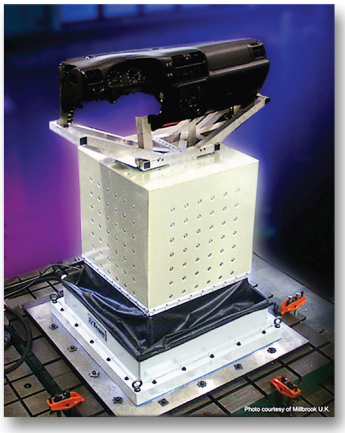
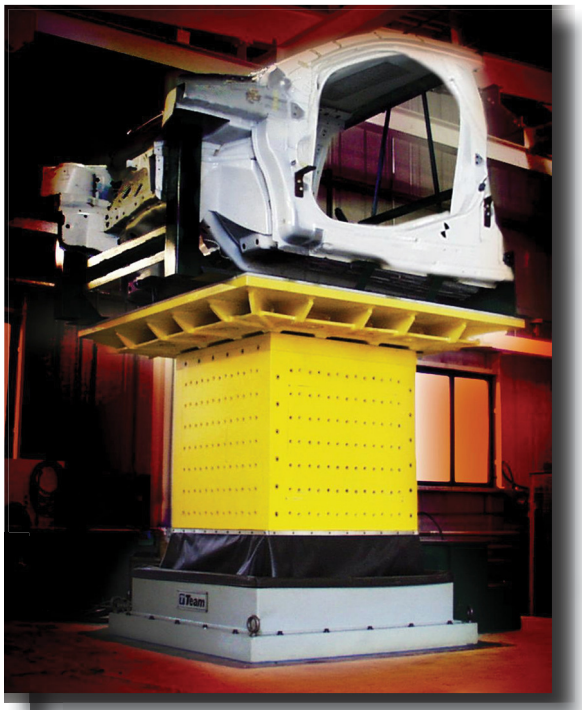
Team
Vibration Testing Equipment

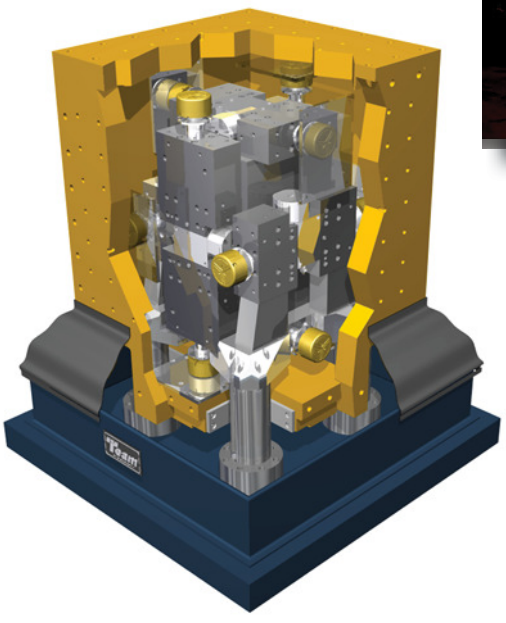
Systems & Solutions

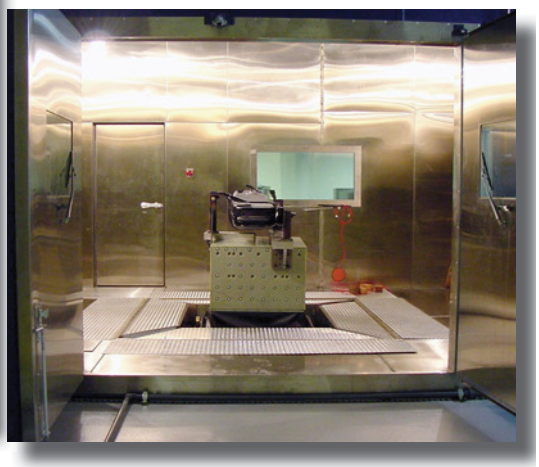
CUBE™
Vibration Test System

6 Degrees of Freedom for Testing Realism









Engineered vibration testing solutions for improved product quality.

***Team* Corporation**
11591 Watertank Road
Burlington , WA 98233
Tel: (360) 757-8601
Fax: (360) 757-4401
sales@teamcorporation.com
www.teamcorporation.com

***Team* Corporation UK**
***Team* Corporation UK Ltd**
11 Old Ladies Court
High Street
Battle
East Sussex
TN33 0AH
United Kingdom
Tel: +44 (0) 1424 777004
Fax: +44 (0) 1424 777005
sales@teamcorporation.co.uk
service@teamcorporation.co.uk
www.teamcorporation.co.uk

Team Corporation´s CUBE™ is a Proven Performer, Providing High Frequency Full 6 DoF Excitation.

The ability to accurately reproduce field conditions is essential for efficient utilization of laboratory time. Product development and validation demand a proven test platform, where durability and reliability are key characteristics. *Team* Corporation is a recognized pioneer in the development of multi-axis test systems. The CUBE™ is the culmination of over 35 years of multi-axis test system design, incorporating lessons learned in the development of the world's most versatile test systems.

Team Corporation is focused on the development of vibration test systems. Our heritage extends from the 1950's and includes the design of some of the world's first multi-axis test systems. With the introduction of the CUBE™ in 1994, *Team* Corporation continued to set the standard for high performance 6 DoF test systems.

Our multi-axial test systems have been delivered to leading companies in the United States, Europe and Asia, with over 30 installations in operation today. Since introduction, 23 companies have selected the CUBE™ as the system of choice for its high frequency capability, ease of integration into an environmental chamber and demonstrated superiority in design. In fact, the first delivered CUBE™is still in operation daily at Ford's Vehicle Vibration Simulation (VVS) Laboratory.

Versatility is a primary feature of the CUBE™. Optional stroke lengths are offered. Various table configurations are available. A thermal protection package permits the CUBE™ to be used in environmental chambers. Requiring only 16 square feet of floor space allows installation in tight quarters. Yet, payloads weighing over 2,000 lbs. have been successfully tested on the CUBE™. Test objects can be mounted on the sides of the CUBE™ if desired, easing fixturing and more closely replicating actual installation conditions.

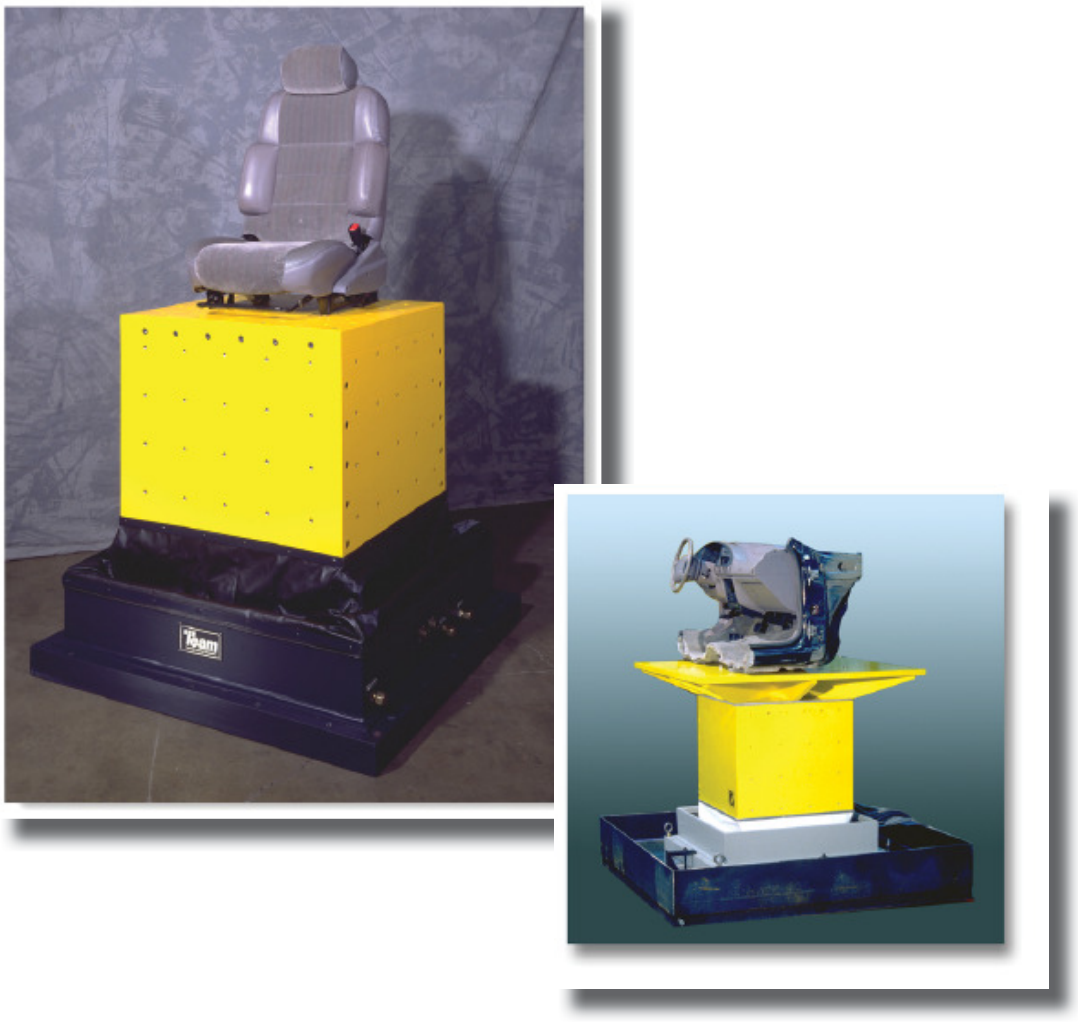
Custom engineering is a hallmark of *Team* Corporation. The CUBE™ can be tailored to meet virtually any testing requirement. A special version of the CUBE™ is used in an acoustic chamber where high energy sound plus 6 DoF excitation reproduce the buffeting of actual flight environments experienced by under wing munitions. An explosion-proof version of the CUBE™ is used for testing fuel systems, fully charged with gasoline. A newly developed CUBE™ cuts the already low noise level to a bare minimum, improving squeak and rattle evaluation of automotive sub-assemblies. A CUBE™ has been installed that can be repositioned in relation to a fixed mounting point through the use of an air-bearing under the base plate. These examples demonstrate the flexibility in application CUBE™ provides the customer, covering the widest possible range of testing needs for product development and validation.

A seismic test system nears completion. Team has designed and manufactured multi-axis test systems for a wide range of applications.

The CUBE™ permits users their choice of test controller options as well. The design of the CUBE™ does not limit the customer to a proprietary test controller. A demonstrated ability to operate with every multi-axis test controller on the market, including offerings by MTS, Data Physics, LMS, IMV, Spectral Dynamics and FCS-COM, ensures the best combination of application software and price. This versatility permits the customer to maintain commonality within the lab, reducing the time needed to bring operators on-line with new equipment. Additionally, some customers use inexpensive single axis vibration controllers to operate the CUBE™ in special applications.

System availability is essential to maintaining cost effective lab operation. High frequency vibration testing places severe stress on typical swivel connections used to attached actuators to the moving table. *Team* Corporation pioneered the use of hydrostatic bearings to eliminate this design weakness. In fact, the CUBE™ has hydrostatic bearings throughout, including the actuator rod and piston.

Installation of other table designs in a thermal chamber is complicated and adds an increased level of stress to test system components. With actuators fully enclosed within the table and a proven thermal protection package, installation in a chamber poses no extraordinary problem for the CUBE™. By eliminating the sources of the most common maintenance problems, the customer is assured a high level of system availability. When service is required, *Team* Corporation has a dedicated group of service engineers to address the problem quickly and effectively.



Simulating Real-World Conditions is Key to Compressing Test Schedules

Replicating real-world vibration conditions requires translation along the x, y and z axes as well as rotations around these axes. Six independent actuators are needed to produce this range of motion. The innovative design of the CUBE™ places all six actuators, plus the servo control valves, within the moving table structure. Besides reducing noise levels and shielding the actuators from environmental conditions, this unique, patented arrangement provides the user with direct control of each translation and rotation.

Replicating field conditions is recognized as critical to obtaining component and sub-assembly performance information. *Team´s* CUBE™ is designed to exactly reproduce recorded road data in the laboratory, with unprecedented frequency response and acceleration accuracy. Measured vibration inputs inside the passenger compartment of an automobile reveal significant content to over 200 Hz. Reproducing a broad frequency band is essential to simulating this operational environment

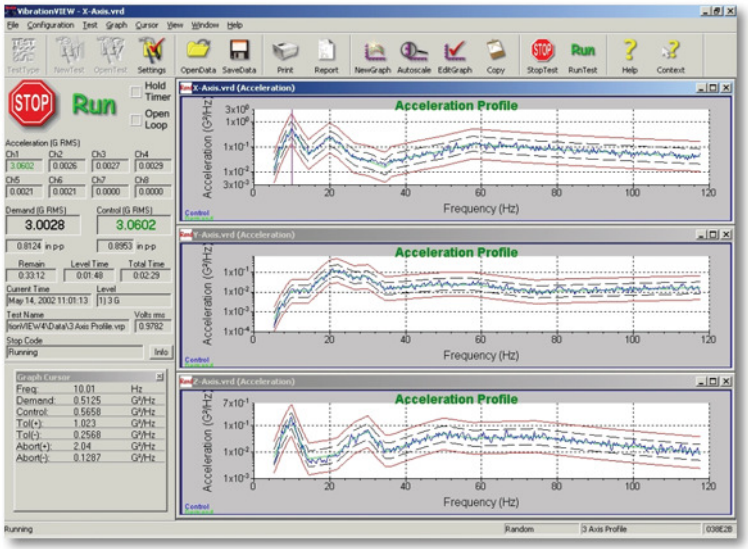
Range of Motion

An important aspect of this arrangement of actuators is the CUBE™'s capability to produce full range of motion simultaneously. For example, at full displacement laterally, the CUBE™ can also provide full displacement vertically and longitudinally. This subtle performance feature is not widely appreciated. Some designs of multi-axis test systems can only produce full displacement in each axis if the other two axes are stationary. An examination of typical recorded road data shows simultaneous displacements in each axis, even at the displacement limits. If a test system is unable to accommodate these motions, the test object will experience a lower level of input than is implicit in the recorded road data.

A wide variety of automotive components and sub-assemblies benefit from this flexible testing capability. These include seats, instrument panels, doors, fuel tanks, exhaust systems and others. Typical testing applications include a variety of excitation methods.

Simulation

Test data preparation involves the elimination of low-level portions from the recorded field data. The result is a compressed drive file exhibiting only the high energy transients produced on the test track. To be effective, the laboratory test system must be able to reproduce this compressed drive file, accurately tracking the rapid changes in displacement, velocity and acceleration over a broad frequency band. The CUBE™ is ideal for this application; the primary design criteria during the development of the CUBE™ were accurate reproduction of extreme field conditions.



Example of replication of an auto-spectrum to 120 HZ.

Random

Some test programs define a test profile using an auto-spectral density or PSD. Here, the laboratory test system must produce a Gaussian distribution of amplitudes which results in the proper combination of acceleration levels through a defined frequency band. The result is a statistically stable program that has proven effective and is used extensively in vibration testing.

Sine

Sinusoidal excitation is used to isolate resonances, accumulate damage at specific frequencies, or excite squeaks and rattles that are frequency dependent. The frequency and/or amplitude of the sine wave may be swept or dwelled to allow the user a flexible means of resonance identification.

Durability

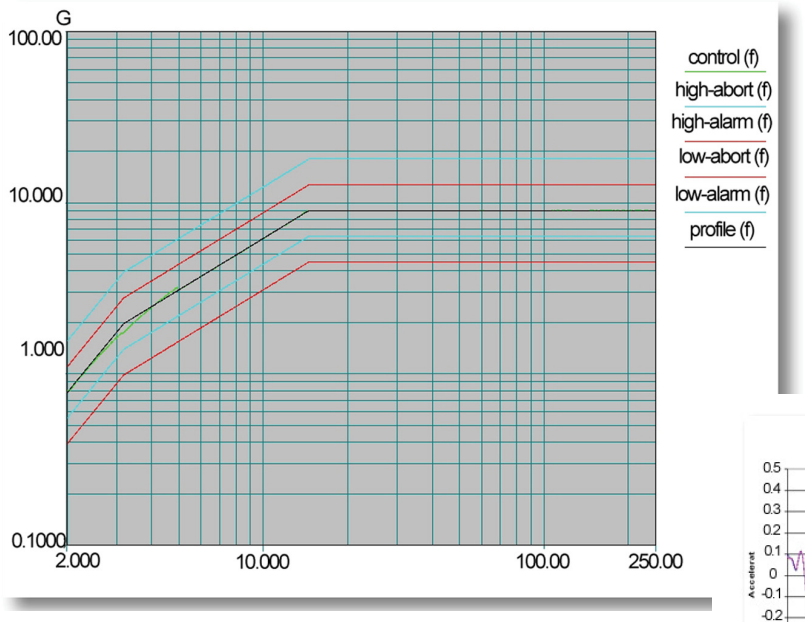
The CUBE™ is increasingly used to assess the durability of a wide variety of components and subassemblies ranging from fuel systems to seats, instrument panels and interior components. Test methods are usually based on simulation of multi-axis service conditions where maintenance of phase between the axes is important. However, the unique kinematics of the CUBE™ design offers the customer the ability to employ combinations of single axis motions where preservation of multi-axial phasing is not a consideration. Cycle or block cycle loading can be used where accelerated tests of simple components, like brackets need to be accomplished.

Noise and Vibration

Squeaks and rattles are a predominant indicator of subjective vehicle quality. The CUBE ™ is particularly well suited to investigate such noises. Caused by components either rubbing together or resonating, these noises are generally non-linear in nature, occurring at discrete frequencies or amplitudes. The ability of the CUBE™ to reproduce the excitation causing these noises makes it invaluable in their isolation.

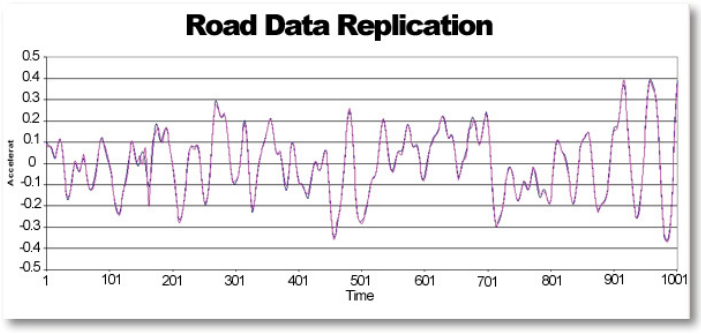
Ride Quality

Subjective evaluation of ride quality was the first application of the CUBE™ and remains one of its predominant testing applications. *Team* Corporation has a specific CUBE™ model designed to assist the study of human evaluation of ride quality. This particular design is carefully crafted to ensure test subject safety while providing the evaluation engineer a fully-capable test system.



Example of CUBE performing a full level swept sine.

Example of Road Data Replication showing Desired and Actual Response



Engineered for the Accuracy, Durability and Dependability Demanded by Test Professionals

System dynamics influence the performance of a multi-axis test system. Engineering a system that not only has the needed displacement, velocity, force and frequency response demanded by test requirements, but also is well damped and exhibits controllable behavior is a formidable task. *Team* Corporation designed the CUBE™ to meet these challenges.

Team Corporation, with over 50 years of design experience in vibration test systems, focused the development of the CUBE™ on dynamic behavior. The goal was to eliminate structural resonance within the operating band of the system. This ensures test results will not be influenced by system dynamics.

Team Corporation accomplished this task by designing a system to address customer requirements, not by revamping an existing design. The result is the CUBE™, a system that optimizes actuator placement, table stiffness and high frequency response.

The geometry of actuator placement eliminates the need for elaborate control schemes to produce pure translational motion. Reduced actuator length minimizes induced bending resonances and raises lateral stiffness. It also provides equal force in each axis, giving greater flexibility for test object placement. Finally, all six actuators are located within the dimensions of the table, greatly reducing the amount of valuable floor space needed to install the system.

The body of the CUBE™ is lightweight yet very strong. Payloads as massive as 2100 lbs. have been successfully tested. With deep cross-sectional dimensions, the CUBE™ body is stiff and resonance free within the performance envelope. Head expanders are available in a variety of configurations to increase payload mounting area. These head expanders are designed to the same standards as the basic CUBE™ body.

Evaluation of a multi-axis test system begins with an exploration of bare-table capabilities. But proof of system performance is only demonstrated by system response with a mounted test object. The influence of a test object on system response is considerable; changing the center of gravity affects performance levels and test object resonances will alter the dynamic behavior of the entire assembly. The robust design of the CUBE™ minimizes the effect of payload resonance and the innovative actuator placement keeps the center of gravity low in relation to the line of motion. These integral design features ensure the best possible reproduction of desired test profiles. They also contribute to the broad frequency response exhibited in actual test results.

Ford's VVS dual CUBE system for simulating the vibration response of a vehicle to recorded road data. Used for the subjective evaluation of ride quality.

Innovative Design, Meticulous Manufacturing and Attention to Detail are Hallmarks of *Team* Corporation

The CUBE™ is an engineered system, from patented actuators through purpose-built hydraulic power supplies. Every component is rigorously designed, modeled and manufactured to the highest standards, ensuring an unprecedented level of performance and customer satisfaction.

Integrated Actuator®

The key innovation to the CUBE™ was the development of a new actuator, one that is powerful yet compact, has frequency response well above anything on the market and incorporates all the features that have made *Team* systems synonymous with quality. The Integrated Actuator® represents a logical evolution of servo hydraulic actuator design. Covered by domestic and international patents, this flexible component has found application in many high frequency systems that define the state-of-the-art for servo hydraulic test systems.

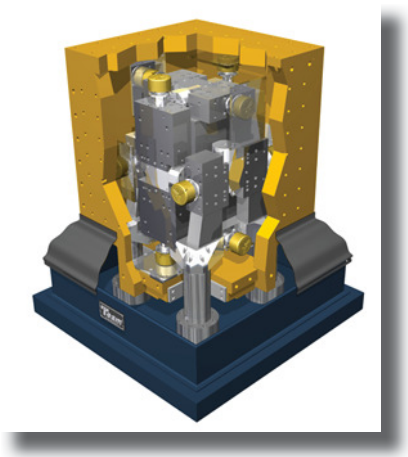
The Integrated Actuator® uses no dynamic seals; every bearing surface within the assembly is hydrostatic. Hydrostatic bearings are well-recognized as the best solution for supporting and transmitting loads in a vibration test system. They are remarkably stiff ensuring very high transmissibility of loads. By eliminating any metal-to-metal contact, no friction is produced and consequently no wear is generated on adjacent surfaces. For all intents, they can be considered to have infinite life. Requiring no periodic adjustment, maintenance is never required.

A fundamental limitation to servo hydraulic actuator performance is a phenomenon called “oil column resonance”. Dependent upon the trapped volume of oil between the actuator piston and servo valve, it constrains the upper limit of possible frequency response. The only way to raise oil column resonance, or raise frequency response, for a given actuator size is to minimize the trapped oil volume. The Integrated Actuator® reduces this trapped volume to a bare minimum by locating the servo valve directly between the actuator piston halves. This eliminates the long oil passages required by conventionally mounted valves. It also reduces the inertia of the oil column to flow, improving actuator response to changing velocity requirements.

Gas charged accumulators are needed for servo hydraulic test systems to attain short duration, high velocity transients. To provide the best response, the accumulators must be mounted as close as possible to the servo valves on each actuator. The CUBE™ has integral accumulators built into the internal structure with extremely short fluid paths to all valves. This ensures lag-free velocity response to command signals. Pressure gauges and charging ports for each of the pressure and return accumulators are conveniently located outside the CUBE™ for simple maintenance.

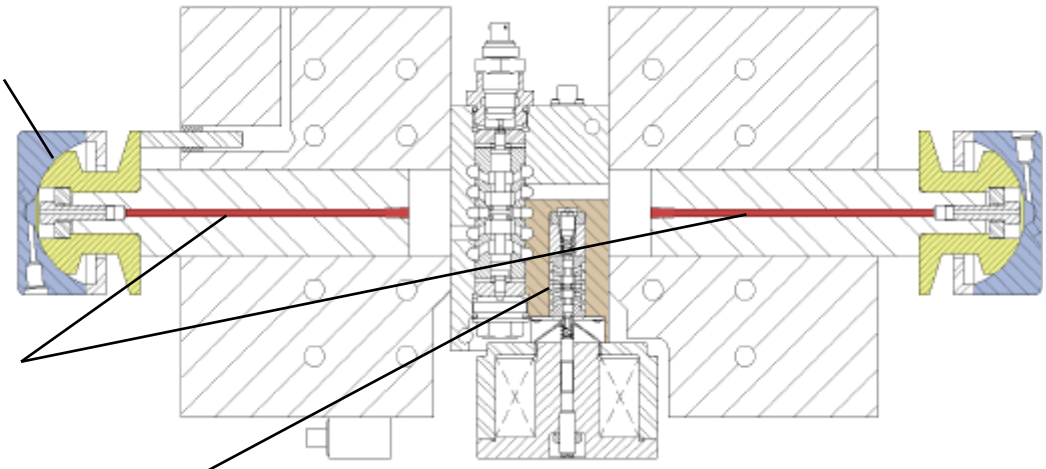
Hydrostatic Pad Bearing

Coupling the actuator to the moving table is perhaps the most problematic issue in multi-axis system design. The coupling must be free of backlash to prevent corruption of test data by rapid load reversals. Typical solutions on other



Integrated Hydrostatic Pad Bearing and Hydrostatic Spherical Bearing allow bi-axial rotation and translation at 90 degrees to the shaker axis.

The split actuator shaft ensures that both hydrostatic pad bearings are preloaded against the inside of the CUBE™ table structure, providing an extremely stiff connection between the actuator and the table.



Integrated Voice Coil servo-valve minimizes oil column and provides high frequency performance

Cross Section through *Team's* patented Integrated Actuator®.

multi-axis test systems use preloaded mechanical bearings. In order to function, these bearings have internal clearances which are minimized through an external preload clamp mechanism. If the preload is set too low, the result will be poor transmissibility of force and noisy operation. If the preload is set too high, large bending moments are transmitted to the actuator piston, resulting in accelerated wear. Correct preload is vital to system performance and must be checked prior to test initiation. Finally, mechanical bearings wear very rapidly in high frequency testing. This requires regular preload adjustment and an accelerated replacement schedule.

Team solved the inherent problems of actuator coupling by using a combination planar and angular bearing that is hydrostatic. Called the Pad Bearing, this device has all the beneficial features of a linear hydrostatic bearing, namely very high transmissibility of force, no friction and no wear. A pad bearing is located on each end of the Integrated Actuator®. The actuator design ensures each pad bearing is constantly kept in compression against the inside of the CUBE™ body, without any operator or software intervention. By remaining in compression, the hydrostatic film is always maintained, even under the highest inertial acceleration and deceleration events. Pad bearings never experience load reversals or tensile loading. This eliminates backlash, and therefore improves test results. Pad bearings require no adjustment and no maintenance, increasing system availability and reducing operational costs.

Reaction Mass

All multi-axis simulation tables are mounted on a large reaction mass to achieve their specified performance. The design of this mass is crucial to overall system response. A reaction mass must be dynamically stiff and well damped to avoid interaction between mass response and actuator function. The best way to ensure a stiff, well-damped reaction mass is to optimize its depth or thickness. Generally, such masses are constructed of steel-reinforced concrete, either mounted on air isolators or set on isolation mat.

With typical multi-axis simulation tables, the reaction mass becomes quite large and costly, since the area needed to mount the system is almost 4 times the moving table area or roughly 120 square feet. Consequently the amount of material increases rapidly with the large mounting area needed. In contrast, the CUBE™, with all actuators mounted inside the body, requires only 16 square feet of surface area to install. Therefore, reaction mass dimensions can be optimized for dynamic behavior with less construction material.

If test lab availability is important to the customer, *Team* offers an air-isolated steel reaction mass with integral constrained layer damping. This approach virtually eliminates facility shutdown for installation since the reaction mass

is set in place on a typical concrete lab floor. A steel mass is about 3 times as dense as concrete and has a better stiffness to mass ratio. This results in more ideal performance. An added bonus is the ability to relocate the entire system very easily as test facility requirements change.

Hydraulic Power Supply and Control Manifold

Trouble-free operation of any servo hydraulic system requires a supply of conditioned hydraulic oil. Valve and bearing clearances have critical tolerances and clean oil at a proper viscosity is vital for accurate operation. *Team* can provide the Hydraulic Power Supply (HPS) correctly sized for the application or the CUBE™ can be operated from an existing HPS.

Every CUBE™ is supplied with a Hydraulic Conditioning Manifold (HCM) which collects and distributes oil supply, return, and drain from the HPS to the CUBE™ and back again. Monitoring devices are interlocked with the valve controllers to shutdown operation if bearing pressure is lost. High/Low hydraulic pressure control and scavenge pump operation is included. A fully functional remote control is provided at the operator's station for HCM and HPS use.

Options

A wide variety of custom systems have been produced, including explosion-proof models, man-rated models, models for use in acoustic chambers, etc. The most common accessories to supplement the standard CUBE™ models are:

Thermal Protection Package

The CUBE™ is uniquely suited for use in an environmental chamber. The body of the CUBE™ provides a primary layer of protection to the actuators, valves and couplings. This protection is extended by the Thermal Protection Package (TPP).

The TPP consists of an internal manifold located inside the CUBE™ body and exterior insulation panels. The oil manifold provides a constant bath of conditioned oil over all actuator, valve and bearing mechanisms, modulating their temperature. No operator or software intervention is required for operation. The external insulation material, reinforced phenolic with very low heat transfer characteristics, moderates temperature fluctuations between the interior of the CUBE™ body and the ambient environment. It also reduces the heat load within the chamber by moderating the transfer of heat from the CUBE™ to test object and chamber interior.

One feature unique to the CUBE™ design is the ability to mount test objects on the sides as well as the top. This desirable feature can be retained when the CUBE™ is used in an environmental chamber. Where overhead clearance is not an issue, the CUBE™ can extend inside the chamber, with a diaphragm extending from the chamber floor to the base of the CUBE™ body. Alternatively to maximize interior space within the chamber, the CUBE™ can be installed with the top flush with the chamber floor.

With the TPP, the CUBE™ has been successfully operated through temperature range of -40 degree C to 150 degree C. Approximately one third of all CUBE™installations include thermal chamber operation.

CEH-60 Head Expander

The top surface of the standard CUBE™ is 32 inches square. This can be increased to 60 inches square by the addition of a head expander, the CEH-60. This unit is a bolt-on device designed and manufactured to the same exacting tolerances as the balance of the CUBE™ system. With a first resonance well above the operational limit of the CUBE™, the CEH-60 has minimal influence on system operation. It provides a stiff, well-damped mounting surface that can be supplied with a customer-specified pattern of threaded inserts.

Custom CUBE™ Installations Coupled with *Team* Engineering Expertise for Advanced Applications

Flexible in application, the CUBE™ is only limited by imagination. Several unique applications meet special needs, bringing the advantages of real-world simulation to unusual testing requirements. Some of these applications are listed below.

Vehicle Vibration Simulation System

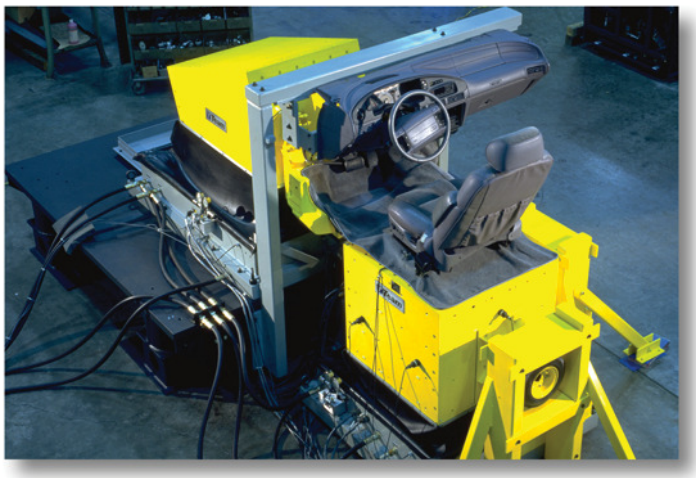
In 1992, the Ford Motor Company embarked on an effort to produce a complex test system to permit subjective assessment of ride quality. Their goal was the creation of a complete system that would precisely recreate the vibration environment experienced by the driver in different automobiles. After an extensive review of available test systems and evaluating proposals from several suppliers for new equipment, Ford selected *Team* Corporation to design, manufacture and commission the needed device.

The concept proposed by *Team* would produce full 6 DoF excitation of the seat, replicating actual road input felt by the driver. The steering column was proposed to have 4 DoF (vertical, lateral, pitch and yaw) to reproduce the tactile feedback of the road felt by the driver´s hands. Finally, a single actuator would supply the vertical input into the floor near the driver´s feet. All actuation devices would have the ability to operate individually or simultaneously.

A primary criterion was accurate reproduction of recorded road surface vibrations to a much higher frequency level than was possible with the current level of available equipment. Ford´s analysis of passenger compartment excitation revealed significant energy at frequencies exceeding 100 Hz. The CUBE™ proved to be ideal for this application.

The result is the Vehicle Vibration Simulation System (VVSS). The final configuration consists of a fully capable CUBE™ exciting the driver's seat, a second CUBE™ limited to 4 DoF providing the steering column input and a high frequency single-axis actuator attached to the floor pan. This arrangement has proven to be exceptionally accurate in replicating road surface vibration. Ford has shown that the background vibration level of the CUBE™ is below that perceptible by a human subject, ensuring subjective evaluation results are only due to the input signal, not to spurious energy from the test system.

The system has been in continual use since it's installation in 1994, providing the Ford Motor Company with an invaluable tool for developing ride quality metrics.



Vehicle Vibration Simulation System (VVSS).

The CUBE™ shown with with test article in acoustic chamber to simulate real-world sound and vibration environment of munitions mounted under wing.

US Army Redstone Arsenal

Simulating battlefield conditions that must be tolerated by munitions mounted on ground vehicles and aircraft is a very difficult task. Ground vehicles experience severe low frequency, large displacement motions simultaneously with typical rough road conditions. Mounted weapon systems also experience intense momentary torsional vibration during firing sequences. Underwing munitions mounted on aircraft are subjected to extreme acoustic conditions as well as severe 6 DoF vibration. A condition known as buffeting, occurring during evasive maneuvers performed at the edge of the performance envelop of the aircraft, add to an already harsh environment.

The Redstone Technical Test Center (RTTC) embarked on an ambitious effort to recreate these severe environmental conditions in a laboratory setting. The CUBE™ was selected as the centerpiece for this facility. Two CUBE™´s have been installed; one for ground vehicle motion replication and the second, installed in a reverberant acoustic chamber, is used to reproduce aircraft flight environments.

The unit dedicated to replicating ground vehicle vibrations has proven particularly adept at reproducing the severe rotational moments experienced during weapon firing. With this proven capability in the test equipment, RTTC initiated an entirely new program investigating the influence of rotational moments on optical sighting instrumentation.

Adding very high levels of acoustic energy to a 6 DoF vibration environment required placement of the CUBE™ within a reverberant chamber. The acoustic energy is supplied by a *Team* Mk VI.2 Acoustic Modulator. This device was developed in conjunction with Northrop Aircraft Division and has been installed in several military and defense related facilities. The Mk VI.2 can generate up to 150 kW of acoustic energy and permits spectrum shaping to match the requirements of various MIL standards. At RTTC, overall sound pressure levels exceeding 162 dB are routinely produced. The design of the CUBE™, with all actuators and valves fully enclosed with the body, provides protection from this acoustic energy and has proven to be ideal for the application.

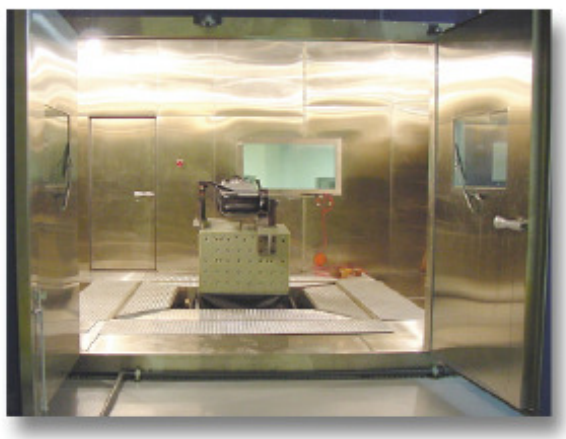
Visteon Fuel Lab

To improve the performance of automotive fuel delivery systems, Visteon initiated a program to expose an entire fuel system, from fuel tank through fuel manifold, to full 6 DoF road and engine vibrations. This ambitious project required the vibration system to meet or exceed the requirements of Class I, Division 2, Groups C&D of the NEC. Popularly known as “explosion proof”, these standards define the requirements to ensure safe operation in an environment potentially exposed to various fuel vapors. *Team* Corporation proposed a modified CUBE™ to solve this vexing problem.

The standards require purging an enclosed space where fumes may collect and where electrical components capable of generating a spark are located. The body of the CUBE™ encloses all electrical components that have this potential. A special diaphragm sealing the CUBE™ body to the test chamber was designed, as was an air purging system with pressure monitor. In operation, the interior of the CUBE™ is kept at a positive atmospheric pressure somewhat higher than ambient, ensuring no migration of potentially flammable fuel vapor. The pressure monitor maintains the pressure differential and shuts down all electrical power if the pressure differential is lost.

This unique adaptation of the CUBE™ permits Visteon to test potentially dangerous products in a safe and efficient manner. The modifications to *Team´s* standard CUBE™ design do not limit the functionality or performance of the system. No operator intervention is required for maintaining a safe testing environment. To our knowledge, this is the only such 6 DoF system in the world meeting the stringent requirements of Class I, Division II design.

The CUBE™ shown fitted with an air purging system for explosion proofing.



The CUBE™ mounted in a thermal chamber.

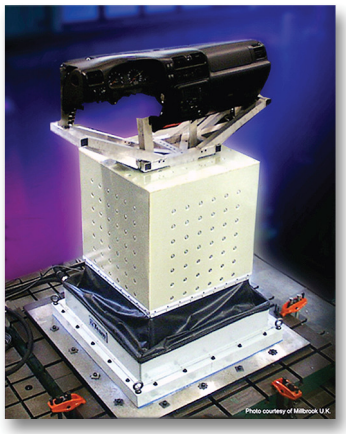
Millbrook Proving Grounds

Millbrook System Test Laboratory has created the ability to perform full system module life simulation by combining multiple environments into one test system. This environmental suite includes 6 DoF excitation, temperature, humidity, sun load and the exercising of mechanical and electrical features during the application of environmental stress. To design in high levels of new vehicle refinement at an early stage, squeak and rattle testing is conducted as part of the durability evaluation of full instrument panels, doors and seating systems.

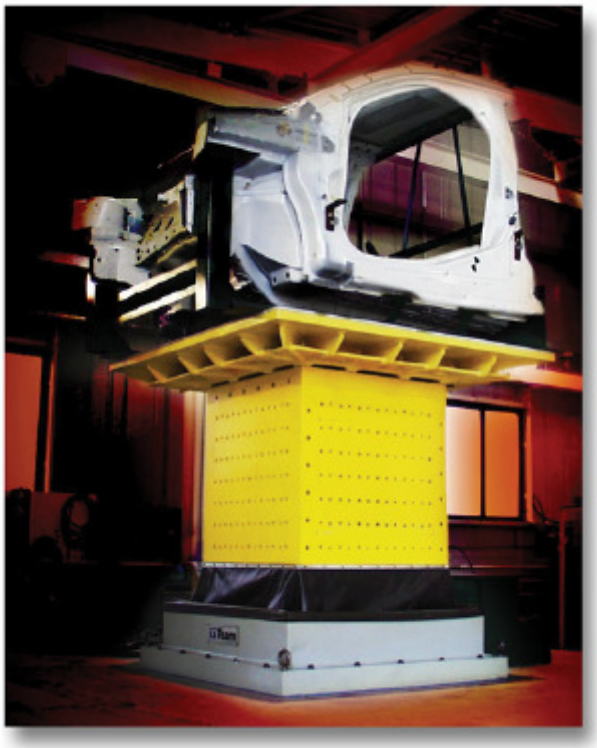
Millbrook selected the CUBE™ as the best system to reproduce the full range of measured vehicle vibrations. The ability to operate the CUBE™ in an environmental chamber without extensive protection was crucial to this decision. The fact that the CUBE™ is significantly quieter in operation than conventional systems was also a major consideration in the selection process.

A typical Life Test requires 300 hours of exposure to selected environmental stresses. Road load data in all 6 DoF is acquired from either customer data or recorded from Millbrook´s test track. This data has frequency content to 250 Hz and acceleration peaks of 6-g. A generic temperature/humidity profile is simultaneously applied, ranging from -40 degree C to +80 degree C and relative humidity to 85%. Infra-heating can increase the surface temperature of test objects to 115 degree C. For stressing any HVAC components, conditioned air is provided at the HVAC intake at the opposite extreme from chamber ambient air, i.e. when the chamber is cold, the HVAC air supply is hot. Acoustic measurements are taken at the beginning and at the end of the test to measure any degradation in performance. Also, microphones are fitted within the test object and can be monitored and given a subjective rating by test engineers or clients.

Sound quality analysis and jury evaluation provides the link between objective measurements and subjective evaluations of squeak and rattle. Potential customer concerns regarding squeak and rattle are thus identified at an early stage in the development process and solutions can be designed in prior to production. This facility, with its advanced capabilities, enables prototype system modules, traditionally tested in a vehicle, to be evaluated at a much earlier stage in development with great savings in cost and time. This concept has proven so successful that Millbrook has added an additional CUBE™ system to handle the increasing work load.



An automobile dash under test at Millbrook.



An automobile sub-assembly under test at Millbrook. Note the CUBE™ head expander.

Demonstrating Flexibility in Application, the CUBE™ Operates with any Manufacturer's Test Controller

Where as all other multi-axis test systems are constrained to a single option for controlling tests, the CUBE™ was designed from conception to allow the customer to decide which test controller best meets their needs.

A fundamental limitation with all other multi-axis test systems is the insistence by the manufacturer of determining the test controller to best operate the equipment. *Team´s* philosophy, however, was to design a system to fully function with any manufacturer´s test controller. This capability has been demonstrated by our broad customer base. The CUBE™ has been easily integrated with test controllers supplied by Spectral Dynamics, FCS-COM, LMS, Data Physics, Vibration Research, IST, IMV and MTS. This functionality permits the customer to leverage their existing investment in test controllers, reducing capital acquisition costs and minimizing the learning curve for producing meaningful test results.

Every CUBE™ is supplied with the necessary servo hydraulic valve drivers to interface with drive signals tailored by the selected test controller. The valve drivers accept the voltage signal generated by the test controller and creates the appropriate drive signal to each Integrated Actuator®. The position response of the actuator LVDT is fed back to the valve driver, providing real-time position response. The control accelerometers provide acceleration response directly to the test controller, enabling monitoring and correction of the desired acceleration versus the actual acceleration. *Team´s* sophisticated valve drivers are a "set and forget" device, transparent to the customer and stable in operation. The valve drivers also give the ability to manually cycle each individual Integrated Actuator®, valuable for checking operation and verifying functionality without software intervention.

Team Corporation has developed close relationships with various suppliers of test controllers. The customer can decide the best combination of hardware and software; *Team* can then act as the prime contractor, supplying both the hardware and software as an integrated package or supply the CUBE™ as a component of the entire test system. The choice is yours. *Team* can provide the solution that´s best for your needs.

Regardless of which direction is selected, *Team* works closely with the test controller supplier to ensure a seamless system installation. Proven to offer the best economy in hardware and software acquisition, the customer is now free to select the high performance of the CUBE™ with a test controller which provides the software modules that fulfill their needs.

Team Corporation´s Service and Support Group Ensures Test System Availability

Testing programs can be severely affected by downtime due to system maintenance or repair. The CUBE™, with friction-free hydrostatic bearings and no periodic mechanical adjustment, provides the customer with unmatched reliability. In the event of a breakdown, *Team´s* dedicated service engineers are able to provide effective support in a timely and cost effective manner.

A test system is only effective if it can be used when needed. Periodic maintenance must be anticipated and carefully planned to minimize program interruptions. The CUBE™, with its fully hydrostatic bearing design and lack of dynamic seals, eliminates the most common sources of periodic maintenance. No longer is it necessary to adjust swivel preload or rebuild actuators to replace leaking piston seals. What has been a bi-annual service requirement on typical multi-axis systems is now fully eliminated.

First and foremost, *Team* Corporation offers annual maintenance contracts to ensure a consistent level of system availability. In the event of unanticipated service requirements, *Team* can dispatch service engineers to provide more extensive maintenance as needed. To augment our customer support function, fully capable service is available locally at select sites.

The only regular maintenance consists of hydraulic filter element replacement. *Team* has established a policy to provide filter element model numbers as defined by the filter manufacturer, allowing the customer to procure these items locally. Of course, *Team* also maintains an inventory of these items to ensure continual availability for the customer´s convenience.

Tell *Team* Corporation Your Needs

Personal and confidential service is the cornerstone of *Team* Corporation´s commitment to systems excellence. Contact *Team* Corporation directly to see if one of our standard CUBE™ designs is right for your application. Your system needs will be reviewed by our staff of engineering experts. With over 35 years of experience dealing with multi-axis test system solutions, *Team* brings a wealth of knowledge to the discussion, suggesting alternative design options to maximize your system capabilities. Let *Team* become your partner in system solutions.

Team servo valve spool and sleeve assemblies.

L to R: Bill Woyski, VP of Research & Development; Doug Lund, VP of Engineering; Bob Tauscher, CEO; Bruce Huntley, General Manager.

Team
VIBRATION TESTING EQUIPMENT

U.S. Headquarters

Team Corporation
11591 Watertank Road
Burlington, WA 98233
USA

Tel: (360) 757-8601
Fax: (360) 757-4401

sales@teamcorporation.com
www.teamcorporation.com

UK Headquarters

Team Corporation UK
Team Corporation UK Ltd
11 Old Ladies Court
High Street
Battle
East Sussex
TN33 0AH
United Kingdom

Tel: +44 (0) 1424 777004
Fax: +44 (0) 1424 777005

sales@teamcorporation.co.uk
service@teamcorporation.co.uk
www.teamcorporation.co.uk

A wholly owned subsidiary of Team Corporation