



Department Project Information

Department Name	MEES	Date Submitted	04/19/2023
Project Title	Design and Manufacture of an Automotive Brake Dynamometer (UNCC_ME_DYNO)	Planned Starting Semester	Fall 2023

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	4	Electrical	1
Computer	1	Systems	
Other ()			

Project Overview:

The motorsports program at UNCC supports a number of competition cars as student projects, including two Formula SAE teams and a Legends race car. These cars allow students to apply hands on the concepts they learn in the program, and explore the topics more deeply. As the students design and develop these cars, they must make data-driven decisions.

In the braking system of a car, students must evaluate properties such as the brake pad friction coefficient, temperature cycle of the brake rotor from friction, and the braking torque produced by the system. Often brake pad manufacturers do not make reliable data available for evaluating the properties of the pads. In order for the students to make informed decisions in the design of the braking system as well as accurately estimate performance of the braking system for use in designing other components of the car, various brake component packages should be tested to gather data.

A brake dynamometer is a device for testing and evaluating the friction and thermal properties of a braking system. A flywheel is attached to a brake hub carrier, which allows the brake rotor to be spun up and replicates the rotational velocity and inertia of a brake disk mounted on a moving vehicle. A carriage holds the brake caliper at the proper application radius along the brake rotor and allows the caliper to apply a clamping force to the rotor and is connected to a load cell. A brake control system applies the clamping load to the brake caliper as controlled by the operator. Temperature sensors are used to determine average rotor temperatures. A motor accelerates the flywheel, hub, and rotor assembly to the operator determined speed.

Project Requirements:



This project must produce a functional brake dynamometer with the following features

- Flexibility for mounting a variety of Formula SAE appropriate calipers and brake rotors
- Safety enclosure to contain all parts in the event of a failure while allowing adequate air flow for cooling
- Control interface allowing the operator to control target flywheel speed and brake line pressure, and the recording of these values
- Output interface that records the measured load at the caliper and the temperatures at the temperature sensors
- Four temperature sensors, two aimed at the front side of the rotor, two at the rear side
- A load cell on the caliper carriage to measure the load from braking torque
- Flywheel and motor assembly sufficient to replicate the inertia of a small race car in motion.

Expected Deliverables/Results:

- Fully fabricated and assembled dynamometer ready for use
- All CAD files and renderings
- BOM for all components
- Software for control and results output
- Documentation instructing on the safe and correct use of the dynamometer

Disposition of Deliverables at the End of the Project:

Hardware developed is the property of the mentor and department.

List here any specific skills, requirements, specific courses, club affiliation, knowledge needed or suggested (If none please state none):

- Machine Design
- Motorsports Concentration
- Electric motor experience