2018 Portfolio
Industrial Technology Vehicle Design

Shop Experience

Winter 2017-2018: Job Shadow at KD Automotive and KD Motorsports

KD Automotive and KD Motorsports in Redmond, Washington, is an independent facility that provides a full range of services from general maintenance and repair, to track preparation for people wishing to participate in high performance driving events, sport driving, and racing schools. They also have the expertise to build competitive race cars, and the owner manages a small fleet of BMW 3-series race cars which are available for rental.

Through job shadowing at KD Automotive and KD Motorsports, I learned additional skills where it was especially rewarding to work in an everyday automotive shop alongside a BMW race garage with techs that have an obvious passion for racing. I was able to learn about:

- General Automotive Maintenance
- Diagnostic Troubleshooting
- Performance Upgrades
- Race Car Development
**#29 Race Car:** I replaced headlights to prepare #29 for a midday race. I also had to replace four ballasts, one for each headlight and control for HID. I followed the wires back up to the power supply, took out all the connections because it was a total mess, and then finally replaced all of them in a more organized fashion.

**Brake Booster:** We test drove the car and noticed the brakes were not working correctly. During the test drive the pedal did not push back after the first brake, and it seemed to lose all its air pressure. We preformed several tests to diagnose the problem, like pumping the brake pedal with the ignition on and then off. I used the Leak Tamer which injected smoke into the lines to make leaks more visible. We were able to determine the master cylinder was working properly, but the brake booster was not. First, I had to detach the master cylinder to make enough room for the brake booster to come out. Next, I worked inside the firewall and took out all the connections to the brake pedal. Once those parts had been removed, I was able to pull out the brake booster and replaced it.

**BMW 7 Series:** Tests showed that cylinder one and two had several error codes and one was misfiring. My first thought was bad spark plug wires, since we had recently diagnosed and repaired a car with similar issues. Therefore, I swapped wire one to the fifth piston and the second to the sixth. Cylinder one and two still had issues, so the simple swap test confirmed the problem was not the wires. Next, I looked at the spark plugs for any signs of failure. One of the plugs was a little oily, so I ended up replacing both spark plugs. When I took them out they seemed really loose, so I made sure to torque the new ones in all the way and that resolved the problem.

The BMW also was super oily in general, so I looked for an oil leak. It seemed to be coming from the cam seals, so I replaced them. I was not sure if that was the only source of the leak, so I left a note for the customer to leave cardboard or something similar under his car to see if anything is leaking after putting in a couple hundred miles.

**Alternator:** A car came in that wouldn’t start. A quick battery test told me that the alternator was not charging the battery sufficiently. I initially took out the accessory belt and then unbolted the AC to make room. Then, I unbolted the alternator, pulled it out the top, and replaced it.
Additional Shop Experience

Summer 2017: Intern at Jay’s Garage

Jay’s Garage in Dayton, Washington, is a one-stop auto repair shop specializing in all aspects of auto repair and maintenance of light trucks and automobiles.

As an intern at Jay’s Garage, I was assigned specific jobs to complete by myself for customers. In addition to completing basic repairs and maintenance, such as changing transmission fluid, oil changes, starter replacements and overall engine inspection. Additional projects I worked on included:

- Electrical
- Brakes and Suspension
- Cooling systems
- Gas & Diesel Engine Performance
- Tires
- Wheel Alignment & Balancing

Electronics: A Ford F250 came into the shop with none of the electronics attached to the steering wheel working properly. I started by removing the necessary components, like the steering wheel and part of the dash. Then I cut, stripped and re-connected the proper wires, checking each one with an amp meter. I used a heat gun to shrink the pink tubes around the wires to keep them connected.

I had a similar situation with a trailer the next day. Only some of the running lights worked and neither blinker turned on. Looking at the wiring it appeared the owner tried to wire the electronics himself, but had not installed them properly. I followed the same steps as the F250 and got the lights working.
**Jeep Liberty Engine:** A Jeep Liberty came in needing a full engine swap because of serious failure. First, I removed the old engine with the help of the lead tech at the shop. The most apparent cause of the failure was a water pump. I could tell from how loose it was, and it obviously was not in working condition. Then I further inspected the engine for failure. I eventually found a rocker that broke off the top of the cam shaft which was obviously the finishing blow. During this project I learned sometimes specific bearings have crack pairs so each one has only one piece it can fit into. I also learned how to use a cherry picker when we removed the engine from the jeep, and how to remove just about everything holding the engine in place.

![Jeep Liberty engine](image1)
![Cherry picker](image2)
![Crankshaft & main bearing](image3)

**Mercury Piston Issues:** An old Mercury was having power issues and it was easy to tell the engine was not running properly. First, I hooked up the VCM 2 Vehicle Communication Module, ran a compression test and power balance test to see if it was fixable. The tests showed piston one was malfunctioning. Once finding this out I tested spark plugs by removing it and then grounding it to see if there was spark. Next, I re-gapped a new spark plug with a cookie (i.e. circular tool that gets wider as you spin it). The new spark plug fixed low power on piston one but it was still shaky at low speeds and there was still not good power. The last thing I did was switched the spark plug wires and this ended up balancing the power out.

![Initial test](image4)
![Spark plug test](image5)
![Final test](image6)
**Tire Mounting and balancing**: Tires replacement was a common service at this garage, which gave me several opportunities to practice unmounting and mounting tires and replacing valve stems. I also got the opportunity to use the digital wheel balance machine and place the weights on the inside of the rim to ensure a correct weight distribution.

**Brakes**: While replacing worn brake pads and rotors, I came across some complications with a caliper mount. This allowed me to also learn to use a rethreading tool, which fixed this particular issue.

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**Air Conditioning**: A car came with the AC not working at all, it needed a few parts as well as a recharge. As it was researching I also replaced both the accumulator and the condenser, as well as the hosing connected to the accumulator. The new hose kept kinking so I made a temporary fix by attaching the old hose onto it to keep its shape. Then I left a note for the customer instructing him to cut off the old hose once the new hose maintained the correct shape.

**Belt and Tensioner**: A truck was brought in that was making an odd noise. After opening the hood, I found the accessory belt was old and cracked, and one of the tensioners was obviously worn out. After removing and replacing the belt, I then replaced the tensioner.
Personal Car Repairs and Customizations

Fall 2014 – Winter 2017: 2004 Mazda RX-8

I chose the RX-8 because it has a unique design: a four-door sports car with small suicide doors, smooth high revving rotary engine, light weight for good handling, and a comparatively low cost. The low cost was in part due to some model reliability issues that I knew I would need to work through. I performed some customizations to improve upon the original design and make it my own. Lastly, I did all the car maintenance myself.

Aesthetics: Mounted the rear spoiler by measuring and drilling into the trunk. Lowered the car by replacing the struts. Added black custom wheels. Applied black film over orange side markers. Painted chrome emblems black. Tinted windows.

Coil Overs: Removed old springs and replaced with new Tien coil overs to lower the car and improve looks and handling.

Power Steering Failure: I replaced the steering wiring harness and rerouted the radiator overflow, so it would not corrode the wiring harness connector under it, as was the original design. This was the most common and inexpensive cause of RX8 steering failure. Next, I replaced the steering computer, which fixed the issue.

Heater Connections: The heater controls were stuck on the coldest setting. I took apart the dash to remove the heater controls and re-soldered the connections on the back of the heater control panel to fix this common RX8 design problem.

Taillights: Taillights were filling with water. Removed the taillight and replaced the gaskets with thicker aftermarket gaskets.

Brake Pads: Replaced worn rear brake pads.