

Intro to the Marine Industry – Final Report

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Class: Intro to the Marine Industry

Instructor: Jimmy Hurff

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Introduction

This class's main goal was to help me understand how outboard motors function through hands-on experience. Throughout the semester, we worked directly on my 1999 Mercury 90 ELPTO, using it as the project motor. My SMART goal was to exceed 40 Miles Per Hour before the end of this semester. I knew it was not going to be an easy task as we were starting the project with an old engine with dirty carbs, the wrong sized prop, a non-working trim unit, bad throttle linkages, but before we even started, we had no clue what was wrong in the first place. I started at 28 Miles Per Hour and had expectations of hitting 40 but I learned that you must work hard and troubleshoot the issues and persevere through the dropping screws into the bottom of the engine before receiving the reality that I have the coolest Ranger on the planet. One of my main motivations for this project was my interest in marine performance and my website, *Full Throttle Marine*. As the name suggests, I have always loved the feeling of speed and wanted to feel that experience of running my small 16' Ranger skiff at its full potential. This project gave me the opportunity to turn that passion into real world knowledge with measurable results.

One of my biggest motivations for this project was my interest in marine performance and my website, [Full Throttle Marine](#). I have always enjoyed speed and performance tuning, and I wanted to experience what my 16-foot Ranger bass boat could truly achieve when operating correctly. This class gave me the opportunity to turn that passion into real-world knowledge while producing measurable results on the water.

SMART Goal

At the beginning of the semester, I created a SMART goal to guide the project and provide a measurable target for success.

- **Specific:** Increase the boat's top speed
- **Measurable:** Improve speed from 28 MPH to 40 MPH

- **Achievable:** Accomplish this through repairs, setup changes, tuning, and testing
- **Relevant:** Directly related to marine technician and performance skills
- **Time-Bound:** Complete the goal before the end of the semester

By the end of the project, I successfully exceeded my goal and achieved a final top speed of **41.6 miles per hour**.

Equipment Description

The primary equipment used throughout this project was a **1989 Ranger 680C**, a fiberglass bass-style fishing boat approximately 16 feet in length. The boat is powered by a **1999 Mercury 90 ELPTO**, which became the focus of nearly all of the mechanical work and performance testing completed during the semester.

The Mercury 90 ELPTO is a carbureted two-stroke outboard engine, meaning that fuel delivery, throttle response, carburetor condition, and propeller setup all play major roles in overall performance. Because the boat was originally purchased as a project, it served as a perfect platform for learning how propeller selection, engine setup, maintenance, and troubleshooting directly affect speed, efficiency, and performance.

Initial Condition and Baseline Performance

Before any work was completed, the boat's top speed was only about **28 miles per hour**. The engine struggled to accelerate properly, the propeller cavitated badly, and the boat had difficulty getting on plane efficiently.

At the time, the boat was equipped with a **13.25 x 20 pitch Quicksilver Laser II propeller**, which I knew was not the right size. Through testing and research, we determined that the propeller placed too much load on the engine, preventing it from reaching its recommended operating range. Although the tachometer was not functioning, the engine appeared to be operating around 4500 RPM when it should have been closer to 5000–5500 RPM.

The excessive propeller pitch reduced acceleration, increased cavitation, and limited top speed. Based on research and testing, we determined that a propeller in the 16–19 pitch range would likely provide much better performance, but not less than 16 pitch or higher than 19.

Research and Learning

Throughout this project, I combined classroom instruction, independent research, and hands-on testing to better understand how different factors influence boat performance.

One major area of study was propeller design and setup. I learned how propeller pitch and diameter affect engine RPM, acceleration, and top speed, and how choosing the correct propeller is critical for achieving optimal performance. I also learned how trim angle, engine height, and weight distribution influence hull drag and how efficiently a boat moves through the water.

In addition, I gained a much better understanding of how carbureted two-stroke outboard engines operate. This included learning how carburetors regulate air and fuel mixtures, how throttle linkages affect engine response, and how fuel system restrictions can create performance issues even when the engine itself is mechanically sound.

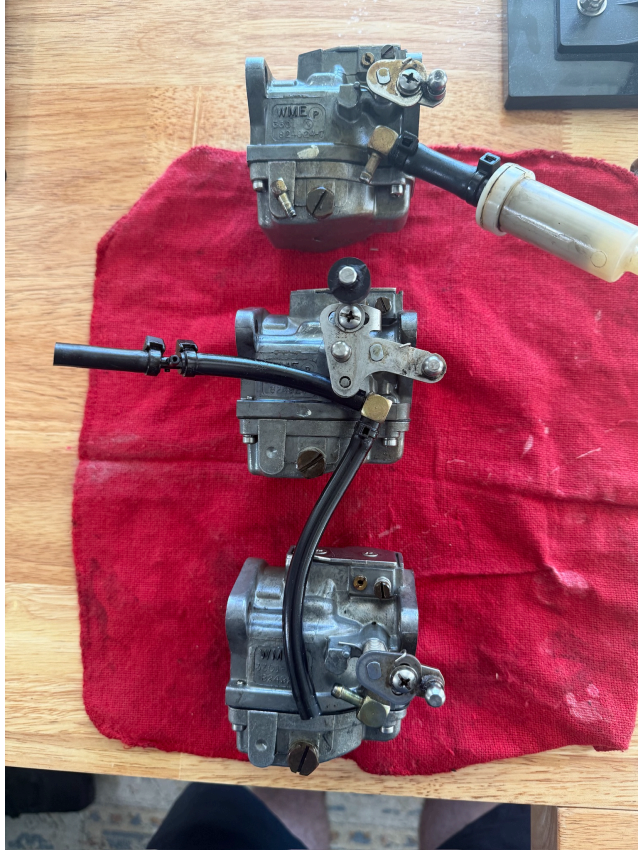
By combining research with real-world water testing, I was able to see how relatively small adjustments could create major performance improvements.

Modifications and Work Performed

Carburetor Rebuild

When we first began working on the engine, our original plan was to perform a basic compression test to evaluate the overall health of the engine before making any major repairs. However, once we attempted to start the motor, we realized that the engine would not even run. What started as a simple inspection immediately turned into a much larger troubleshooting process. As we looked in the engine the next thing I noticed was that I had all of the carburetors and fuel lines fully taken out of the engine. This led to a full carburetor rebuild that included cleaning internal passages, replacing worn components, and correcting float adjustments. The experience showed how quickly small diagnostic work can turn into a major repair project when dealing with older marine engines.





Fuel System Repairs

After rebuilding the carburetors, the engine was still experiencing poor fuel delivery and would bog down under acceleration and while trying to get on plane. At first, we believed the issue was related to the carburetor floats, so we removed the carburetors again and replaced the floats in an attempt to solve the problem. However, after additional troubleshooting, we discovered that the actual issue was not inside the carburetors at all, but instead came from the external fuel system. We ended up replacing the fuel hose, primer bulb, and water-separating fuel filter to restore proper fuel flow to the engine. Once the damaged and restricted fuel components were replaced, the engine's fuel delivery improved significantly, reducing bogging issues and helping the motor run much smoother and more consistently.

Trim Motor Replacement and Engine Height Adjustment

The original trim motor failed after only eight months of use, requiring replacement with a new OEM Mercury Marine trim motor. Replacing the trim system required removing the outboard from the transom, disconnecting the old assembly, and reinstalling the new unit.

After reinstalling the trim system, we raised the engine approximately one and a half inches higher on the transom. This adjustment was intended to reduce lower-unit drag, minimize cavitation, and improve propeller efficiency while the boat was on plane.

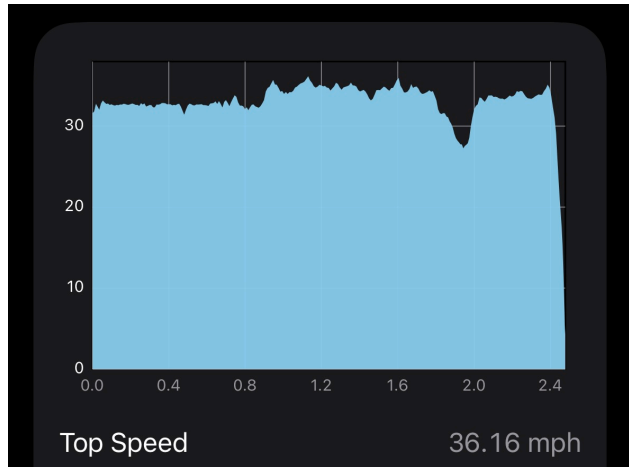
Propeller Selection

During the process of selecting the correct propeller, I visited a propeller shop in General Propeller to get more professional advice about my setup. While I was there, a lady named Ms. Gloria helped guide me through several different propeller options and explained how differences in pitch, blade design, and material could affect the performance of my Ranger 680C and Mercury 90 ELPTO. She showed me multiple propellers that they had available and helped me better understand which setups would likely work best for my boat. After discussing the engine performance issues and my speed goals, she helped direct me toward the PowerTech propeller that I eventually purchased and tested on the boat. Visiting General Propeller was very helpful because it gave me real-world guidance from someone with experience in marine performance setups and helped me make a more informed decision during the propeller selection process.

Before purchasing the final PowerTech propeller, I spent a lot of time researching different propeller options that would better match the setup of my boat. After comparing several choices, I narrowed my options down to three propellers: a Solas Amita 3 13.25 x 18 pitch, a Solas Rubex 13.25 x 17 pitch, and a Quicksilver 13.25 x 18 pitch propeller. Out of those options, the Solas Rubex was my number one choice because I believed the 17-pitch design would allow the engine to turn higher RPM and improve acceleration while reducing the bogging and cavitation issues I was experiencing. I ultimately decided to purchase both the Solas Rubex 17-pitch propeller and the 19-pitch PowerTech propeller because I was unsure how significant the performance difference between the two pitches would be. Since I did not have a working tachometer at the time, I wanted the ability to test both setups and determine whether the engine performed better with a 17-pitch or a 19-pitch propeller. This gave me more flexibility during the testing process and helped me better understand how propeller pitch directly affects RPM, acceleration, and overall boat performance.

Testing Process

After purchasing both propellers, I performed on-water testing with the Solas Rubex and the PowerTech propeller to compare their performance and determine which setup worked best for my boat. The Solas Rubex 13.25 x 17 propeller noticeably improved acceleration and allowed the engine to turn higher RPM compared to the original setup. During testing, the boat reached a top speed of about 36.2 per hour with the Rubex installed. The engine is a little faster with the 19 pitch, but they still both made big differences. The engine felt much more responsive with both props, and even having the pitch lowered by 1 helped reduce some of the bogging and cavitation problems that existed before the repairs and modifications.



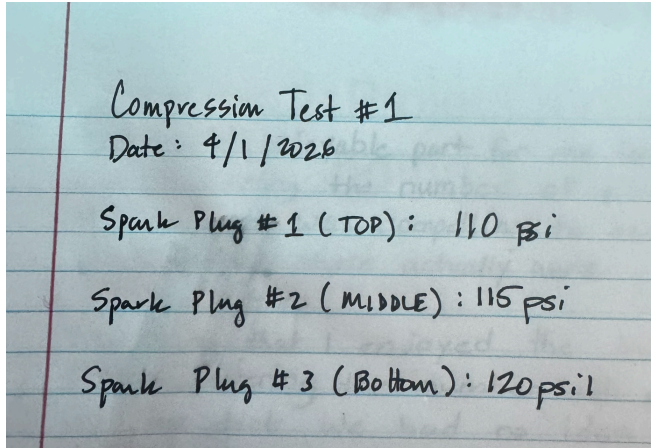
The image above are the results with the Solas Rubex 13.25x17.

After testing the Rubex, I switched to the 13 x 19 PowerTech propeller to compare overall performance. Even though the PowerTech placed slightly more load on the engine because of the higher pitch, it still allowed the motor to turn significantly more RPM than the original 20-pitch propeller, which had previously kept the engine around 4500 RPM. With the PowerTech installed, the boat ultimately achieved a top speed of 41.6 miles per hour. While the Solas Rubex produced higher RPM and strong acceleration, the PowerTech provided the best balance of RPM and top-end performance, making it the fastest overall setup that I tested during the project.



This image is the top speed with the Power Tech 13x19.

We performed an actual compression test on the engine to check the overall condition of the engine after all of the major repairs. The results were actually pretty good. The top cylinder had 110 PSI, the middle had 115 PSI, and the bottom had 120 PSI. Since the numbers were fairly close together, it showed that the engine was still healthy internally and that most of the performance problems were likely caused by fuel delivery and setup issues rather than serious engine damage.



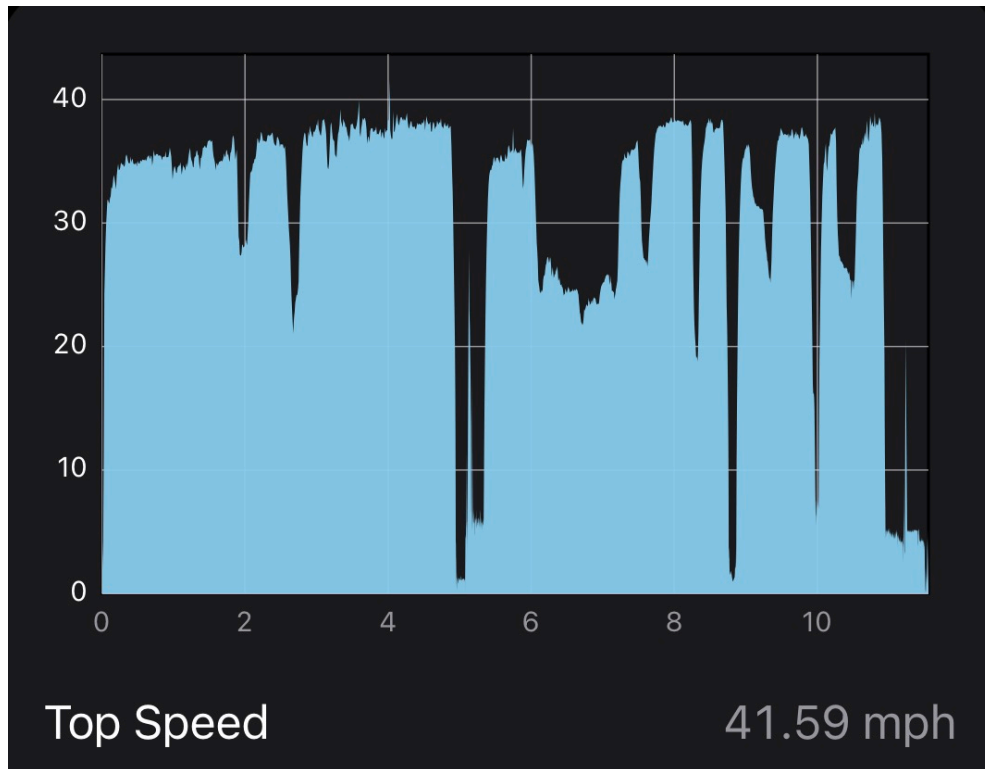
Results

The final results of the project showed a major improvement in overall boat performance.

Performance Category	Result
Starting Top Speed	28 MPH
Final Top Speed	41.6 MPH
Total Speed Increase	+13.6 MPH

In addition to the increase in top speed, the boat accelerated much more smoothly, got on plane faster, and no longer suffered from severe bogging or cavitation.

The boat's top speed increased by **about 48.6%** over the course of the project.



Analysis

The improvements were successful because each modification addressed a different weakness in the boat's overall performance system.

Rebuilding the carburetors restored proper fuel and air delivery to the engine, allowing it to run smoother and respond more consistently throughout the RPM range. This created a stronger mechanical foundation for additional tuning and setup improvements.

Changing from the original 20-pitch Quicksilver Laser II propeller to the 19-pitch PowerTech propeller was one of the biggest performance improvements. The lower pitch allowed the engine to spin more freely and operate closer to its recommended RPM range. This improved acceleration, pretty much stopped cavitation, and increased top speed.

The fuel system repairs also played a major role. Replacing the damaged fuel hose, primer bulb, and fuel water separator restored proper fuel flow to the engine and eliminated the bogging issue. Finally, raising the engine height reduced lower-unit drag and allowed the propeller to operate more efficiently in the water. Together, all of these modifications worked as a complete system to dramatically improve the boat's performance.

Challenges and Problem Solving

This project involved several challenges and required a large amount of troubleshooting and patience.

The biggest challenge for me was honestly replacing the trim motor. Taking the engine off the transom and trying to get back behind it without being able to see anything is very tough and I hope we don't have to do it again.

Another challenge was trying to find what was causing the bogging issue. We had no idea what was causing it before so we just had to keep experimenting before we found that it was the exterior fuel line.

Skills Gained

Throughout this project, I gained valuable mechanical and technical skills related to the marine industry.

Some of the most important skills I developed included:

- Carburetor rebuilding and adjustment
- Fuel system troubleshooting
- Understanding propeller setup and selection
- Diagnosing engine performance problems
- Marine rigging and engine setup
- Data collection and performance testing
- Real-world troubleshooting and problem solving

This project also improved my confidence in working on outboard motors and gave me hands-on experience that directly relates to the marine technician field.

Conclusion

This project successfully achieved and exceeded the original SMART goal established at the beginning of the semester. Starting with a boat that could only reach 28 miles per hour and suffered from multiple mechanical issues, I was able to improve the setup, diagnose problems, and increase the final top speed to 41.6 miles per hour.

More importantly, the project taught me how important troubleshooting, persistence, and proper setup are in marine performance. Every repair and adjustment contributed to the final result, and the experience provided valuable real-world knowledge that cannot be learned from textbooks alone.

By the end of the semester, the project transformed both the boat and my understanding of how marine engines and performance systems operate.

Future Improvements

Although the project was successful, there are still several areas that could be improved in the future.

Possible future upgrades include:

- Installing a working tachometer for more accurate engine tuning
- Testing additional propeller designs and materials
- Possibly Adding a jack plate
- Replace the reeds to improve fuel efficiency and top speed

These upgrades could help improve both performance and efficiency even further.
