

New Orders...

Team recently received an order from **Advantage R&D** of Houston, Texas for a **dual-shaker system** for testing oil drilling tools to very high acceleration levels. The system layout is such that the tools can be tested across the front of the 'T'-shaped working area in the X axis, then rotated and tested in the Y axis. Finally, the tool is rotated 90° on the center of the slip plate and tested in the Z axis.

The **Korean Automotive Technology Institute (KATECH)** recently placed an order with Team Corporation for a 6 degree of freedom **multi-axis shake table (MAST)** system. Featuring a 5 ft. X 7 ft. table and 6 inches of stroke in each axis, the table will be used for a variety of automotive test applications. The system incorporates many unique features including zero-backlash, hydrostatic couplings.

Weapons System (Continued from page 3)
out in the field and record the actual conditions and then return to the lab and replicate those same conditions repeatedly. Because the CUBE is located indoors, the RTTC is able to replicate the field conditions without external variables such as individual driver, vehicle speed, or weather conditions.

To record the actual vibration in the field, a ruggedized portable data acquisition system including a portable PC computer is used. Acceleration time histories are recorded on instrumented test vehicles that are driven over various road surfaces at the RTTC test track. This data is analyzed, reduced, and digitized using the multi-axis test system controller. This data is then used by the test engineers to reproduce, in the laboratory, the same conditions seen on the test track.

GlobalSpec.com Showcases Team's Products

Team Corporation actively updates and expands its web presence both through Team's own web site, www.teamcorporation.com, and by showcasing products on GlobalSpec.com.

GlobalSpec leverages the Internet, searchable database technology, and engineering specifications to provide extensive search capabilities for engineers and technical buyers worldwide.

In a recent survey conducted by GlobalSpec, they reported that if technical buyers and engineers aren't using the Web or a search engine to find technical products and services for their projects, they could be at a competitive disadvantage.

Approximately 800 recipients responded to the survey with 92% of the survey respondents stating they use the Internet to obtain product specifications.

Oil Column (Continued from page 2)
nant frequency is given by:

$$F_n = (K/M)^{1/2} \div 2\delta$$

The spring rate K for the actuator is calculated as:

$$K = 4A \cdot \text{Area}^2 \div \text{Trapped Volume}$$

Where B is the bulk modulus of the oil. This natural frequency is usually called the "oil column resonance".

Looking carefully at the spring rate equation, one sees that as the trapped oil volume increases, the spring rate goes down. Stroke has a very large influence on trapped volume, so short stroke actuators inherently have higher oil column resonances than long stroke actuators with the same force and load mass. The significance of the oil column resonance is that of all classic second order systems: the output/input transfer function rolls off at frequencies above F_n . To overcome the roll off, the valve must supply increasing amounts of oil to achieve the same force output. At some point, the valve ceases to be able to deliver the increased flow required. Therefore, the force output falls off at the frequency where the valve can no longer supply the needed oil.

Team's two stage, voice coil driven servo valves are recognized worldwide as delivering full flow to the highest frequency of any production valve. This fact results in Team servohydraulic actuator systems delivering higher force levels at higher frequencies than any other comparable system.

Engineered
vibration testing
solutions for
improved
product quality.

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Team News

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TENSOR™

The Next Generation of High-Frequency, Multi-Axis Vibration Testing

Team Corporation sets the standard again with the introduction of the TENSOR™ high-frequency, multi-axis vibration testing system. Incorporating Team's advanced hydrostatic bearing technology, the patent pending device provides a zero-backlash, multi-degree-of-freedom platform for use with either electrodynamic or servohydraulic shakers.

"TENSOR™ is the next generation of multi-axis vibration testing," says Clyde Harman, Team Corporation Sales Manager. "It is an extension of Team's 40 year legacy of being at the forefront of multi-axis testing."

It has long been recognized that testing in all axes simultaneously provides a more realistic representation of actual field conditions. The design of a mechanism capable of reproducing the needed frequency bandwidth has been a major hurdle in furthering the widespread acceptance of this mode of environmental test. For over 40 years, Team Corporation has been in the forefront of developing useful multi-axis systems, robust in design and high performance in capability.

TENSOR™ can be configured for tri-axial excitation (translation along each of three orthogonal axes) or full 6 DoF excitation (three translations and three rotations). The customer is offered a choice of exciter; Servo-hydraulic actuators have superior power density to cost ratio while Electro-dynamic shakers provide a wider frequency bandwidth with more lin-



Team TENSOR™ Multi-axis Test System

ear behavior.

TENSOR™ follows in the footsteps of Team's highly successful CUBE™ product which was introduced in 1992 and now has over 20 installations worldwide. More information on TENSOR™ is available at Team Corporation's website, www.teamcorporation.com.

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Other News... Engine Valve Actuators

Team Corporation recently delivered two engine valve actuators to a major U.S. automaker. These actuators are used to study variable valve timing in pursuit of economy and performance. These units are the latest in a series of engine-valve actuation system designed and manufactured by Team over the last 20 years.

Large Slip Table

The Physics Department of the University of Perugia located in Terni, Italy recently took delivery of a large, 2.1 m X 2.1 m T-Film(tm) Slip Table system. The slip table will be used by Lockheed-Martin Corporation for testing of space-bound systems and then be permanently installed at the University.

Table-top Seismic Simulator

The Department of Geology at Eastern Washington University located in Cheney, Washington is the recipient of a Team Table-top Seismic Simulation System. The department plans to use the equipment to further their study of the formation of MIMA mounds and to do other research.

Multi-Axis Testing Seminar

Team Corporation is pleased to announce a one-day, educational seminar covering Electrodynamic and Servo-hydraulic Multi-axis Vibration Testing. This seminar will be held in the Fall of 2002 at two locations: Detroit, Michigan and the Washington D.C. area. Opening with a continental breakfast, the seminar will present a number of qualified speakers discussing the history, current practice and future trends in multi-axis testing. Opportunities to discuss the presentation topics with the presenters and other guests will be

available during the morning and afternoon coffee breaks or during the Team-hosted luncheon. An open discussion period will also be available at the end of the presentations. Each attendee will be provided with a bound copy of the proceedings.

At this time Team is polling potential attendees to ensure adequate facilities in both locations. Details for registration and a speaker list will be available in August 2002. There will be a nominal charge.

Please respond by visiting our website, www.teamcorporation.com, and indicating your interest. You may also download the registration form at the same address and fax it back to Team.

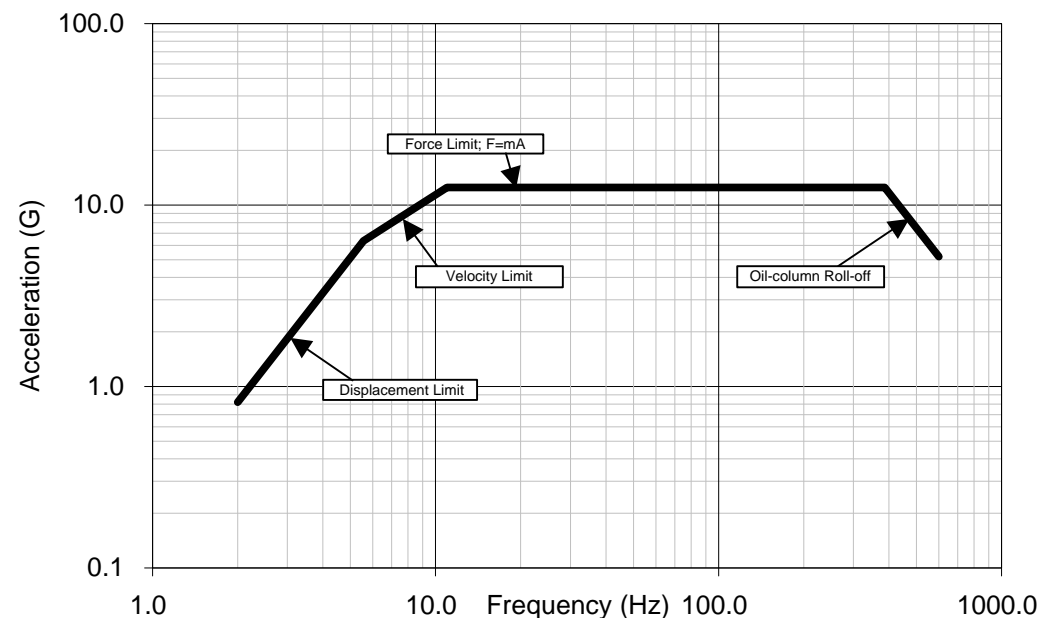
Oil Column Resonance De-mystified

The hydraulic shaker sine force (or acceleration) vs. frequency curve is defined by various physical constraints. At low frequencies, the physical stroke limits the sinusoidal acceleration. At some higher frequency the velocity capability of the shaker limits the sine acceleration. As frequency goes up, the velocity needed for a specific acceleration level goes down, and Newton's law $F=ma$ comes into effect. The hydraulic shaker is a physical system and at some still

higher frequency, the valve and hydraulic system dynamics conspire to limit the flow available to the actuator, rolling off the acceleration capability with increasing frequency.

To understand hydraulic system dynamics, one must recognize that oil is far from the theoretical "incompressible" fluid. It is compressible, and the compressibility for hydraulic oil is called the Bulk Modulus. It is effectively about 175,000 lb/in². This means that the oil trapped between the servo valve and the piston is compressible, and the complete actuator with a load mass on the piston can be analyzed as a second order spring-mass system whose reso-

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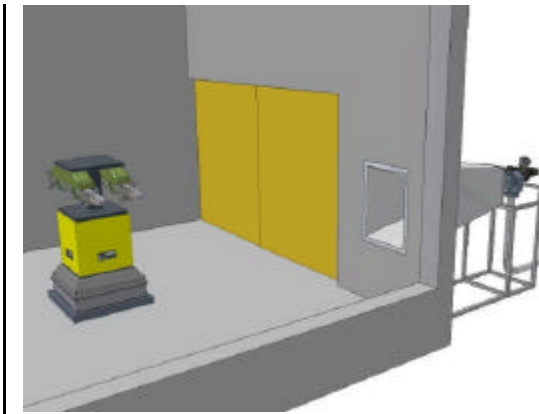


Multi-axis Testing of Under Wing and Ground Vehicle Weapons Systems

High frequency multi-axis testing-controlled vibrations in all six degrees of freedom at the same time-has become the latest tool used by the U.S. military for problem solving. This type of testing allows the test engineer the most realistic duplication of the vibration environment, resulting in the ability to reproduce field observations in the laboratory, quickly solving his specific problem.

The U.S. Army Redstone Technical Test Center (RTTC) is interested in the performance characteristics of different weapons systems during their life cycle. Some of the weapons to be tested are mounted under the wing of an aircraft; some are mounted on ground vehicles. While these environments are very different from each other, both need to be addressed using multiple degrees of freedom vibration to replicate "real-world" conditions. In addition the life cycle conditions of the Under Wing Weapons Systems require a combined environment of multi-axis vibration with high intensity acoustic noise.

To address the multi-axis vibration replication, RTTC selected Team Corporation's CUBE® multi-axis vibration test system. To generate the high intensity acoustic noise, a Team Corporation 150 kW Mk VI.2 Acoustic Modulator was chosen. The Mk VI.2 generators have been installed at several military and defense related test facilities throughout the world. In most cases, the high intensity acoustic facilities are single-purpose facilities with no vibration capability. A few installations utilize the Mk VI.2 in a combined environment with single degree of freedom vibration test systems. However, the installation at RTTC is the first of its kind to use the CUBE® multi-axis vibration test system and the Mk VI.2 acoustic generator together (see Figure 2). This combined environment allows the test engineers to more accurately reproduce the in-flight conditions



Team CUBE installed in reverberant chamber with Team Acoustic Modulator on right.



TEAM CUBE testing ground-vehicle weapon system.

in the testing laboratory.

With the Mk VI.2 coupled to the large reverberant chamber that is installed at RTTC the system can produce overall sound pressure levels (OASPL's) in excess of 160 dB. Using a "White Noise" generator and 1/3 octave spectrum filters the spectrum can be shaped according to MIL-STD 810D specifications.

To best simulate the environment that ground vehicle weapons systems must tolerate; RTTC must perform these same types of tests. As weapons are carried on military vehicles such as tanks or Armored Personnel Carriers they will experience vibrations very similar to a typical off-road vehicle. For military vehicles there are times when there are severe low frequency, large displacement motions combined with the typical rough road motions. Another vibration unique to military vehicles happens during live firing of the weapons. The weapons system see an intense momentary torsional vibration during the live fire test. With the CUBE® 6 degree of freedom test system, RTTC can go

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New Orders...

Team Corporation recently received an order from Saehan Engineering for a bi-axial seismic test system. The system, incorporating a 1.5 meter square table, will be used to perform IEEE 344 and IEEE 382 tests on payload up to 300 kg.

Samsung has ordered dedicated horizontal and vertical vibration test systems for testing of their air conditioning products. The systems are being supplied complete with controls, air-isolated reaction masses, and sound-insulated hydraulic power unit.

Adding to the number of NEBS GR-63 installations completed by Team, Alpha Technologies, a major power supply manufacturer in the U.S. has purchased a NEBS GR-63 Seismic Test System from Team. Capable of performing 100% of the vibration tests for NEBS GR-63 qualification, the system is scheduled to be installed in October of 2002.

The University of Leuven recently purchased a Team CUBE for their Department of Mechanical Engineering. The system will be installed in late 2002 with IST-supplied control electronics and software.