

dyne is integrating the 900 Series ESS into a test system with direct electric motor drive capable of 0 - 8000 RPM speed changes in 2 seconds as well as providing torsional test capabilities. The final assembly will be installed in an acoustic thermal chamber.

### Biaxial Shake Table for RPI

Rensselaer Polytechnic Institute (RPI) was awarded a grant through the NEES consortium to upgrade their uni-axial geotechnical centrifuge shake table to a bi-axial model. PVL Enterprises, in conjunction with Team Corporation, was awarded the contract to develop the new shake table design. Building upon Team's long experience with centrifuge shake table actuators, PVL designed a table with simultaneous excitation in both the x and y-axes that is compact, powerful and has very high frequency response. Team's proven actuator design, utilizing our patented Integrated Actuator technology incorporating hydrostatic bearings and our Voice Coil Servo Valve, is the key design element. With controllable frequency response to 400 Hz and force ratings exceeding 11,000 lbf, the resulting table is only 1.0-m x 1.2-m in size. This state-of-the-art centrifuge shake table is an important addition to research institutions investigating the effects of earthquakes on large earthen structures and building foundations.

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work directly on the inside faces of a light-weight magnesium alloy 'cube' on which the test table is mounted.

This system eliminates the linkages that can reduce performance in traditional systems and allows test inputs that are significantly more representative of real-world conditions. The system also allows a low background noise level, helping facilitate squeak and rattle assessment.

Test cycles will typically be derived either from usage simulation on Millbrook's range of global terrains or from the vehicle manufacturer's own data. Test pieces can be instrumented with sensors in the chamber exactly as they were in the test vehicle, providing confirmation that the laboratory systems are accurately simulating real-world input. If significant deviation occurs, maybe due to fatigue of a component, the test can be stopped automatically by the control systems.

*The content of this article was contributed by Millbrook. If you have an interesting application featuring Team products and would like to be featured in our newsletter, please contact Clyde Harman at : [Clyde.Harman@teamcorporation.com](mailto:Clyde.Harman@teamcorporation.com)*

### Next Issue...



Korea Automotive Technology Institute receives a Team MANTIS, our new, high performance 6-degree-of-freedom multi-axis shaker table.

**Nuclear** (Continued from page 2) lar system has flat acceleration response to better than 150 Hz, exceeding the required bandwidth by 50%. Smaller systems of the same design have demonstrated a frequency bandwidth approaching 500 Hz.

### Team announces Annual Sales Award

Team Corporation's Sales Manager, Clyde Harman announced the winner of Team's Annual Sales Award recently. "I was pleased to extend our congratulations and praise to Mick Burt for his sales efforts during our last fiscal year. Mick's efforts went a long ways in helping us work toward our sales goals," said Harman. Burt, the Director of Team UK, is headquartered in Saint Leonard's on Sea, England and responsible for all of Team's European sales efforts.



Mick Burt (right), Team UK's Managing Director receives Annual Sales Award

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# Team News

Volume 2, Number 3

## Nuclear Qualification Test Systems

Qualification testing for various components used in nuclear power plants is governed by a variety of standards. One of the most common is IEEE-382, which defines a variety of vibration tests including single and multi-axis excitation. Team Corporation has designed and built a family of systems that satisfy these stringent test profiles plus offers the customer extended frequency bandwidth for added testing capability.

The tests defined by IEEE-382 are divided into two broad categories, Vibration Aging and Seismic Simulation tests. Vibration aging is a test program recreating the normal plant induced vibration which includes system operating transients and other dynamic vibratory environments. Seismic simulation tests are designed to demonstrate equipment operability during and after exposure to the dynamic effects of an earthquake that could reasonably be expected to occur at the plant site. The table on page 2 lists the variety of tests and test levels that are required.

Team Corporation's designs are unique as the reaction mass, with effective air isolation down to 2 Hz, is an integral part of the system. This approach offers significant advantages to the customer; no facility disruption is required to build a poured-in-place concrete mass and acceptance testing can be performed in its entirety at the factory, fully



Biaxial Shaker System for IEEE-382

demonstrating the system's capabilities.

The design is centered on Team's patented **Integrated Shaker** to produce the required excitation and hydrostatic bearings to react off-axis motions. A single actuator, mounted under and parallel to the table top's longitudinal axis, produces horizontal excitation. Any tendency for the table to roll or yaw is

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## New Orders...

### Engine Valve Actuators

Team Corporation recently received orders from General Motors and Robert Bosch Corporation for automobile engine valve actuators. The actuators, originally developed by Team for Stanford University 2 decades ago, are used by engine manufacturers to study variable valve timing and valve lift profiles.

### 2 Hydrashaker Systems for Samsung

Samsung Electronics recently ordered two vertical Hydra-shaker systems for facilities in Korea and Thailand. These high-performance systems feature Team voice coil servovalves for high frequency operation, 1.2 m tables with integral damping, low frequency isolated reaction masses and PC-based vibration control software for random and sine testing.

### T-Film Slip Table System for Europe

A major aerospace engineering and testing firm in Europe recently purchased a 1 m T-Film slip table system for testing payloads up to 4000 kg at accelerations up to 50 g. The custom table features an extended drive adapter to reduce the electro-magnetic field produced by the electro-dynamic shaker at the test specimen location.



### First Order

Team Corporation recently received an order for the first production unit of the TENSOR(tm) high-frequency six degree-of-freedom vibration test system. The order came from a major global automotive electronics manufacturer.

Introduced in June of this year, the TENSOR is a multi-degree of freedom vibration testing module that is configurable for either 3 or 6 degree-of-freedom vibration testing applications up to 2000 Hz. TENSOR can be used with either electro-dynamic or servohydraulic exciters depending on the application. Additional information about the TENSOR can be found on-line at <http://www.teamcorporation.com>.

"This order, coming so quickly after



the TENSOR's introduction, validates Team Corporation's strategy to offer the most comprehensive range of multi-degree of freedom vibration test systems available," said Bob Tauscher, President of Team Corporation.

TENSOR joins Team Corporation's CUBE(tm) and multi-axis shaker table products to provide a comprehensive range of multi-degree of freedom vibration test solutions for applications requiring frequencies up to 2,000 Hz.

Vibration Aging			
<b>Swept Sine</b>	Single axis	5 to 100 Hz	0.75-g not to exceed 0.025 inch DA
Seismic Simulation			
<b>Swept Sine</b>	Single Axis	2 to 35 Hz	24 ips from 2 to 8 Hz then 3.1-g to 35 Hz
<b>Sine Beat</b>	Single Axis	1/3 octave from 2 to 35 Hz	36 ips from 2 to 8 Hz then 4.7-g to 35 Hz
<b>SRS from an Acceleration Time History</b>	Bi-Axial	3 Hz to 60 Hz	5% damping, max SRS level 9-g from 3 to 10 Hz decreasing to a ZPA of 3-g 40 Hz to 60 Hz

Table 1: IEEE-382 Test Requirements

**Nuclear** (Continued from page 2)  
reacted by an array of hydrostatic bearings located on the sides of the reaction mass enclosure. These bearings provide an extremely high level of rotational moment control, compensating for dynamic response of the test article and/or an eccentric center of gravity. Two similar actuators are mounted vertically under either end of the table, providing vertical excitation and dynamically reacting pitch moments. With this arrangement of actuator and bearing

elements, it is possible to produce pure linear translation in the longitudinal and vertical axes, either singly or simultaneously.

Team delivered the system shown on page 1 to Saehan Engineering and Qualification in Korea. With a specimen mounting area of 1.5 meter by 2 meter and a designed payload capacity over 300 kgs., this system permits complete IEEE-382 vibration testing of dimensionally large test objects. This particu-

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## Second CUBE shakes up traditional testing

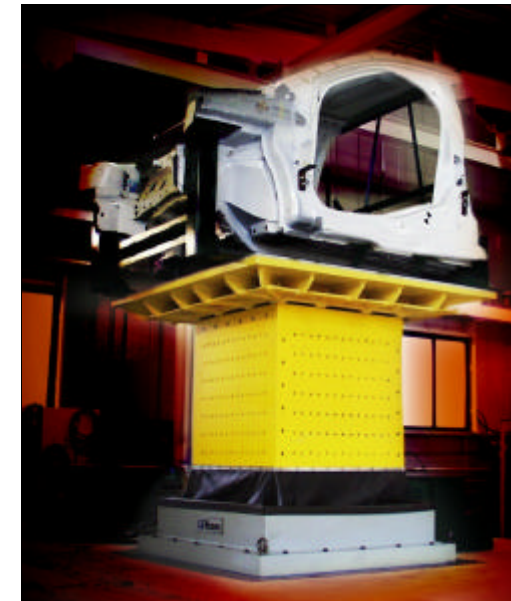
A second Cube™ has been installed at the Millbrook test and development centre in Bedfordshire (UK). The new test system, manufactured by the Team Corporation, allows components from cup-holders to complete front-end modules to undergo accelerated whole-life testing under controlled laboratory conditions.

"It typically takes us no more than two weeks to reproduce the entire life of a vehicle, equivalent to 150,000 customer miles with the complete range of surfaces and climatic conditions," says Ellis Wilkinson, Head of Millbrook's System Test Laboratories. "This is undoubtedly the way forward to help vehicle manufacturers and their suppliers reduce costs, increase quality and shorten time-to-market."

The first Cube, installed in 1999, has proved extremely successful. "The one thing that has surprised us is the very high proportion of work that has come from first tier manufactures," comments Wilkinson. "They are taking increasing responsibility for validation against lifetime targets, so our ability to simulate ever aspect of usage, including the module interfaces, is tremendously important to them."

Millbrook's second Cube provides full environment simulation including temperature, humidity and infra-red heat loading, with UV ageing due soon. Structural isolation from the laboratory is provided by a 45 tonne seismic block. Investment in the two Cubes and complementary test systems now exceeds £1 million.

"One of our goals for the new Cube was to greatly increase the amount of data that can be derived from each test," adds David Brooker, System Test laboratory manager. "We have paid particular attention to integrating the testing of sub-systems, for example by allowing the operation of the glove-box, ashtrays and cup-holders during Instrument



Team CUBE Installation at Millbrook.  
(Photo courtesy of Millbrook)

### Panel tests."

Another complementary procedure developed by Millbrook uses a binaural head to provide objective and subjective evaluation of squeak and rattle. Engineers can listen to the noises generated by the system in as-new condition and again at different points in the test to evaluate degradation throughout the vehicle's life.

In one extreme test, Millbrook designed a system that would circulate water at 1200C (with pressure pulses) around the cooling circuit of a front end module, control a typical pressure cycle for the air conditioning condenser and blow variable temperature air across the under-hood area of the module to simulate airflow and engine heat.

Millbrook operates as an independent vehicle test and development centre with the most comprehensive range of tracks, calibrated hill routes and laboratories available anywhere in the world. Specialist sectors include whole-vehicle durability, powertrain, safety, component and systems test, NVH, emissions and alternative fuels engineering.

The Cube takes its name from the innovative mechanism that allows it to operate at frequencies up to 250 Hz – significantly higher than the 50-60 Hz of previous generation systems. High-frequency servo-hydraulic actuators

(Continued on page 4)

## DTE integrates Team R-10 Rotary Actuator

Team recently delivered a rotary actuator to Ohio based DTE for integration into an engine damper test system. The test requirements were for a constant displacement of .3 degrees double amplitude over two different frequency ranges for two different test articles. The first was 0 to 80 Hz with a 600 lb-in<sup>2</sup> test specimen and the second was 0 to 450 Hz with a 50 lb-in<sup>2</sup> test article. Team was able to provide a cost effective and timely solution using our V50 voice coil driven servo-valve and a modified R-10 rotary actuator.

## New Product Design for Europe

Team, working with our French agent and distributor Actidyn Systemes SA, is supplying a newly designed version of its 900 Series Engine Simulation System (ESS) to PSA. Team's 900 Series ESS has been used to accurately simulate the torsional pulsations seen in the crankshaft of gasoline and diesel engines for over 15 years. Based on Team's proven spinning rotary actuator, the 900 Series ESS is used to study the effects of dynamic torque loads on engine driven components and systems. The ESS reaches speeds typical of today's engines and provides realistic test conditions for engine driven components and systems. Until now, while the rotary speed capability was inclusive of modern engine RPM ranges, the ESS did not provide for high amplitude RPM changes. Acti-