# CASE STUDY A NEW INTERNATIONAL CENTER FOR AUTOMOTIVE RESEARCH AT CLEMSON UNIVERSITY – GREENVILLE, SOUTH CAROLINA

The new Clemson University International Center for Automotive Research (CU-ICAR) is the premier automotive and motorsports research and educational facility on the Clemson University campus in Greenville, South Carolina. The vision for the expansive 90,000 square foot center originated several years ago with the goal of establishing world-class facilities for automotive/motorsports research including internationally recognized graduate automotive engineering programs. Through the CU-ICAR, Clemson University will interface with industry for the associated engineering, management, marketing and communication disciplines related to automotive and motorsports research.

Bob Geolas, CU-ICAR Executive Director, summarized the mission of the center; "It is a showplace that will attract people from around the world, becoming a model for engineering advances as well as economic development. We're talking about a place that will push the forefront of technology and opportunities for our faculty and students. It's a great reflection of the talents and skills at Clemson as well as Greenville."

## Chamber Technical Specifications

A key addition to the CU-ICAR is the state-of-the-art automotive EMC test chamber designed and installed by ETS-Lindgren, experts in the test and measurement industry. Notable chamber features include:

- Modified FACT 3™ chamber of Series 81 - 100 dB modular RF-shielded panels with interior shield dimensions of 8.53 m x 6.10 m x 5.94 m, including a raised reflective ground plane
- Unique "dual-elevation" RF shielded floor to accommodate the 43.18 cm deep turntable in a limited ceiling clearance area and rise to 30.48 cm deep for the remaining chamber footprint
- Heavy-duty 2 m diameter turntable with a 1,497 kg distributed load capacity
- Fully automatic pneumatically operated Euroshield sliding equipment door, measuring 2.1 m x 2.4 m, features a flush sill to facilitate push button entry/egress
- Hybrid absorber treatment on all wall and ceiling surfaces
- Chamber designed for certification with normalized site attenuation per FCC, Part 15, 3 m measurements
- Testing capability in accordance with IEC 61000-4-3, EN 50147-2 and ANSI C63.4 from 30 MHz to 18 GHz for automotive EMC radiated emissions and immunity testing
- Meets CISPR 25 automotive component test requirements

## About ETS-Lindgren

ETS-Lindgren is an international manufacturer of components and systems that measure, shield, and control electromagnetic and acoustic energy. The company's products are used for electromagnetic compatibility (EMC), microwave and wireless testing, electromagnetic field (EMF) measurement, radio frequency (RF) personal safety monitoring, magnetic resonance imaging (MRI), and control of acoustic environments.

Headquartered in Cedar Park, Texas, ETS-Lindgren has manufacturing facilities in North America, Europe, and Asia. Additional information about ETS-Lindgren is available at www.ets-lindgren.com. Additional information about ETS-Lindgren's parent company ESCO and its subsidiaries is available at www.escotechnologies.com.

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## An RF Chamber for Evaluating Automotive Components and Systems

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Though some people fondly remember the days when automobiles had relatively few electronic components and a disabled vehicle could often be fixed with nothing more than a wrench; the fact is that today's cars and trucks are safer, more fuel efficient, and significantly more reliable than their purely mechanical ancestors. Electronic systems enhance the performance of the engine, transmission, steering and brakes - while helping to keep the driver alert and informed. New vehicles rely on dozens of microprocessors and miles of wiring to meet stringent government standards for safety and fuel economy, while also satisfying various consumer requirements for comfort, convenience and style.

Integrating dozens of electronic systems in the confined space of an automobile along with a growing number of RF transmitters and receivers for communications, navigation and entertainment presents a considerable electromagnetic compatibility challenge. So when Clemson University was setting up their International Center for Automotive Research (CU-ICAR) in Greenville, South Carolina, the ability to make EMC-related measurements was a high priority. The design of this facility, however, presented some unique challenges. For example, university research often requires highly accurate measurements of well-defined sources under tightly controlled conditions. Commercial automotive EMC tests on the other hand, require a wide variety of test equipment and environments. Furthermore, the devices under test in automotive applications range from small electronic modules a few centimeters long weighing a few ounces to vehicles that are several meters long weighing over a ton. The operating frequencies of automotive systems range from DC to tens of GHz. Clemson needed to design a test facility capable of performing the widest possible range of automotive EMC tests with a limited budget and a fixed amount of space.

The original plan was to devote more than two thirds of the 50' x 30' electronics lab floor space to an RF chamber large enough for full vehicle testing. However, it soon became apparent that it was desirable to perform many measurements outside the chamber and that the extra space inside the chamber would not be well utilized. Clemson University worked with ETS-Lindgren to design a 22' x 30' chamber that required less than half of the available lab space, but was still large enough to hold a mid-sized car. This chamber is a modified version of standard 3-m EMC test chamber with a reinforced floor and a large air-driven sliding door. The chamber is sunk into the floor of the lab so that the raised metal floor of the chamber is level with the concrete floor in the lab.

Clemson worked with a variety of test equipment vendors to come up with a list of antennas, analyzers, amplifiers, cables, probes and test fixtures to support the testing of greatest importance for automotive research. Specific equipment required for tests relevant only to certain automotive OEMs was not purchased. Instead, more flexible test equipment capable of simulating a wider variety of test conditions was chosen. Although some of this test equipment is more expensive than the application specific equipment it replaces, the overall equipment costs were significantly below what it would have cost to support all possible automotive EMC test procedures. As a result, the Clemson facility will be capable of simulating the conditions of most commercial automotive EMC test procedures while also supporting FCC and CISPR EMC tests, antenna measurements, model validation and research projects at frequencies from DC to several GHz and higher. All of this at a cost of just under $1.5 M USD.

Electronics and effective electronic systems integration will be a key factor affecting the success or failure of automotive companies in the coming years. An ability to make accurate and meaningful EMC measurements can make a tremendous difference in the cost and reliability of automotive systems.

### For more information on the EMC Chamber:

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