

# Green Go-Kart Dyno

## Capstone Senior Design Project • Spring 2025



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### Problem Definition

There is a need for an all-in-one dynamometer that enables consumers to accurately measure the power output of small engines while effectively filtering harmful combustion emissions. This solution must be capable of operating in enclosed environments without requiring an external ventilation system.

**Mission Statement:** To create cutting-edge, eco-friendly testing systems for small displacement engines, delivering precision and affordability to empower users while promoting environmental responsibility.

### Benchmarks



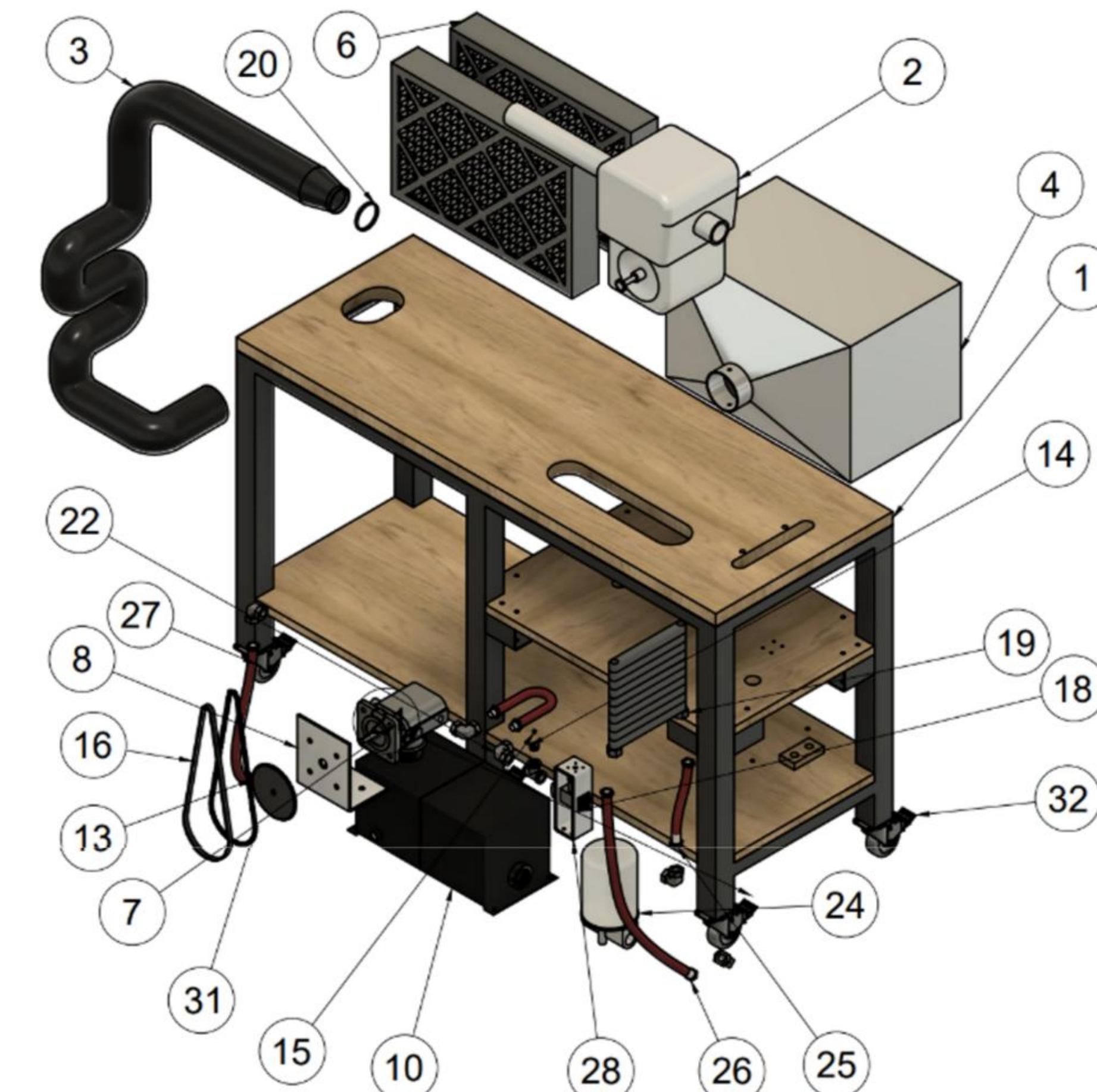
Fast Factory Small Engine Dyno

|                      |        | Final Design                | Benchmark                |
|----------------------|--------|-----------------------------|--------------------------|
| Design Requirements  | Weight | Pressure Gauge + Duct Snake | Fast Factory Dynamometer |
| Durability           | 7.6    | 7                           | 7                        |
| Maintenance          | 5.75   | 7                           | 7                        |
| Cost                 | 7      | 8                           | 5                        |
| Performance/Accuracy | 8.8    | 8                           | 8                        |
| Safety               | 9      | 7                           | 4                        |
| Portability          | 4      | 5                           | 4                        |
| Weighted Total       | 302.85 | 250.85                      |                          |

### Customer Requirements

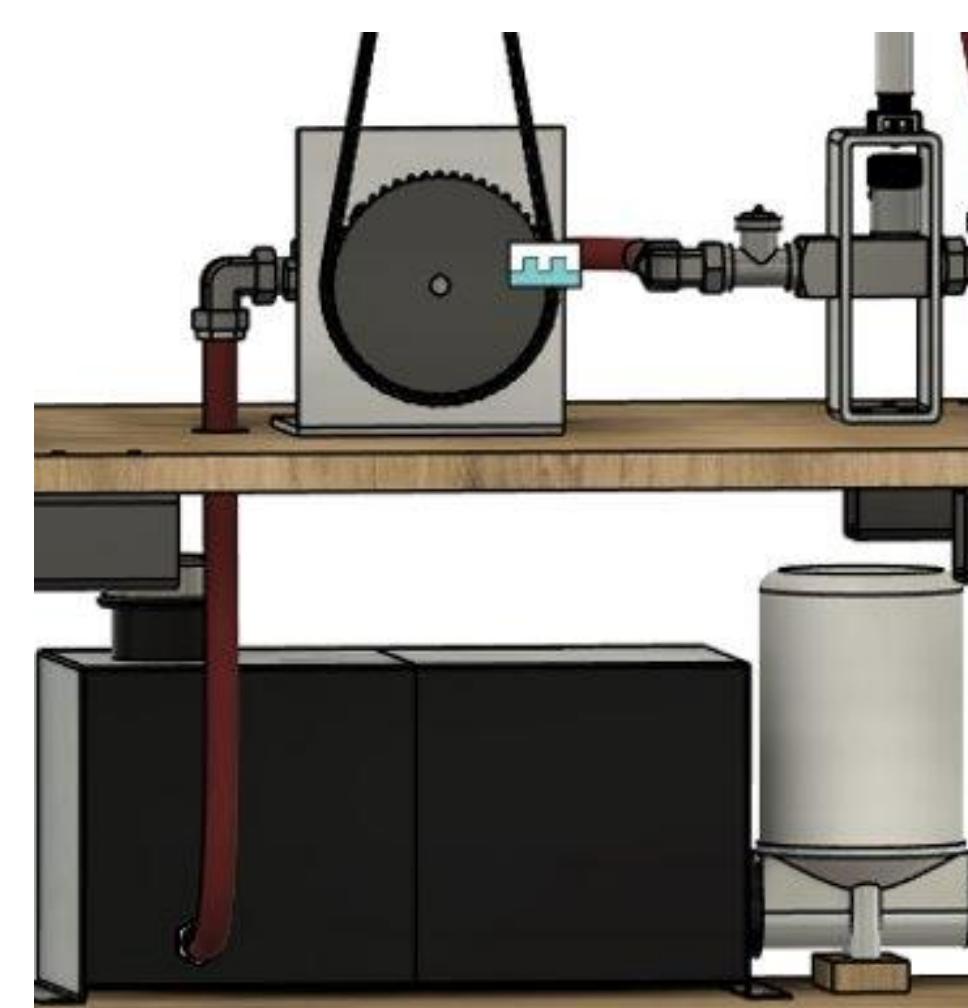
| Customer   | Requirement          | Details                                   |
|------------|----------------------|---|
| Buyer      | Cost-effective       | Total system cost < \$4000                |
|            | Eco-conscious        | Emissions < 50 ppm                        |
|            | Market-ready         | Data within 5% of catalog specs           |
| Spectators | Clean air            | Advanced exhaust filtration               |
|            | Safety prioritized   | Exhaust shielding & chain guards          |
|            | Long-term health     | Reduced toxin exposure                    |
| User       | High durability      | Engine tolerates 16,000 RPM & 1200°F      |
|            | Easy maintenance     | Components swapped in < 60s               |
|            | Improved performance | Ventilation boosts response & reliability |

### Final Design



| PARTS LIST |     |                                   |      |     |  |      |     |                          |
|------------|-----|-----------------------------------|------|-----|--|------|-----|--------------------------|
| ITEM       | QTY | PART NAME                         | ITEM | QTY | PART NAME                                      | ITEM | QTY | PART NAME                |
| 1          | 1   | FRAME                             | 12   | 1   | TEE  | 23   | 3   | ELBOW                    |
| 2          | 1   | KT100 ENGINE                      | 13   | 1   | PUMP CHAIN SPROCKET                            | 24   | 1   | HYDRAULIC FILTER         |
| 3          | 1   | DUCT LINE                         | 14   | 1   | 3/4" TO 1/8"                                   | 25   | 1   | VALVE-COOLER LINE        |
| 4          | 1   | FILTER CASING                     | 15   | 1   | PRESSURE SENSOR                                | 26   | 1   | COOLER-FILTER LINE       |
| 5          | 1   | WOOD BASE                         | 16   | 1   | SPROCKET CHAIN                                 | 27   | 1   | TANK-PUMP LINE           |
| 6          | 2   | 38811T89_PANEL AIR FILTERS        | 17   | 1   | ELBOW  | 28   | 1   | VALVE & MOTOR BRACKET    |
| 7          | 1   | VEVOR HYDRAULIC LOG SPLITTER PUMP | 18   | 1   | 1042K21_FLOW-ADJUSTMENT INLINE HYDRAULIC VALVE | 29   | 1   | MOTOR                    |
| 8          | 1   | PIMP BRACKET                      | 19   | 1   | OIL COOLER                                     | 31   | 1   | 6027K134_ROLLER CHAIN    |
| 9          | 1   | PUMP SYSTEM WOOD BASE             | 20   | 1   | DUCT CLAMP                                     | 31   | 1   | 6027K134_ROLLER CHAIN    |
| 10         | 1   | 5 GALLON HYDRAULIC TANK           | 21   | 1   | PUMP-SENSOR LINE                               | 32   | 6   | 2702T71_CART-KING CASTER |
| 11         | 1   | 0.95" TO 0.75"                    | 22   | 1   | ELBOW 3/4"                                     |      |     |                          |

### Dynamometer Pressure System



#### Design Components:

- 2' x 1" and 5' x ½" steel-braided hydraulic tubing
- 16 GPM, 30 HP hydraulic pump

#### Design Intent:

- Simulate engine load via controlled fluid flow
- Ensure safe operation at 1653.7 psi
- Pump power safely exceeds engine output

### Exhaust Filtration System



#### Design Components:

- Selection 25' x 4" PVC air duct tubing
- 12" cooling fan

#### Design Intent:

- Cool exhaust from 1200°F to 183°F using snaking ducts and convection
- Use heat exchanger principles to maximize cooling efficiency (90% effectiveness)
- Ensure exhaust is below 225°F limit for safe MERV 16 filter operation

### Testing & Validation

| Category            | Test Area              | Details   |
|---------------------|------------------------|---|
| Dynamometer Testing | Cart Mobility          | Verified ease of movement and stability with multiple users         |
|                     | Pump Operation         | Confirmed fluid circulation and leak-free system                    |
|                     | Sensor & Motor Control | Validated accurate sensor readings and gear motor function          |
|                     | Structural Integrity   | Engine ran at 10,000 RPM (90s) and 15,500 RPM (15s) without failure |
|                     | Power & Data Accuracy  | Power data within 5% of reference values                            |
| Exhaust Filtration  | Ducting Integrity      | No leaks detected during operation                                  |
|                     | Pollutant Reduction    | Emissions verified < 50 ppm   |
|                     | Maintenance Access     | Filters easily replaceable  |

### Future Improvement

- Universal Engine Mount: Develop an adjustable fixture for faster engine swaps across various models
- Compact Footprint: Redesign cart layout to reduce space without sacrificing functionality
- Enhanced Cooling: Upgrade fan and duct design for quicker exhaust temperature drop and better filter longevity
- Noise Reduction: Add acoustic insulation to lower sound levels during high-RPM operation
- Remote Operation: Implement wireless controls for added safety and convenience during testing

### Acknowledgements

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