Test Vehicles
The Texas A&M Transportation Institute’s (TTI’s) instrumented vehicles allow researchers to conduct driver behavior research in test track and on-road environments. The vehicles are equipped with vehicle acquisition data systems and other portable systems that allow TTI research staff to evaluate driver response and performance to a variety of on-road devices and in-vehicle technologies.

TTI’s newest instrumented vehicles are a 2015 Toyota Sienna and a 2015 Ford Explorer. A 2006 Toyota Highlander serves as an additional instrumented vehicle. The vehicles can each be used alone or in tandem.

Vehicle Data Acquisition Systems
The principal system used within TTI’s 2015 instrumented vehicles is the Dewetron DEWE2-M4-ADAS vehicle data acquisition integration system. Essentially a large portable computer, the system serves as the data acquisition device for all the peripheral systems in the vehicles. The Dewetron ADAS consists of a 120 GB solid-state disk drive combined with an Intel Core i7 processor running on a standard Microsoft Windows platform. The instrumentation allows eight analog and up to four CANBUS inputs. Also supported are eight digital inputs and eight digital I/Os, with data collection rates up to 5,000 samples per second.

The 2006 Toyota Highlander is equipped with an earlier version of the Dewetron data acquisition system, the DEWE5000. Peripheral systems in the vehicles include the following:

- **Trimble DSM232 Differential Global Positioning System (DGPS)** – used with real-time kinematic (RTK) satellite navigation, the Trimble DGPS provides centimeter-level locating accuracy with up to a 50-millisecond data-update rate.
- **Vorad radar** mounted on the front of the vehicle enables the collection of headway data.
- **Assistware SAFETRAC** tracks the lateral lane position of the vehicle, lane width and lateral velocity.
- **Potentiometers** collect data on the position of the brake pedal, the accelerator pedal, and the steering wheel.
- **Crossbow Piezoresistive Accelerometer** collects 3-axis acceleration data.
- **Three Microsoft HD USB cameras** are positioned to collect video data on driver head movements and general glance directions; hand positions and body movements; and foot movements.
Test Equipment
Noninvasive physiological testing equipment is used in some studies to obtain objective measures of participants’ stress levels, workload, and glance patterns while driving. These devices are portable and can be used in test vehicles as needed.

Eye-Tracking Systems
Historically, the most common use of eye-tracking systems has been to evaluate static displays such as signs or web pages as viewed by stationary subjects. Eye tracking in a vehicle allows TTI researchers to remotely determine metrics such as glance position, glance frequency, and pupil diameter without affixing equipment to the participant. Both the FaceLAB\textsuperscript{TM} and Fovio are portable and provide freedom of movement for the subject. This allows for the collection and examination of real-time eye behaviors while driving, both in the simulator and in the field. The EyeWorks\textsuperscript{TM} software provides analytical tools to quickly process eye-glance data and identify regions of interest in the visual scene to automatically tabulate glances to those locations.

- TTI uses the Fovio eye tracking and driver monitoring system for on-road and closed-course studies. This low-profile, enclosed system mounts inconspicuously on the dashboard. It offers fast calibration for research subjects and improved eye tracking for nighttime studies.
- FaceLAB\textsuperscript{TM} employs two dashboard cameras and an infrared emitter to detect a driver’s eyes. TTI operates two FaceLAB eye trackers to allow for concurrent research projects, or the two systems can be coupled to allow up to four cameras to capture 180 degrees of head movement.

Driver Stress Detection
The Shimmer\textsuperscript{TM} Wireless Galvanic Skin Response (GSR) Sensor measures real-time stress and other effects on drivers’ sympathetic nervous systems. The sensor uses an 8 mHz, 16-bit microcontroller and Bluetooth\textsuperscript{TM} radio to collect data at a rate of 10 Hz and transmit the data to a host computer for permanent data storage.

The Zephyr\textsuperscript{TM} BioHarness 3 Electrocardiogram is a compact sensor used to measure heart rate, heart rate variability, and breathing rate.

The Flir\textsuperscript{TM} Thermal Camera system measures physiological signals from its thermal and hyper-spectral imaging systems. Perinasal perspiration and respiration rates from the thermal camera can be analyzed in conjunction with eye tracking and other physiological information in order to measure driver stress and workload.

About TTI
The Texas A\&M Transportation Institute, established in 1950, seeks solutions to the problems and challenges facing all modes of transportation. The Institute works on over 700 research projects with over 200 sponsors per year in the United States and abroad at all levels of government and in the private sector. TTI is recognized as one of the finest higher-education-affiliated transportation research agencies in the nation. TTI has saved the state and nation billions of dollars through strategies and products developed through its research program. TTI research has a proven impact — resulting in lives, time and resources saved.