

Problem Definition



- The **TEXTRON TUG 660E Belt Loader** is a self-propelled, electrically driven vehicle designed to **lift cargo and luggage** to aircraft cargo bays with its **adjustable conveyor belt**
- The vehicle weighs **8000 pounds** and is capable of speeds up to **15 mph**
- The **current parking brake unit is costly**, provides **insufficient torque**, and presents **excessive complexity** during installation and maintenance
- We have set out to **develop an electric parking brake with high braking torque and a manual override**

Key Design Requirements

- 🔧 Offer both **electric and mechanical engagement and disengagement**
- ⚙️ **Apply ample braking torque (185 Nm)** to prevent towing through the brake
- 📡 Shall be **compatible with CAN J1939 network**
- 💰 Designed to **cost under \$1000** and **fit the IP67 rating**
- ⌚ **Shall be installed within 10 minutes** once on the assembly floor
- ⚠️ The brake must operate with a **peak of 15 A and 12 V source**
- 🕒 **Applying and releasing the brake will occur within 1 second** of user input

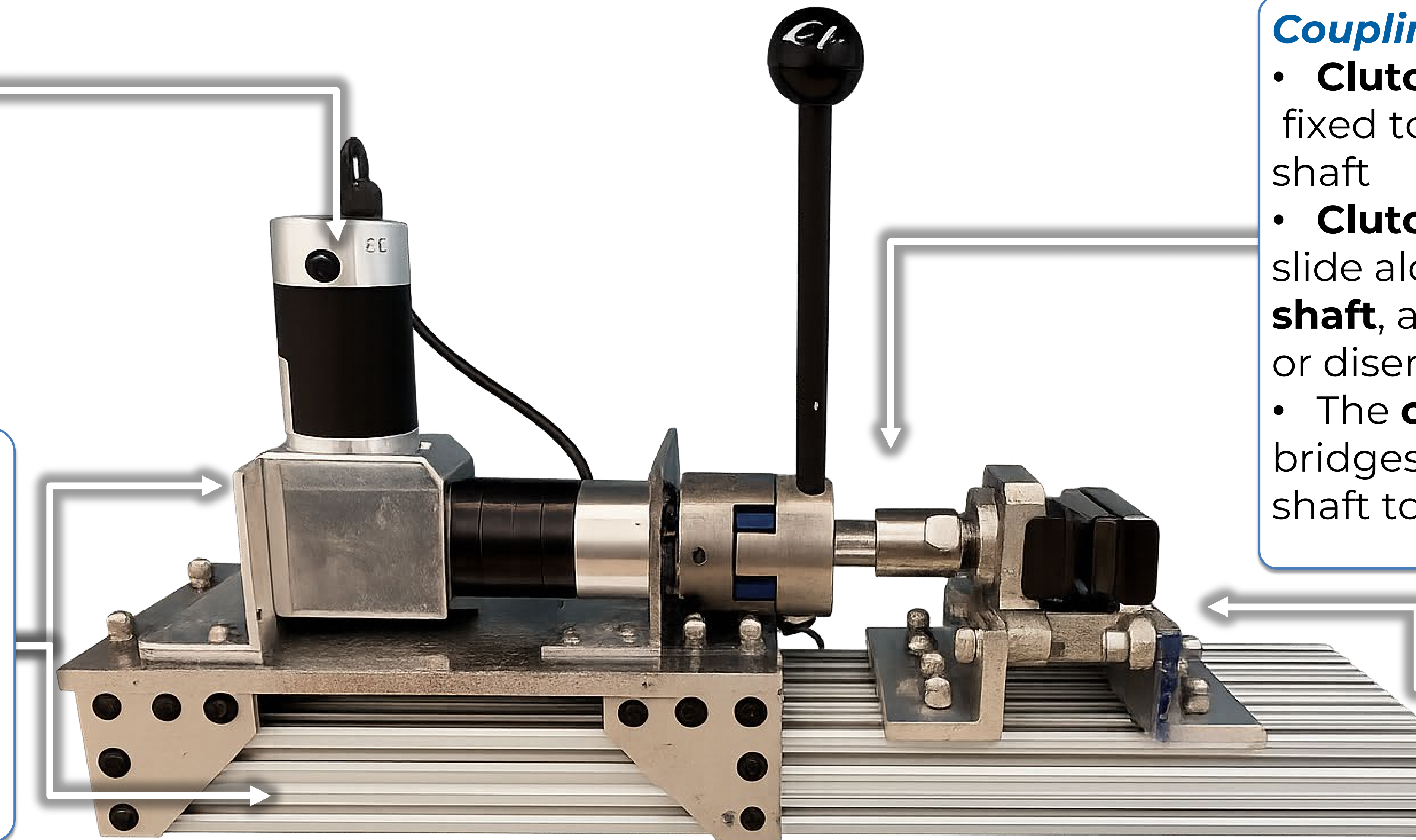
Design Overview

Reversible Brushed DC Right-Angled Gearmotor

- Meets voltage and current requirements
- Holding torque of **40 Nm** and **16 RPM**

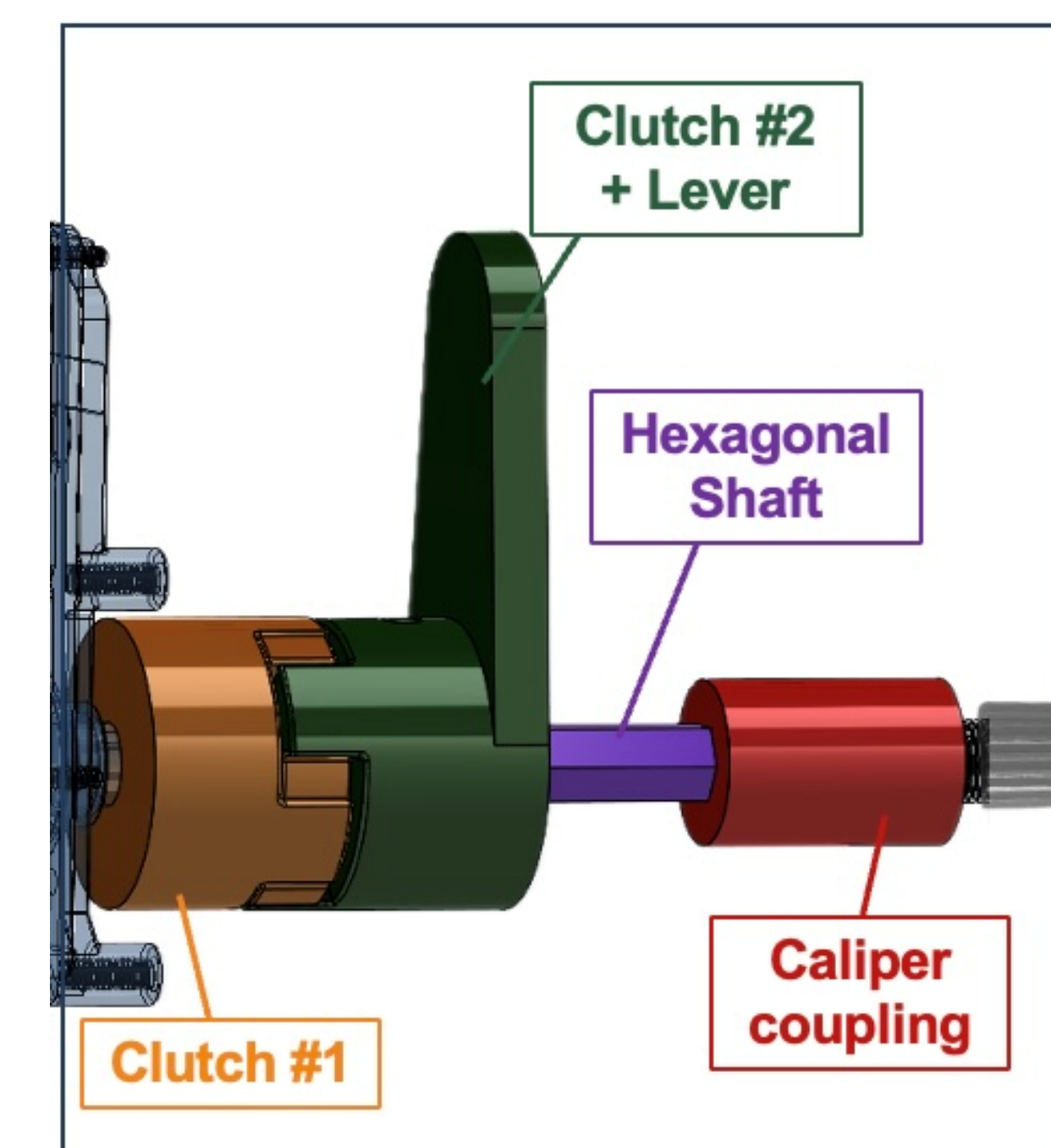
Structural Support

- Aluminum brackets to ensure **structural support and alignment**
- Steel plating and bars to attach the design to the TUG 660E Beltloader support brake operation



Coupling Assembly

- **Clutch #1** is rigidly fixed to the motor output shaft
- **Clutch #2 and lever** slide along a **hexagonal shaft**, allowing it to engage or disengage from Clutch #1
- The **caliper coupling** bridges the hexagonal shaft to the caliper brake



515 Series Caliper Disc Brake

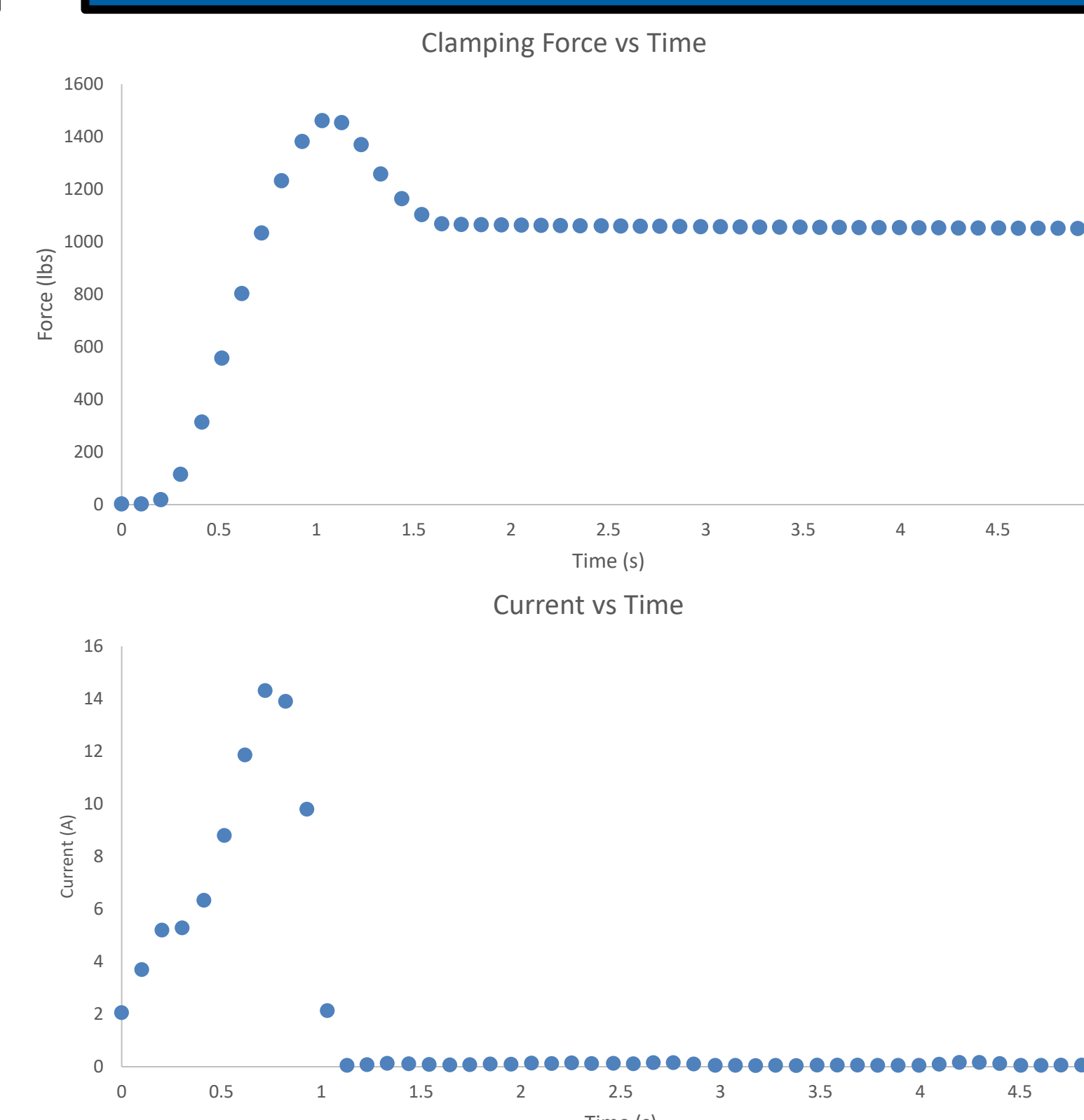
- **Converts** rotational motion into linear motion
- **Clamps directly** on a 12-inch rotor

Solution

Our solution is an **electromechanical parking brake** assembly that:

- ✓ Combines the reliability of a **mechanical caliper** with the convenience of **electrical actuation**
- ✓ Enables **fully electric brake** application and release during normal operation, while **allowing mechanical operation** for towing and maintenance purposes via **manual override**
- ✓ **Meets all technical requirements**
- ✓ **Compatible with CAN1939** network
- ✓ **Reduces cost** and installation **complexity**
- ✓ Delivers **enhanced braking torque**

Results



Load Cell Testing

- A load cell measures the clamping force between the brake pads
- Recorded a peak of **1500 pounds**, and held stable at **1000 pounds**

Torque Test

- A towing simulation to confirm that the brake properly clamps down on the rotor and prevents slipping

Vehicle Integration

- On-site visit allowed for complete integration testing of the Belt Loader Parking Brake

Future Goals

- ☐ Gathered important dimensions of how this design will integrate into the TUG fleet and future vehicles
- Moving towards full vehicle integration:**
- ☐ IP67-rated casing to protect our parking brake
- ☐ Train technicians to install it within the time restraint
- ☐ Completely install the brake into a TUG 660E and evaluate complete operation

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 Anyone else?***