

Configuration for Bi-axial Seismic Table

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Quotation Number: **2009032**

Date: **Feb 16, 2009**

Valid until: **Apr 15th 2009**

Customer: **University of the Philippines**

MTS Contact: **Vincent Tay (vincent.tay@apt.com.sg)**
(65)9688-1417 (Mobile); (65)6846-7874 (Fax)

Shipment Schedule: **8 months, ex-orks from date of receipt of downpayment plus one month of seafreight.**

Total: Nine Months

Shipment Terms: **CIF Philippines SeaPort**

Payment Terms: **Payment to APT or MTS**

**60% down, 40% upon receiving of PO,
40% by irrevocable confirmed LC upon presentation of
shipping documents**

Equipment Packed For: **Ocean Freight**

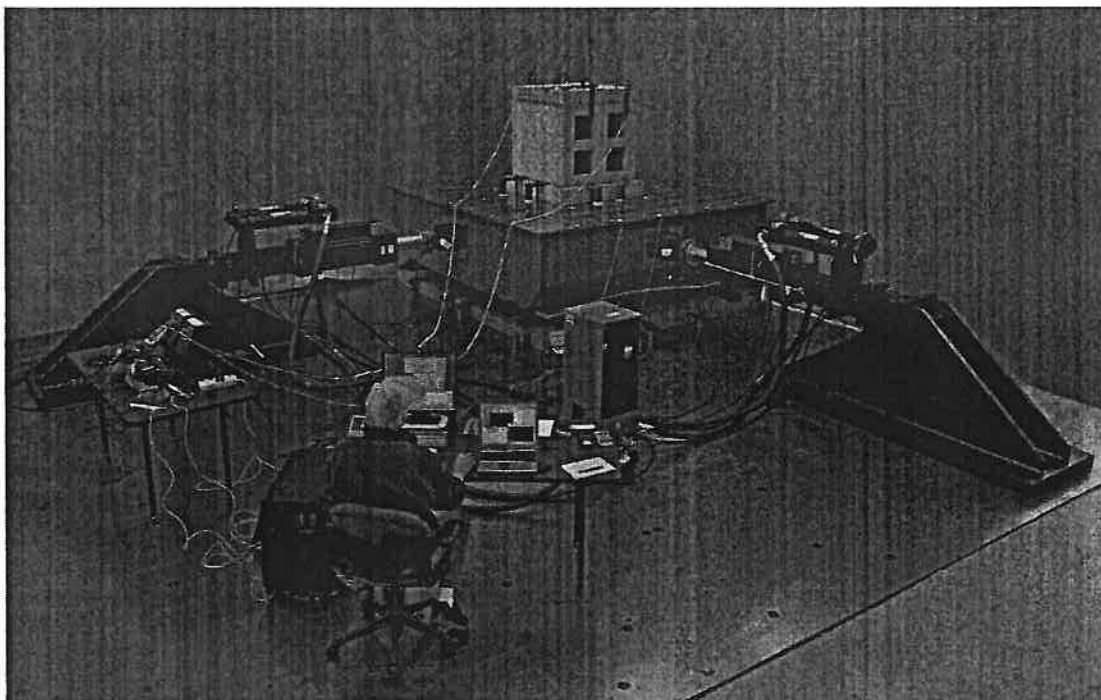
Prepared by: *Vincent Tay*
Vincent Tay

Forward Advance Pinnacle Technologies Pte Ltd
P.O. to: 627A Aljunied Road, #06-02
BizTech Centre, Singapore 389842

Any contract resulting from this quotation shall incorporate the MTS General Terms and Conditions.

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Bi-axial (X-Y) Shake Table for Seismic Testing



Note: above price is for reference only. Please refer to the quote text for the final configuration.

1.1

Bi-axial (X-Y) Shake Table Assembly

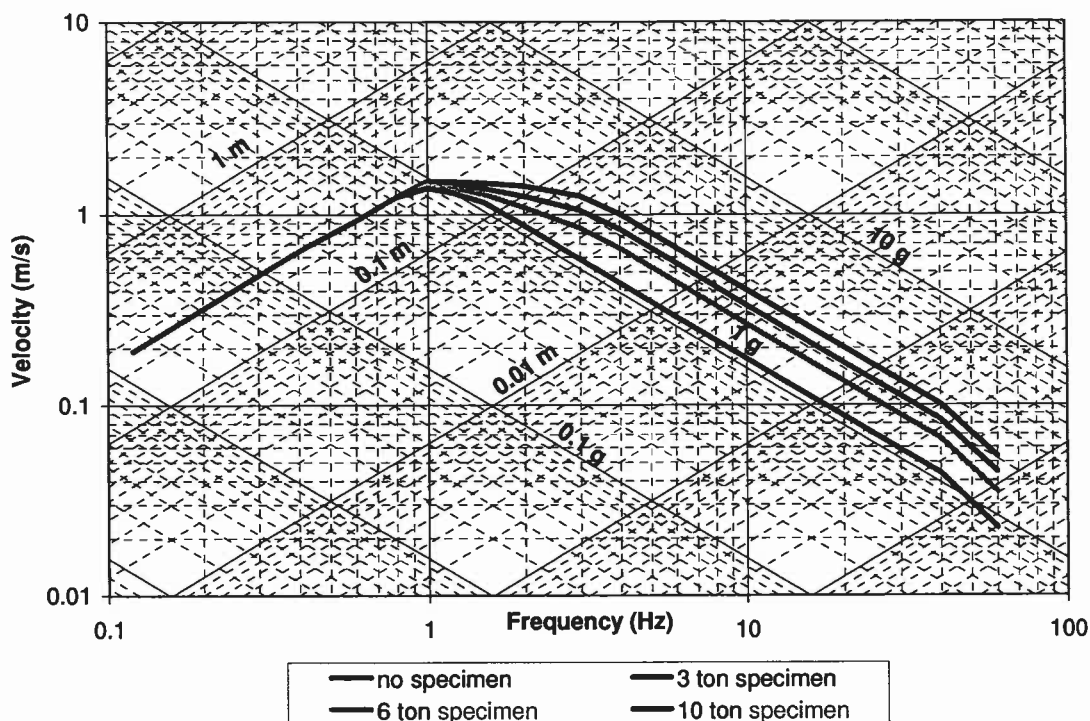
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1.1.1

MTS 3.0 m Bi-axial Shake Table

1

- Table size: 3.0 m x 3.0 m working area
- Table includes a grid of M24 threaded holes for specimen mounting
- Dynamic displacement: 500 mm total (+/- 250 mm)
- Frequency range: 0 - 50 Hz
- Maximum specimen mass: 10,000 kg,
- Maximum velocity at X or Y direction: +/- 1.2 m/sec
- Maximum acceleration at X or Y direction: 1.1 g
- Maximum acceleration zero mass X or Y direction: 2.6 g
- Height of Center of Gravity of specimen at 10 ton: 3m
- Horizontal Mass Eccentricity: 1m
- Maximum overturning moment: 30 meter tons
- Linear guide bearing assemblies with protective bellows
- Closed-housing DC accelerometer: +/- 8 g
- Baseplates include 30 mm diameter clearance holes for attaching base to floor
- Minimum clear floor space for table assembly installation: 10 m x 10 m



The above performanc curve is for reference only.

1.2	Shake Table Actuator Assembly	2
1.2.1	MTS model 244.30S Actuator Assembly	2
	- Dynamic stroke: 508.0 mm - Static stroke: 609 mm - Cushions each end: 42.9 mm - Force at 21 MPa: +/- 246 kN - Servovalve rated flow: 630 Lpm (MTS model 256.18C) - Includes differential pressure transducer, MTS model 660.22A-01 with protector assembly - Includes 3.8 L close-coupled accumulators on Pressure and Return	
1.2.2	MTS model 249.32 Swivel Base Assembly	2
	- Force capacity: +/- 150 kN - Adjustable bearing clearance to minimize backlash. - Swivel angle: -75 degrees, +90 degree - Tilt angle: +/-14 degrees	
1.2.3	MTS model 249.32 Swivel Head Assembly	2
	- Force capacity: +/- 150 kN - Adjustable bearing clearance to minimize backlash. - Swivel angle: -75 degrees, +90 degree - Tilt angle: +/-14 degrees	

2 Bi-axial Seismic table Control System

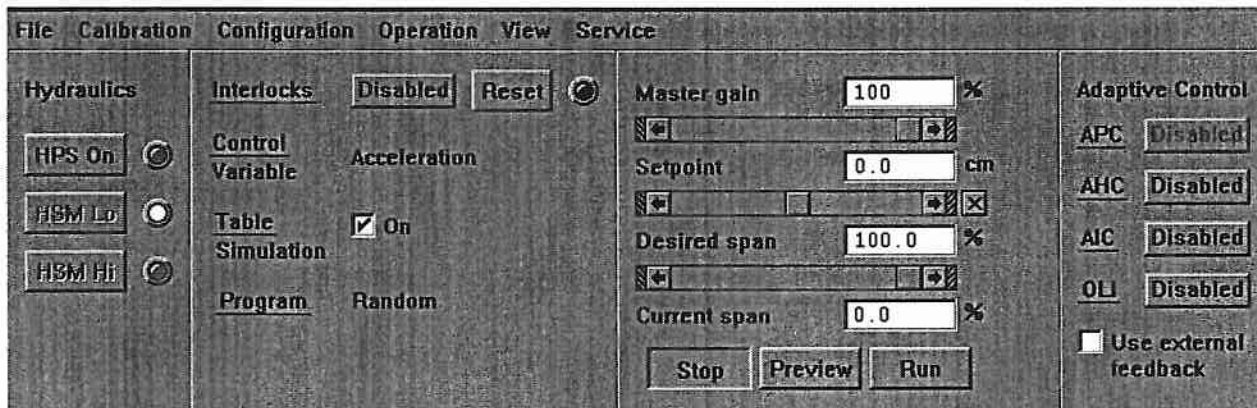
2.1 Bi-axial Seismic Simulation Control 1

2.1.1 MTS Bi-axial Seismic Simulator Controller 1

Controller hardware for two actuator/servo valve assembly. A digital controller manages command generation, data acquisition, signal conditioning, event detection, and other servo related tasks. Advanced Digital Universal Signal Conditioning provides 16 bit resolution for AC and DC transducers. The conditioners utilize state of the art Digital Signal Processors for low noise and high accuracy.

2.1.2 Remote Emergency Stop 1

2.1.3 MTS Bi-axial Seismic Simulation Software



MTS Seismic Digital Control software provides an advanced graphical user interface, or GUI. Full functionality is provided through the GUI for system tuning, test set up and operation, table data acquisition, and advanced high level adaptive control for high fidelity earthquake wave form reproduction. The control software includes;

The following set of High Level Fixed Control Techniques

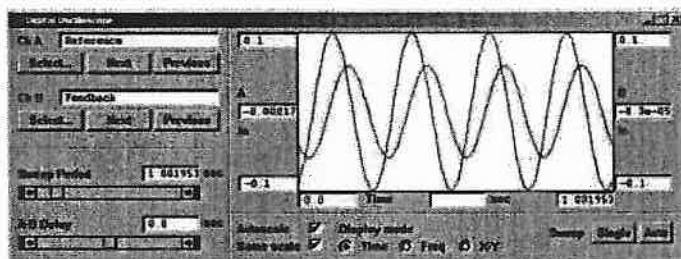
Three Variable Control, or TVC, for high fidelity reproduction across a wide band width. TVC includes a reference generator and velocity computer for deriving command and feedback signals in displacement, velocity, and acceleration. TVC is necessary due to the wide band width associated with seismic time histories.

Delta Pressure Stabilization, or DPS, for effectively dampening oil column compliance to allow for higher gain settings across a wider band width. The ability to maintain high gain settings without decreased stability is critical for high fidelity seismic wave form reproduction.

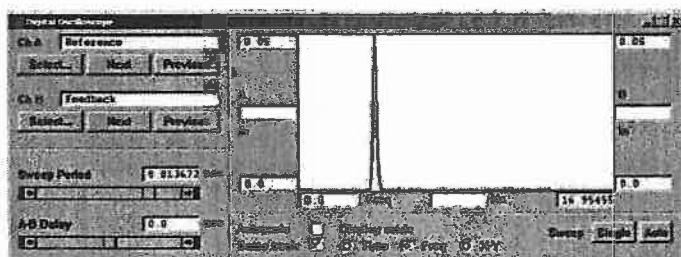
Servo Valve Flow Linearization, SFL, for effectively removing the inherent non-linearities present in all servo hydraulic systems. SFL significantly reduces the potential for errors in desired motion with respect to velocity and acceleration profiles.

The following set of patented MTS Adaptive Control Techniques

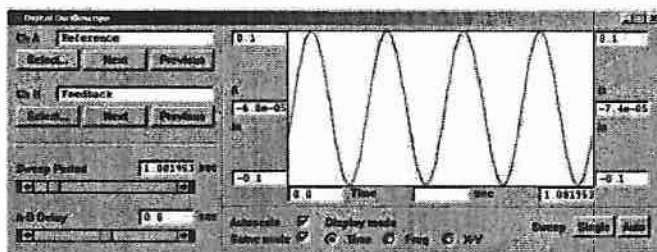
Amplitude Phase Control, or APC, for automatic correction of amplitude and phase errors during sine wave testing. A network of time domain digital filters measures the system input and output to detect errors in amplitude and phase. The input signal is then automatically scaled by the inverse of the amplitude error and shifted by the negative of the phase error. APC quickly reacts to changes in the system to maintain minimal error in amplitude and phase even when changing system dynamics are present.



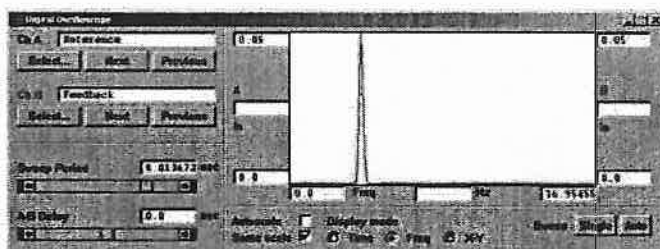
In the frequency domain, the response amplitude obviously falls short of the command amplitude:



Above is an example showing Command and response time domain signals w/o APC



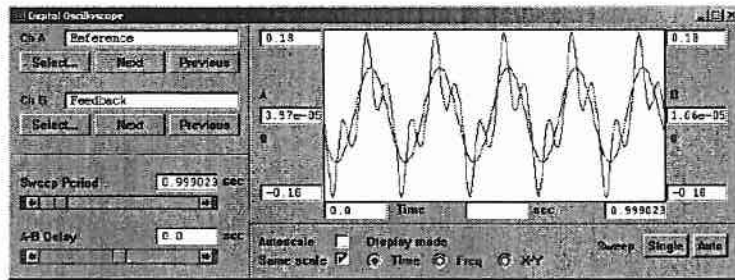
In the frequency domain, the response amplitude matches the command amplitude:



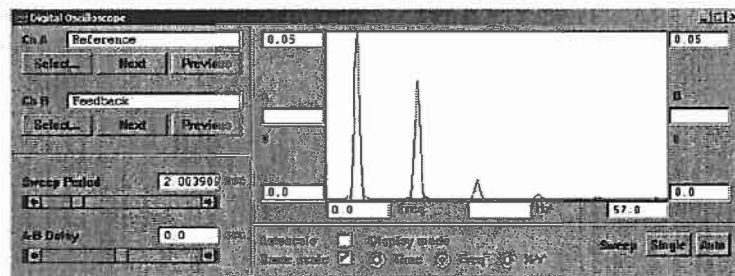
Above is an example showing Command and response time domain signals with APC

Adaptive Harmonic Cancellation, or AHC, for control and elimination of harmonic distortions during sine wave testing. AHC is based upon the technologies developed in the science of active noise cancellation. AHC automatically eliminates unwanted harmonics by adding a signal with exactly the right phase and amplitude such that the harmonic is canceled. AHC automatically adjusts to changes in the system or specimen response.

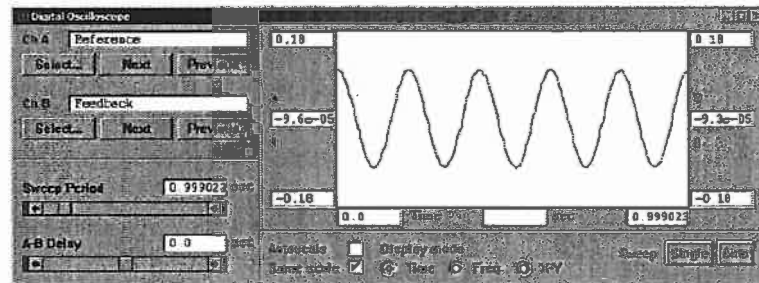
Note: Amplitude Phase Control and Adaptive Harmonic Cancellation can be used simultaneously for reducing linear and non-linear errors when performing sine wave testing.



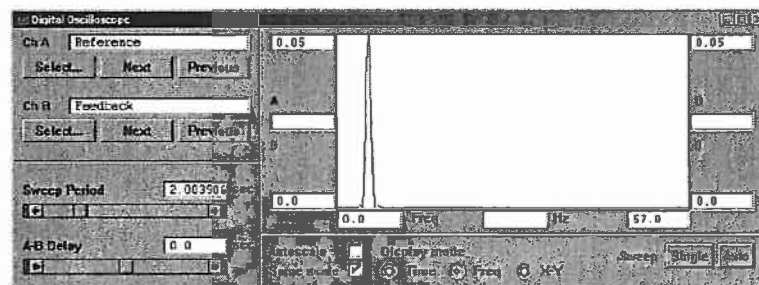
In the frequency domain, harmonics are clearly visible in the response:



Above example shows command and response time domain signals without AHC



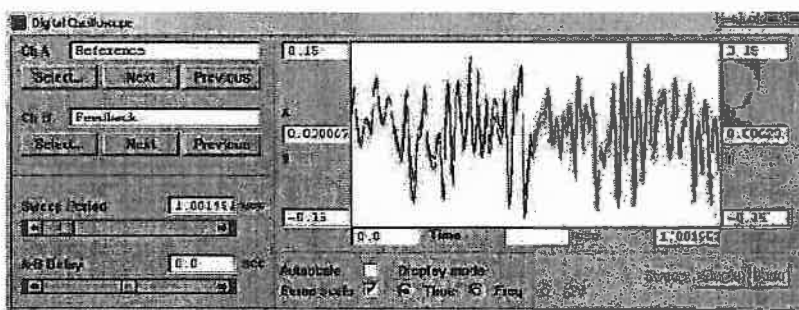
In the frequency domain, the harmonics are gone and the response amplitude at the fundamental frequency matches the command amplitude:



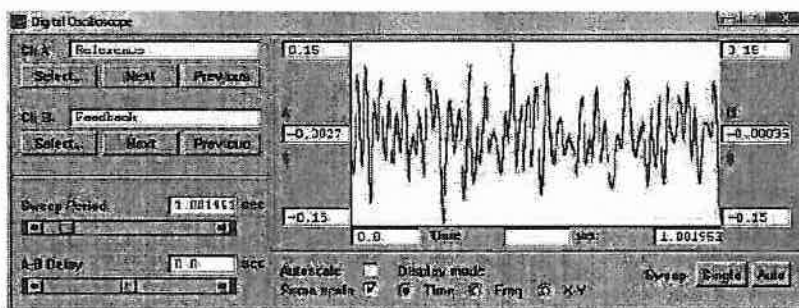
Above example shows command and response time domain signals with AHC

Adaptive Inverse Control, or AIC, for reducing linear distortions during random wave form testing. AIC uses a digital filter to measure the frequency response function of the system. The command signal is then scaled by the inverse of this function so that the overall frequency response is closer to unity. AIC automatically adjusts to changes in the system or specimen response.

Below is an example showing command and response without AIC:

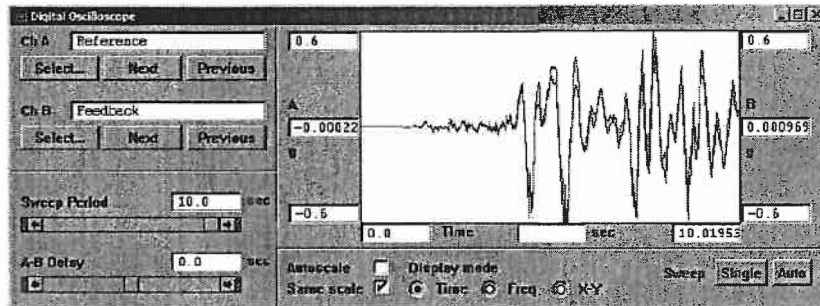


With AIC, command and response are almost perfectly overlaid:

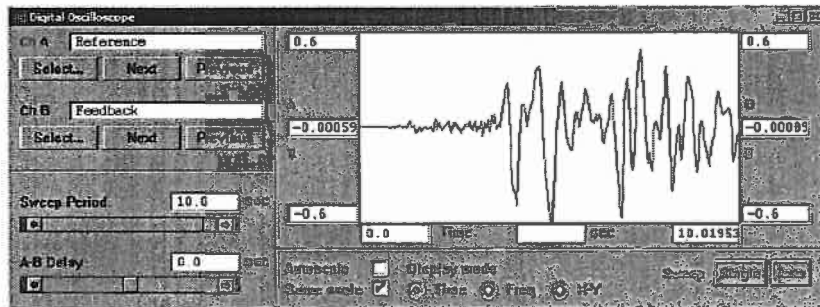


On Line Iteration, or OLI, for reducing the affect of non-linear distortion causes during random wave form testing when the highest levels of wave form fidelity are required. OLI uses the digital filters of AIC to measure the frequency response function of the system while the drive file is played out. OLI than modifies the drive file and repeats the process. The drive file is modified, or iterated, a number of times until the output of the system closely matches the original drive file.

Below is an example showing desired and response time histories without OLI:



After several iterations of OLI, desired and response are almost perfectly overlaid:



Command Function Generation

Test wave forms that can be generated by the internal function generators include:

Cyclic: Square, triangle, and sine with adjustable amplitude and frequency. Sine sweep and dwell capability is also provided.

Random: Bandlimited and shaped noise with adjustable RMS amplitude. Shapes include flat, $(1/f)^2$, $(1/f)$, f , $(f)^2$.

File: Any file of arbitrary points can be played out. Quadratic interpolation is used to upsample to the control update rate. The file can be generated using commercially available data analysis packages or selected from the many thousands of earthquake time histories available in the research community.

Data Display

A number of internal and external signals are available for display for monitoring and diagnostic purposes. These include table command and feedback in displacement, velocity, and acceleration. Signals can be observed in the following manner;

Digital oscilloscope: Displays two signals simultaneously on the computer screen in real time. Signals can be shown in time, frequency, or phase (X-Y) domains.

Digital meter: Displays the current value of a signal, its maximum and minimum achieved values, and its peak and valley achieved values.

Digital Frequency Response Function Plotter: Used to display one or two transfer functions in phase or amplitude versus frequency.

In addition, a time- & date-stamped status log is maintained of all machine operations, limit detector trips, etc. The log is maintained on disk and can be examined at any time.

Additional functionality

The control system software and Graphical User Interface provide the user with the ability to perform a number of very important additional functions.

Data acquisition of all internal and external signals to digital file is provided. A file translator is also provided to convert from the acquired binary format to a text format suitable for transfer to many other analysis packages.

All electronic hardware is accessed through the graphical user interface for purposes of calibration. All calibration parameters can be stored to a digital file.

A test parameter file can be created to record the test specific settings for a given test. These may include settings of the function generator, system gain, TVC settings, among others. Multiple test parameter files can be stored.

Any internal or external signal can be used for limit detection purposes. The signal, action to be taken, upper and lower limits, and persistence are selected through the GUI.

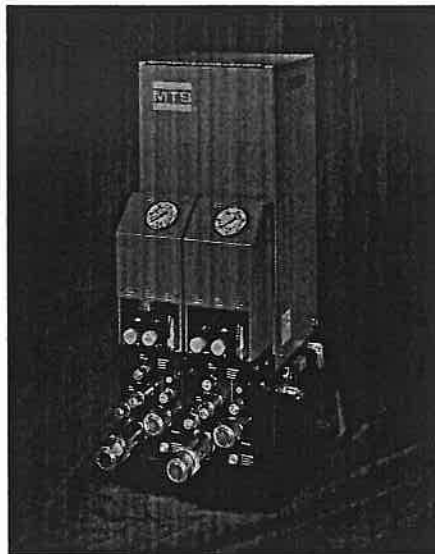
2.2	System Cables	
2.2.1	Delta P Stability Cable, 15m	2
2.2.2	Ground Cable, 15m	1
2.2.3	HSM Cable, 290,293,294, 24V, Hi /Low, 15m	1
2.2.4	LVDT Cable, 15m	2
2.2.5	ServoValve Cable, 15m	2
2.3	Personal Computer (PC) Package	
2.3.1	PC, miniumn configuration	1
	• Intel Core 2 Duo processor • 2 GB RAM (minimum) • 160 GB hard disk • DVD+/-RW • 10/100/1000 Ethernet controller	

- Windows XP Professional SP2

2.3.2 19 inch Compaq LCD Monitor 1

3 Hydraulic Sub-System for the Seismic Table

3.1 293.32 Hydraulic Service Manifold (HSM) 1



- 950 Lpm maximum total flow capacity.
- On/Off, Hi/Low Control.
- 21 MPa operation.
- 1 Station.
- 3.8 L Pressure & 0.95L Return Accumulators.

3.2 293.32 HSM Accumulator 1

- 19 L Pressure
- 7.6 L Return

3.3 Accumulator Manifold Assembly, stand alone unit. 1

- 38 Liter pressure
- 19 liter return.
- Installed between hardline and 293.32 HSM.

3.3 1.5 m Hose Set, -32 pressure, return and - 16 drain 1

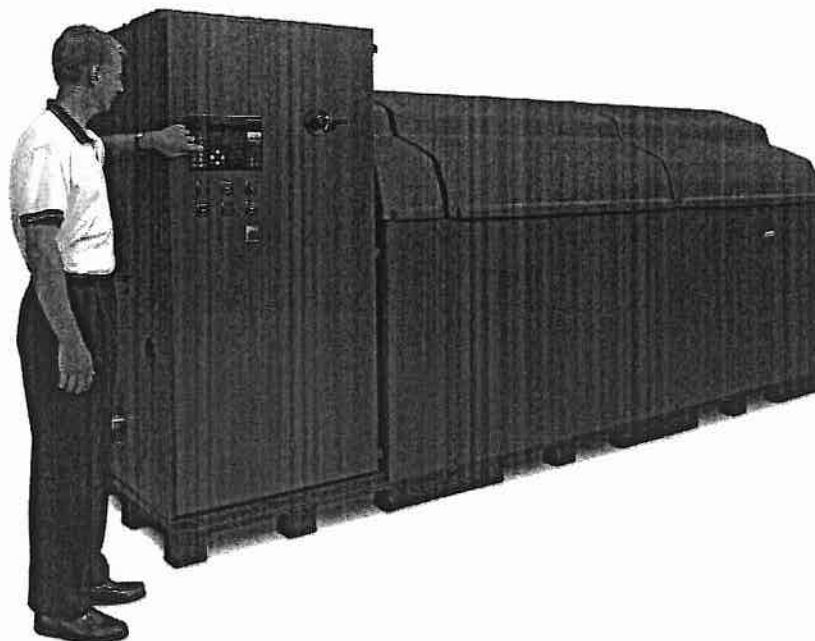
Connection End 1: Hardline take-off
Connection End 2: Hydraulic Service Manifold

3.4 4.5 m Hose Set, -32 pressure, return and - 2
16 drain

Connection End 1: Hydraulic Service Manifold
Connection End 2: Actuator/Servo Valve Manifold

3.5 Model 505.120 Hydraulic Power Unit 1

Silent Flo Series.
68 db(A) noise fully compensated.
454 LPM (120 GPM) nominal flow rating.
Operating Pressure: 21 MPa (3000 PSI).
460 VAC, 3 PH, 60 HZ incoming power.
24 VDC control.
Water cooled with SST heat exchanger.
950 L (250 GAL) aluminum reservoir.
3 micron return filtration.



3.6 Hardline distribution 1

Hardline 15m max..
Includes pressure, return and drain line.
454 lpm. from the HPU units.
Mounting hardware & Installation included.
Hardline design, engineering and installation by MTS.
Change in length may affect price

4	Installation, Commissioning & Training	
4.1	System Installation	1
	All MTS equipment will be completely assembled and checked out at the MTS facility prior to shipping. Upon delivery, it is the responsibility of the customer to position, grout and anchor(table) the table assembly to the customer supplied seismic mass.	
	After the grout has cured, MTS technicians will connect the hydraulic hoses and control cables to the HPU, HSM and controller.	
4.2	System Commissioning	1
	A functional demonstration of the performance of the table will be conducted with a bare table. Tests using a customer supplied specimen can be conducted after acceptance however the results of the test will in no way affect the final commissioning of the system.	
4.3	Training in the use of the System	1
	After installation is complete, MTS field service technicians will train the customer in the safe use of the equipment purchased in this quotation. Training will also be conducted in the operation of the hydraulic system and all features of the control system including software.	
	This training will take 5 days.	
	Upon completion of the installation, training and commissioning of the system, the customer will be asked to sign acceptance of the system.	

Total System price, CIF Major Seaport, Philippines US\$975,000
Less Discount US\$39,000

Total Discounted Price, CIF Major Seaport Philippines.....US\$936,000

NOTE:

1. The prices quoted above are expressed in US dollars, unless otherwise noted. Prices do not include any local, state, or federal taxes, if applicable.
2. The local delivery from Philippines seaport to Univesity of Philippines is not included in this quote

Standard Project Engineering and Services

Documentation

MTS supplies one set of documentation. Documentation is supplied on CD; paper copies are also provided for some items. Depending on the system configuration, documentation consists of some or all of the following:

Software Information

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Includes descriptions of some or all of the following, as appropriate for the system: System Controller software, Test Definition software, Data Analysis software and other software tools.

Operation Information

Includes system operating instructions and information.

Reference Information

Pertinent system drawings, parts lists, and product information manuals.

Note: For MTS Minneapolis based servocontrolled systems, the documentation is supplied in pdf format on a browser-based CD. Paper copies of the System Reference manual are available on request for an additional fee.

Vendor Manuals

As received by MTS for equipment such as personal computers.

Customer Responsibilities

Facility Requirements

The customer should perform a detailed review of the machine specifications to assure that the facility where the machine will be installed has an appropriate sized dock to accommodate the dimensions of the MTS system being purchased. The path that the system will take to its final destination should be measured to verify that the entry into the building, any doorways, elevators, or stairways that the machine must travel through, will accommodate the dimensions of the purchased MTS system. The customer should have appropriate moving equipment available to position the machine. Please pay close attention to the fork-lift handling instructions that accompany the shipment.

Equipment & Personnel

The customer will provide suitable equipment and personnel to unload and set in place all items in the contract, prior to the arrival of the MTS installation engineer. It is the customer's responsibility to ensure the system is handled and manipulated per the packing instructions.

Power

Electrical power for MTS supplied equipment will be provided by the customer. This electrical supply should be free from power transients caused by other equipment on the circuit. This includes appropriate electrical power for the hydraulic power supply (HPS) as well as a fused disconnect when an HPS is purchased. The desired HPS voltage must be specified at the time of the order.

Water

If a hydraulic power supply with a water to oil heat exchanger or water-cooled accessories are purchased, a cooling water supply and drain of sufficient capacity are required. The cooling water lines shall be provided and connected by the customer.

Environment

Environmental requirements are indicated in the associated product literature. If purchased, the hydraulic power supply will require a room with adequate ventilation to ensure the maximum temperature for the room does not exceed 104 degree F (40 degree C). The electronic components and computer equipment should be located in a suitable environment with respect to temperature, humidity, and dust.

Specimens

For installation, demonstration, and training, the customer will provide suitable specimens and other materials appropriate for use with the equipment described in this quotation.

Commissioning and Acceptance

The commissioning and acceptance of the purchased system would be carried out under no load conditions e.g. without any specimen.

Warranty

MTS warrants equipment of its manufacture to be free of defects in materials and workmanship for a period of 12 months after shipment from its plant or 12 months from completion of commissioning at your site if MTS installs the equipment. MTS allows a maximum of 3 months for transit; the warranty shall not exceed 15 months from shipment in any case. MTS shall, at its option, repair or replace free of charge within the warranty period any components or assemblies supplied by MTS which prove to be defective in workmanship or materials, subject to the following:

MTS reserves the right to request the prepaid return of such defective items to its plant for inspection and evaluation.

Expendable items (oil, lamps, seals, filters, etc.) and items subject to normal wear and/or replacement, will not be covered under warranty if their failure is the result of normal wear. Re-calibration of transducers is not covered by this warranty.

MTS reserves the right to reject those claims for warranty where it is determined that failure is caused by Buyer made modifications, improper maintenance, misuse or abuse of the equipment.

This warranty is extended only to the original Buyer of the equipment.

Items supplied by MTS but not of its manufacture (computers, oscilloscopes, commercial software packages, etc.) carry the original manufacturer's warranty which is passed on to the customer who is responsible to deal directly with the manufacturer on warranty issues.

MTS Integrated Software, MTS will provide telephone consultation and strive to correct errors brought to its attention for the period of the warranty.

This warranty is expressly in lieu of all other warranties expressed or implied, statutory or otherwise, including any implied warranty of merchantability or fitness or suitability for a particular purpose. No warranties are expressed or implied which extend beyond the description of the face hereof. In no event shall MTS be liable to the Buyer for collateral, indirect, incidental or consequential damages of any kind.

MTS assumes no liability for damages arising from the use of the equipment by the buyer or any third party. By purchasing MTS equipment, the Buyer assumes all liability for any damages of any kind which may result from its use or misuse by the Buyer, Buyer's employees, agents, contractors or any other third party unknown to MTS or the Buyer, including damages due to failure of the equipment.

MTS Limited Warranties is the over-ruling document in the event of a conflict or misunderstanding and is incorporated by this reference.

Currency & Taxes

The prices quoted above are expressed in US dollars, unless otherwise noted. Prices do not include any Goods and Services Tax, local, state, customs or federal taxes, if applicable. The prevailing tax rate at time of supply shall apply, if any.



Advance Pinnacle Technologies Pte Ltd

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Company & GST Registration. No.: 200205536D

MTS-Specific Clauses

The parties expressly agree that the purchase and use of Material and/or Services from MTS are subject to MTS' Terms and Conditions, in effect as of the date of this document, which are located at <http://www.mts.com/en/about/terms/> and are incorporated by reference into this and any ensuing contract. Printed Terms and Conditions can be provided upon request by emailing MTST&C@MTS.com.

MTS Limited Warranties (P/N 114093-26) is the over-ruling document in the event of a conflict or misunderstanding and is incorporated by this reference.