | | |
| | Insolubles % | 0.3 | <0.8 | | | | | | |
| | TBN | | | | | | | | |
| | TAN | | | | | | | | |
| | ISO Code | | | | | | | | |

Story continues: The motor is still quite crusty inside, even with the cleaning. And I've since had a few parts failures. The first part to fail was the exciter coil under the flywheel. After ordering a new one and replacing it, the motor ran again. The next failure, after about an hour of run time, was the intake valve spring (see the initial Report of the Month). When that spring broke it released the half-moon clips that secured the valve and sent the intake valve into the combustion chamber, bending the valve and temporarily stopping the the engine. I removed the intake valve from the combustion chamber, ordered a new one, and replaced it along with the intake and exhaust springs (just for peace of mind).

Blackstone notes: The first and second samples in this series are the reports from right after the spring broke, then the follow-up sample after it was repaired. This sample is from the boat's lower unit, and you've already read in Ryan's article what a problem lower units can be. This one did not handle the submerging as well as the engine did. Iron and aluminum are high, and copper is out of line too. Significant water contamination is present though we're surprised sodium only read 38 ppm.

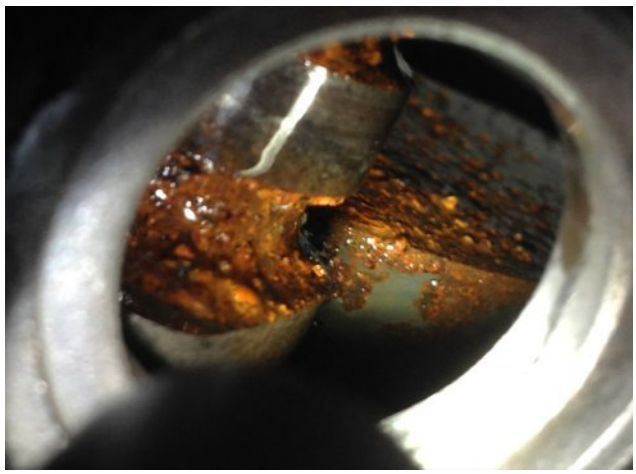
# Report of the Month

What are we looking at in this report?

To learn more about where the elements are coming from, click here.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | MI/HR on Oil | 2 | UNIT / LOCATION AVERAGES | | | | | | UNIVERSAL AVERAGES |
| | MI/HR on Unit | | | | | | | | |
| | Sample Date | 1/18/2018 | | | | | | | |
| | Make Up Oil Added | | | | | | | | |
| | | | | | | | | | |
| ELEMENTS IN PARTS PER MILLION | ALUMINUM | 3 | 10 | | | | | | 6 |
| | CHROMIUM | 0 | 0 | | | | | | 1 |
| | IRON | 3 | 64 | | | | | | 24 |
| | COPPER | 1 | 3 | | | | | | 7 |
| | LEAD | 1 | 1 | | | | | | 2 |
| | TIN | 0 | 0 | | | | | | 0 |
| | MOLYBDENUM | 131 | 115 | | | | | | 95 |
| | NICKEL | 0 | 0 | | | | | | 0 |
| | MANGANESE | 0 | 0 | | | | | | 0 |
| | SILVER | 0 | 0 | | | | | | 0 |
| | TITANIUM | 0 | 0 | | | | | | 0 |
| | POTASSIUM | 1 | 1 | | | | | | 1 |
| | BORON | 82 | 84 | | | | | | 48 |
| | SILICON | 5 | 6 | | | | | | 11 |
| | SODIUM | 21 | 17 | | | | | | 11 |
| | CALCIUM | 1488 | 1335 | | | | | | 1692 |
| | MAGNESIUM | 32 | 248 | | | | | | 68 |
| | PHOSPHORUS | 561 | 624 | | | | | | 703 |
| | ZINC | 673 | 716 | | | | | | 845 |
| | BARIUM | 0 | 0 | | | | | | 0 |
| | | | Values Should Be* | | | | | | |
| PROPERTIES | SUS Viscosity @ 210°F | 67.4 | 65-76 | | | | | | |
| | cSt Viscosity @ 100°C | 12.25 | 11.6-14.8 | | | | | | |
| | Flashpoint in °F | 385 | >375 | | | | | | |
| | Fuel % | <0.5 | <3.0 | | | | | | |
| | Antifreeze % | 0.0 | 0.0 | | | | | | |
| | Water % | 0.0 | <0.1 | | | | | | |
| | Insolubles % | TR | <0.6 | | | | | | |
| | TBN | | | | | | | | |
| | TAN | | | | | | | | |
| | ISO Code | | | | | | | | |

Both images are from the fuel ports. Not pretty.



This oil sample is a reference sample from the owner's other Tohatsu engine, to see how metals should look. Maybe with a little luck and a lot of TLC, the submerged engine will eventually wear like this. Time will tell.

Story continues: To date, I've continued to run the motor periodically and I've got it to the point now that ir runs just about well enough to trust it out on the water. It will be an interesting experiment to see how long the engine keeps running.