EXECUTIVE SUMMARY

The University of Michigan SAE Baja Racing Team designs, builds and races an off-road race vehicle each year. Historically, the team has employed a continuously-variable transmission (CVT) to provide variability in the reduction of the drivetrain which has a large number of tuning parameters. Due to current testing limitations, the Baja Team has identified a standalone CVT dynamometer setup as an acceptable and high-impact solution for increasing tuning efficiency, accuracy, and repeatability in a controlled environment. Team 13 has been tasked with its development. With a CVT dynamometer, the Baja Team will be able tune the CVT quickly and much more thoroughly while performing year-round tuning without requiring an operating vehicle.

The Baja Team has requested that the dynamometer meet a variety of requirements to ensure usability, and Team 13 has generated appropriate engineering specifications to fulfill these requirements in Table 1.

Table 1: Requirements as outlined by the Baja Team, with associated specifications.

User Requirement	**Engineering Specification**
Measure Engine Speed	Able to measure up to 3800RPM
Measure Engine Torque	14.5 lb-ft between engine and transmission
Measure CVT Output Speed & Torque	Able to measure up to 9000RPM
Measure CVT Output Torque	Able to measure up to 44 lb-ft
Adjustable	8.5" minimum, 12" maximum distance between CVT Input/Output axis
Mobile [3]	Max. width: 31 inches
Accurate	Max. 2% resolution error
Serviceable	< 2 minutes to remove or install CVT
Total Cost Within Budget	Dynamometer must not exceed $12,000

Team 13 has not found a suitable commercially available system that fits both the engineering specifications and project budget and plans to pursue the development of a custom transmission dynamometer. Dynamometer absorber concepts of hydraulic pump, water brake, inertial, friction brake, eddy current, and electric motor were analyzed and Team 13 has selected an electromagnetic particle brake as the absorber due to its high level of control and reliability. The particle brake concept has two primary subsystems; mechanical and sensing/control. These subsystems incorporate the engineering fields of mechanics, controls, and manufacturing. Manufacturing was completed in the Wilson Student Team Project Center after engineering analysis was used to design or select components. Additional evaluation of materials selection and environmental impact were also considered. Once completed, each subsystem was validated and the overall design was evaluated against the engineering specifications. Team 13's design met all the engineering requirements as specified by the Baja Team.

The purpose of this report is to document project motivation, background, project requirements, engineering specifications, concept generation and selection, alpha and final design, engineering analysis and information, and project, manufacturing, and validation plans for the SAE Baja CVT dynamometer.