

# **TMSI**

***Testing innovation***



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## *An Introduction to TMSI*



*TMSI corporate offices are conveniently located in Northeast Ohio for easy access to transportation and Industry. Please contact us at 9073 Pleasantwood Ave. North Canton, OH 44720 or call (888) TMSI-USA or (888) 867-4872.*

**Founded** in 1991, Test Measurement Systems, Inc., (**TMSI**) specializes in manufacturing, updating, installing and commissioning of Custom-Designed Scientific & Test Engineering Systems. These include Data Acquisition/Control Systems as well as Test Fixturing, Loading Frames and Actuators. The company offers creativity and state-of-the-art expertise for the development of new and unique custom tailored solutions to industrial problems and R&D projects. **TMSI** relates to the client by working to prescribe and provide an optimal selection from the offerings of all test equipment manufacturers to meet testing requirements.

**TMSI** employs scientists and engineers of various skill levels (B.S., M.S. and Ph.D.) to offer hi-tech expertise in the areas of software, machine, and electronics design as well as test automation, analytical data studies, and system vibration analyses. We provide highly specialized solutions to industrial problems each year. The demand for such low-volume, yet highly-specialized products, creates a niche market for which **TMSI** is uniquely equipped to serve in an efficient and timely manner.

**TMSI** is an integrator of scientific data systems with skills required to perform all of the related functions beginning with transducer selection and applications and continuing through all stages of analog signal conditioning, digital data sampling, computer data-base integration, all levels of data processing, and generation of tabular and/or graphical data reports.

**As a Test Manufacturer, TMSI** is in the unique position of being able to evaluate and select from a number of data acquisition and test system products to best fit specified requirements, even though these may not all be manufactured by the same hardware supplier. Being a Test Manufacturer means that **TMSI** must add value to the hardware products provided by third parties, and we do this in two ways:

**TMSI** produces applications software that exactly fits the customer's needs—both current and upgradable into the future.

**TMSI** provides systems services to assure proper application of the data system and on-going maintenance to assure continued conformance to the specified requirements.



## *An Introduction to TMSI*

*Continued*

This requires that **TMSI** be on a constant lookout for new developments in hardware and software technology while being able to implement such improvements into the data systems that it provides. As a consequence, **TMSI** provides an independent eye for sources of information on the latest hardware and software developments in the world of scientific data systems.

Application-optimized, up-and-running systems, selected from an industry-wide cross-section of available equipment and software choices, are **TMSI**'s goal in considering technical requirements and available budget. Only when necessary does the company develop and manufacture software, transition, or interface circuits in order to provide required features that are not commercially available, or are necessary to connect incompatible but integral system components.

**TMSI** services extend far beyond the installation of a finished system. Full documentation is retained at our offices to be used for field support via telephone or on-site as required. We also provide a website ([www.tmsi-usa.com](http://www.tmsi-usa.com)) with question and answer support available within 24 hours where one can port data and application code files directly to or from **TMSI** for instant clarification and interpretation. **TMSI** can directly view a customer's computer screen in real time to assist in diagnosing operating problems as an online resolution—we call this **InstantServiceCall™**.

**TMSI** endeavors to provide services of the highest quality and associates itself with clients who endeavor to likewise provide their customers with products and services that are among the best in their respective industries. If your integration and software needs and our mutual goals align, please call to discuss your project with our team of professionals!

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The future holds many advances in the fields of computer control, testing, data acquisition, and analysis. With these advances, more sophisticated testing and analysis techniques will be developed and implemented. **TMSI** will be a front-runner in this market by acquiring and training bright and knowledgeable experts from a wide range of scientific and technical fields.

Future possibilities at **TMSI** range widely, including single computer systems configured to interface “smart” hardware and software, advanced control and acquisition systems for multiple test laboratories, analysis packages including advanced statistical analyses and neural net interpolation tools, collective data-basing of results from multiple laboratories, and collaborative presentation of collective results. Advances in technology will soon allow for mass amounts of data to be acquired and analyzed, which means more rapid advances for the products *you* manufacture in the coming years.

Acquisition, presentation, and analysis of data are vital portions of testing systems. The need for correct interpretation and easy presentation of correctly acquired data creates the ever growing need for advanced custom hardware, software, and tools. **TMSI** offers such hardware, software, and tooling in addition to having expertise for selecting commercially available state-of-the-art hardware and software in a market for complete test measurement and data acquisition systems.

Today’s product improvements tend to be evolutionary rather than revolutionary, meaning that performance improvements occur incrementally over time. Product performance may be incrementally optimized only by making precision test measurements. Cascading a number of such improvements can produce significant changes in *your* product. **TMSI** features the ability and technology to allow *you* to take the next step into the future.





## Consulting Services

The final endeavor pursued by **TMSI** is in the area of consulting. Complementing our knowledge in test measurement and data acquisition systems, **TMSI**'s staff is built of professionals from various fields and disciplines. Our expertise extends to *general mechanics, tire mechanics, vehicle dynamics, vibrations, systems analysis, customized user interfaces, data acquisition, control, & analysis programming, neural networks in pattern recognition & data analysis, small volume electronics in signal processing & test systems control, and test systems integration*. **TMSI** employees remain on the cutting-edge of technology by designing, implementing, and using state-of-the-art equipment and processes which enable us to assist our clients in efficiently moving into the future.



Our consulting services go beyond just recommending and implementing the most advanced technology in these fields. **TMSI** evaluates the tasks and needs of the customer and recommends solutions by using the range of available technology to best realize the desired results. Not only do the processes and systems best fit the current task, but **TMSI** also analyzes possible future uses and upgradability for the system based on possible breakthroughs and/or trends in current technology advancement. These future-adaptable solutions allow our customers to remain ahead of their competitors and make easy transitions in an ever-changing market.



## *Products and Services*

### *Tire Industry*

- Tire Endurance Machines
- Tire Endurance Modular Add-On Test Devices
  - Dynamic Slip and Camber Systems
  - Rolling Resistance Attachments
  - Tire Force and Moment Systems
  - Infrared Tire Temperature Sensors
  - Controlled Tire Pressure Systems
  - Tire Failure Warning Systems
  - HSU Spindles with DFMS
- High Speed Uniformity Machines – Lab and Production Systems
- Dynamic Force Measurement System (DFMS) applied to:
  - High Speed Tire Uniformity, Lab and Production
  - Coarse Road Surface Tire Testing
  - Force and Moment Tire Testing
- Tire Rolling Resistance Measurement Machines
- Machine Control and Data Acquisition Systems
  - For Tire Endurance Testing including Slip and Camber
  - For High Speed Uniformity Machines
  - Tire Load and Deflection Machines
  - Tire Rolling Resistance Machines
- Tire Load and Deflection Machines
- TMSI OnLevel Flat Belt Tire Testing Machines

### *TMSI Services*

- Machine Design and Engineering Consultants
- Vibration Analysis
- Tire Mechanics Consultants
- Spare Parts for all products sold
- Service and support for all products sold

### *Automotive Industry*

- Automotive Crash Test Sleds
- Air Bag Test Systems
- Bumper Test Systems (FMVSS Part 581)
- Automotive Head Restraint and Seat Back Test Systems (FMVSS 201/202)
- Automotive Seat Belt and Seat Belt Anchorage Test Systems (FMVSS 207/210)
- Automotive Side Intrusion / Roof Crush Test Systems (FMVSS 214/216)
- Environmentally Controlled Vibration Test Systems (Shakers)
- Machine Control and Data Acquisition Systems and upgrades for above

### *Various Industries*

- Specialty Testing Machines
  - Ball Screw Torque Tester
  - Hydraulic Servo Valve Tester
- Machine Control and Data Acquisition Systems per customer requirements
- Electronics Hardware
  - Card Cage Units
  - Analog and Digital Interface Units
  - Data Acquisition Interface Units
  - Custom Electronics
- System Integration
- Servo Control System upgrades



# OnLEVEL™ Tire Test Machine by



The TMSI OnLEVEL™ Tire Test System is the first in the world to provide real data in real time for such a wide range of tests. In an instant and on a single test station, OnLEVEL measures:

- Forces and Moments
- Rolling Resistance
- High Speed Uniformity
- Conicity & Plysteer
- Ply-Steer Residual Aligning Torque
- Conicity Residual Aligning Torque
- Rolling Radial Spring Rate
- Revolutions Per Kilometer (RPK)

OnLEVEL does all this on a realistic flat road surface with computer-controlled speed, load, inflation pressure, steer angle, and camber angle while capturing tire performance data for instant analyses. Engineering reports and data archival are immediately available upon the completion of each test using TMSI's built-in report generation system.

Moving from one type of test to another while the same tire remains mounted is as easy as a few keystrokes and mouse clicks, enabling increased productivity in acquiring data on each tire design for immediate feedback to your designers, engineers, and customers.

Each test has a pre-defined script and report generator that enables you to focus on results rather than creating new report formats or figuring out test calculations. Your customers get the data that they want quickly and efficiently.

OnLEVEL's flat roadway surface, operating at speed, is the principal feature that makes this set of tests more accurate and more realistic than data generated on traditional round-wheel machines. It gives tire technologists and vehicle analysts real stresses and strains rather than those artificially induced by a round road wheel. OnLEVEL brings your company to the forefront of testing technology.

The measurement head and computer data system's hardware and software are designed to run many different tests, all on the same machine. Completing several tests on a single machine enables an unrivaled level of streamlined data generation. The traditional method of moving a tire from one testing machine to another is cumbersome, time-consuming, and can lead to days of testing rather than minutes with the OnLEVEL system.



	OnLEVEL™	FT III	FT LTR
<b>Tire Sizes</b>			
Passenger Car	Most	Most	Most
Light Truck	Most	Some	Most
Racing Tires	Some	NO	All
<b>Testing Capabilities</b>			
Steady State Force & Moment	√	√	√
PRAT	BEST	Maybe	Maybe
Sine Sweep F&M	√	Limited	√
Wheel Torque or Traction	√	NO	√
Rolling Resistance	√	Maybe	NO
<b>Uniformity</b>			
Low Speed	√	√	√
Medium Speed	√	NO	Maybe
High Speed	√	NO	NO
Effective Rolling Radius	√	√	√
Revolutions per Kilometer	√	√	√
Spindle Clock Data Acquisition	√	√	√
<b>Performance Specifications</b>			
Speed (kph)	±250	±200	±320
Slip Angle (deg)	±15, ±30	±30	±30
Camber Angle (deg)	-12, +45	-12, +45	-10, +45
Loaded Radius (mm)	200-500	200-475	250-475
Wheel Torque(N-m)	3000	N/A	5000
Wheel Vertical Load Max (N)	24000	24000	30000
Lateral Force Max (N)	24000	15000	30000
Sweep Rate (Slip & Load; deg/sec, mm/sec)	15,75	15,75	15,50
Sine Sweep Frequency Range (Hz)	5	1	5
Load Cell Resonance (Hz)	>100	~35	>100
Inertial Compensation using DFMS ‡	√	NO	NO

‡ TMSI Patent number 6,606,569



# OnLEVEL™ Tire Test Machine by



TMSI's proven ability to deliver innovative, high-value test and measurement solutions that customers demand puts us at the top of today's high-tech testing industry. Our machine designs utilize the latest 3-D computer design techniques and finite element analyses. Our manufacturing processes produce the stiffest and lightest machine frames while maximizing strength, increasing resonant frequencies, and minimizing deflections and wear under load.

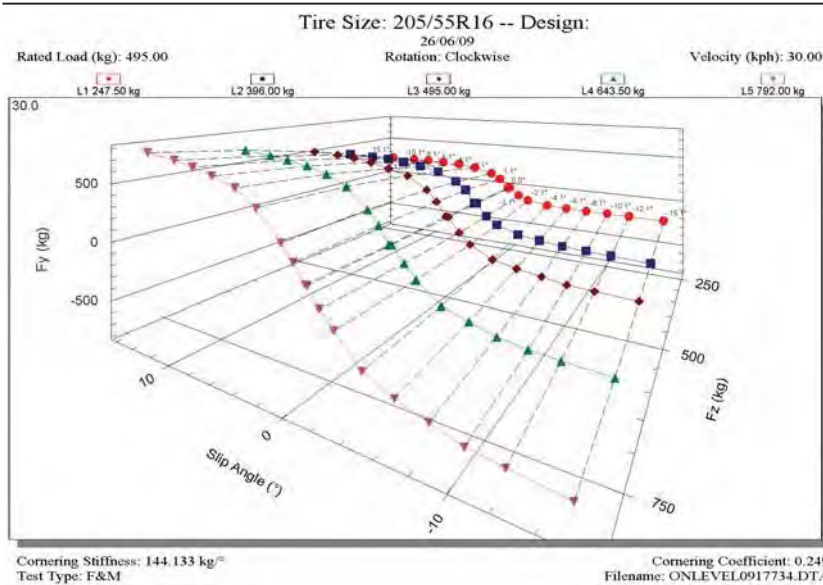
At the same time, our test frames are self-reacting so as not to transmit specimen loads into the building foundation.

Our test control programs use the latest digital closed-loop control techniques, as well as modern data reduction and analysis algorithms such as DSP and Fuzzy-Logic, to squeeze the maximum information from experimental data.

They then provide instant reporting and archival of test results to inform customers of how their products performed.



Reports are easily accessible, extremely usable, carefully detailed, and formatted to fit each customer's needs.



Customers who require meaningful technical information and analyses on their products have come to rely on TMSI as a powerful partner in product development, testing, and improvement, which ultimately strengthens marketplace advantage and consumer satisfaction.

*TMSI, our innovation fuels yours!*

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## *HSU-500 High Speed Uniformity Machine*

The Model HSU-500 High Speed Uniformity Machine measures forces, moments, unbalance, rolling resistance, RPK, ply-steer, and conicity in passenger and light truck tires at speeds up to 240 kph (150 mph), without machine resonant effects to 500 Hz. To achieve accurate and repeatable measurements, the machine has been designed and tested using *TMSI's* patented Dynamic Force Measurement System (DFMS) to remove machine resonances from tire vibration data. Pat No. 6,606,569



### **PC Control and Data Acquisition**

- Windows Operator Interface
- Minimal learning curve for test engineers
- Automatic test execution and data storage
- Easy programming using spreadsheet lists
- Consistent repeatable tests using stored tests
- Custom tests per user requirements

### **Measurements:**

- Radial, lateral, and tangential force variations
- Rolling resistance force, overturning moment, and aligning moment
- Dynamic and static unbalance
- Radial or lateral runouts
- Harmonic magnitudes and phase angles.
- Average Values of forces and moments, including a special test for conicity / ply-steer measurements.
- Loaded radius, inflation pressure, RPK, Road wheel speed, and tire rotation



## *Model 1064B High Speed Uniformity Machine*

*(Formerly made by ITW Akron Standard)*

The Model 1064B High Speed Uniformity Machine measures forces, moments, and unbalance in passenger and light truck tires at speeds up to 240 kph (150 mph), with minimal machine resonance effects. To achieve accurate and repeatable measurements, the machine has been designed and tested to assure high machine resonant frequencies. The spindle resonant frequency is greater than 600 Hz. Including a precision wheel mass.



### **PC Control and Data Acquisition**

- Windows Operator Interface
- Minimal learning curve for test engineers
- Automatic test execution and data storage
- Easy programming using spreadsheet lists
- Consistent repeatable tests using stored tests
- Custom tests per user requirements

### **Measurements:**

- Radial, lateral, and tangential force variations
- Rolling resistance force, overturning moment, and aligning moment
- Dynamic and static unbalance
- Radial or lateral runouts
- Harmonic magnitudes and phase angles.
- Average Values of forces and moments, including a special test for conicity / ply-steer measurements.
- Loaded radius, inflation pressure, RPK, Road wheel speed, and tire rotation



## *RR-500 Tire Rolling Resistance Test Machine*

The Model RR-500 Tire Rolling Resistance Test Machine measures tire load and rolling resistance force, as well as Revolutions Per Kilometer (RPK) in passenger and light truck tires or truck and bus tires at speeds up to 240 kph (150 mph). Rolling resistance can be measured using either (or both) the force method or torque method. Tire vibration effects due to tire nonuniformity and tire/wheel unbalance are resolved using high speed data acquisition and fuzzy logic to remove measurement uncertainties. RR-500 can be equipped with either one or two tire test stations so that a single machine can test both passenger/light truck tires on one station and truck/bus tires on the other station.



### **PC Control and Data Acquisition**

- Windows Operator Interface
- Minimal learning curve for test engineers
- Automatic test execution and data storage
- Easy programming using spreadsheet lists
- Consistent repeatable tests using stored tests for:
  - SAE J1269, J2452
  - ISO 18164, 28580Includes Regression Analyses and MERF & SMERF
- Custom tests & analysis per user requirements

### **Measurements:**

- Radial force (tire load)
- Rolling resistance force
- Loaded Radius
- Effective Rolling Radius
- RPK
- Inflation Pressure
- Road wheel speed,
- Ambient Temperature

### **Controls:**

- Tire load, or
- Loaded radius
- Road wheel speed
- Inflation pressure
- Rotational direction (CW/CCW)



## *Tire Endurance Testing Machines Two or Four Stations*

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### **TTM-4SSTP4 (Four Position Truck and Passenger Combination Machine)**

- **Advanced Technology:** Digital load and speed control, integrated slip and camber capability, designed and optimized with finite element analysis techniques are used to provide our customers with the highest possible value.
- **PC Control and Data Acquisition system running under Windows®**
  - ⇒ Minimal learning curve for training test engineers
  - ⇒ Automatic test execution and data storage
  - ⇒ Consistent testing using stored test recipes
  - ⇒ Tire Operating History
- **Modular Options:** Test carriages are compatible with any optional equipment or spindle sizes. This permits a customer to purchase the basic machine at one point in time, and at a later date purchase optional equipment without any modification to the base machine.



## Tire Endurance Testing Machines Two or Four Stations

(Continued)



**TTM-4.5P2 (Two Station Passenger & MC)**



**TTM-4T2 (Two Station Truck)**

Patent Numbers 4,870,858 and 6,606,569 apply

### Capacities by machine model number and by tire test station.

Machine Model Tire Types	TTM-4.5P Passenger	TTM-4TP Passenger	TTM-4TP TTM-4T Truck	TTM-4SSTP Passenger or Truck
Tire Diameter Range	356 - 813mm 13 - 32"	356 - 1626mm 14 - 64"	457 - 1626mm 18 - 64"	356 - 1626mm 14 - 64"
Min Rolling Radius	166 mm 6.5"	178 mm 7"	228 mm 9"	178 mm 7"
Max Section Width	381 mm 15"	711 mm 28"	711 mm 28"	711 mm 28"
Loading Positions	2 or 4	2 or 4	2 or 4	2 or 4
Roadwheel Dia.	1707.57 mm 67.227"	1707.57 mm 67.227"	1707.57 mm 67.227"	1707.57 mm 67.227"
Roadwheel width	381 mm 15"	508 mm 20"	508 mm 20"	508 mm 20"
Max. Speed	350 kph 219 mph	350 kph 219 mph	200 kph 125 mph	300 kph 188 mph
Max Load	2269 kg 5,000 lb	5,000 kg 11,023 lb	10,000 kg 22,046 lb	7,700 kg 16,970 lb
Minimum Bead Diameter (Spindle)	10"	12"	16"	12"

### Modular Options

- Dynamic steering
- Camber attachments
- Inflation control
- Rolling resistance
- Infrared temperature sensors
- Spindle Brakes
- Load calibration kit
- Precision rims
- Safety Cages
- Force and Moment System
- Tire Failure Warning System
- HSU Spindle with DFMS



## Tire Endurance Testing Machines Two or Four Stations

(Continued)



**TTM-1.0TP2 (Two Station Truck / Passenger )**

### Capacities by machine model number and by tire test sta-

Machine Model Tire Types	TTM-1.0TP TTM-1.0P Passenger	TTM-1.0TP TTM-1.0T Truck
Tire Diameter Range	356 - 1448mm 14 - 57"	457 - 1448mm 18 - 57"
Min Rolling Radius	178 mm 7"	216 mm 8.5"
Max Section Width	711 mm 28"	711 mm 28"
Loading Positions	2	2
Road wheel Dia.	1707.57 mm 67.227"	1707.57 mm 67.227"
Road wheel width	508 mm 20"	508 mm 20"
Max. Speed	241 kph 150 mph	200 kph 125 mph
Max Load	5,000 kg 11,023 lb	10,000 kg 22,046 lb
Minimum Bead Diameter (Spindle)	12"	16"

### Modular Options

- Dynamic steering
- Camber attachments
- Inflation control
- Rolling resistance
- Infrared temperature sensors
- Spindle Brakes
- Load calibration kit
- Precision rims
- Safety Cages
- Force and Moment System
- Tire Failure Warning System
- HSU Spindle with DFMS



## *Dynamic Steering Attachment for Tire Test Machines*

This modular Slip / Camber system is a stand alone, bolt on unit designed to provide precision digital hydraulic servo control for slip angle. Measurements made on the standard unit are cornering force, aligning torque, slip angle, and camber angle. Full force and moment measurement is also available.

The unit features a patent-pending roller cam design which provides precise on-center steering, eliminating the off-center loading and link / pivot errors experienced in other systems. A convenient camber adjustment is provided in the standard unit and Dynamic Camber can be added as an option.



### **Capacities:**

- Radial Force 24 kN Max
- Cornering Force  $\pm 22.2$  kN Max
- Aligning Torque  $\pm 1$  kNm Max
- Slip Angle Range  $\pm 12$  degrees
- Camber Angle Range  $\pm 12$  degrees
- Tire Outside Diameter (O.D.) 813 mm Max
- Tire Section Width 318 mm Max



The **TMSI** Dynamic Steering Attachment can be bolted on to existing Tire Endurance Testing Machines with little or no modification necessary to the machine loading carriage. The system is shown mounted to a TTM-4 (formerly Akron Standard) Tire Test Machine. It can also be retrofitted to machines made by other manufacturers.



## *Camber Fixture for Tire Test Machines*

*TMSI's* Digital Camber Fixture will fit a standard TTM to provide a means of introducing a camber angle into the tire test procedure. The Camber fixture will bolt onto an existing TTM carriage without any modifications required. The camber angle is set by manually adjusting two jack screws. The Camber Fixture is equipped with a camber angle output to be input into a data collection system.



### Specifications:

- Max Camber Angle:  $\pm 10$  degrees
- Max Load Capacity: 10,000 Kg (22,000 lbs.)
- Approximate Weight: 199 Kg (438 lbs)
- Dimensions: 44 cm (17.5") Wide x 52.2 cm (20.56") High x 24.1 cm (9.5") Deep





## *Rolling Resistance Measurement Attachment*

*For Tire Test Machines*



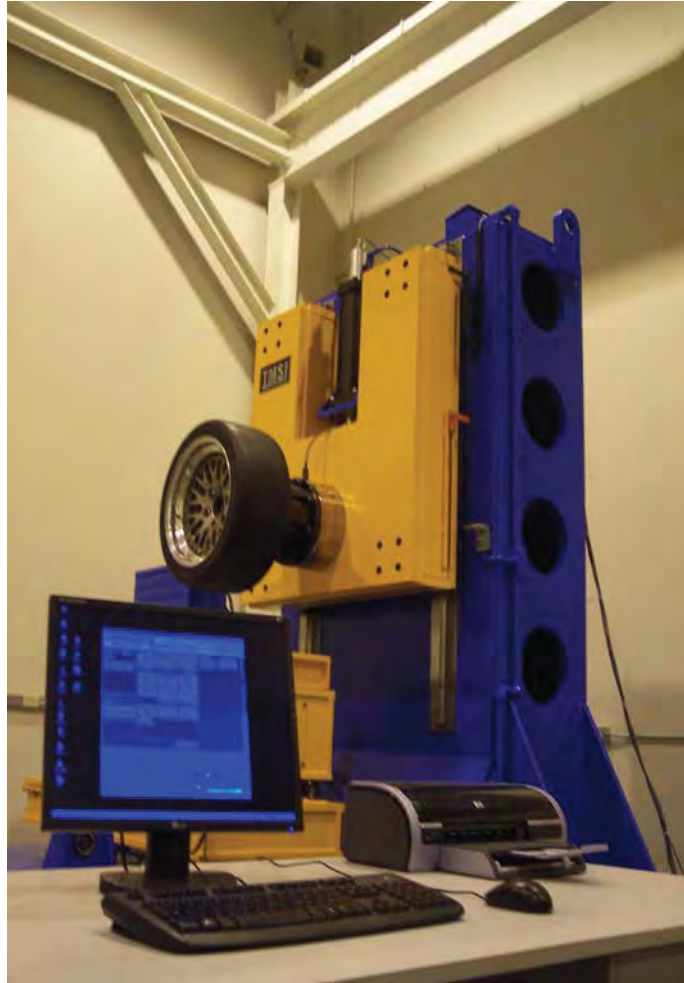
**Modular, low cost attachment to add Rolling Resistance Measurement capability to existing Tire Endurance Testing Machines.**

- Measurement by the “Force Method”
- Compatible with other options  
(Inflation Control and Infrared Sensors shown)
- Testing Sequences, data acquisition/reduction, and report generation for SAE J1269, J2452 and ISO 8767 (when supplied with machine control upgrade)



## *Tire Load / Deflection Test Machine*

The Load/Deflection Test Machine applies a requested load to a test specimen at a user-prescribed load or deflection rate while recording both the load and deflection data. The system consists of a mechanical load frame with three servo controlled test movements that may be run simultaneously or programmed in pairs or individually. Tests are controlled by a TMSI Industrial PC Control System (ServoTrac), which is interlocked with the electric controls of both the Hydraulic Power Unit and all three actuators for full test automation and data reduction, presentation, and archival.



### **Servo Control of:**

- Radial Movement Z
- Lateral Movement Y
- Footprint Torsion
- Slip Angle

### **Measurements:**

- Radial Force, Radial Spring Rate
- Lateral Force, Lateral Spring Rate
- Torsional Moment, Torsional Spring Rate
- Aligning Moment



## *ServoTrac™ Data Acquisition and Control System*

The **TMSI ServoTrac™ Data Acquisition and Control System** is housed in a 20.5" W x 72" H x 24" D instrument rack enclosure. The following components are included:

- Intel Based Microprocessor industrial Computer
- Standard Hard Disk Drive
- Removable Disk for Data Archive and Storage
- Random Access Memory (RAM)
- 1280 x 1024 (or better) LCD Monitor
- Windows XP Professional OS (or greater)
- 16+ Channel A/D, DIO On-board data acquisition/reduction system
- 6+ Channel Anti Alias Filters
- Modem and/or Ethernet connectivity



### **Data Acquisition/Control:**

Parallel full-time data acquisition/control processing is accomplished by MicroStar Data Acquisition Processors (DAP) which feature on-board CPU and memory as well as Analog to Digital and Digital to Analog converters. Closed-loop PID control is achieved on-board the DAP unit for full software tenability of hydraulic actuators in load feedback control.

- Pentium Based Data Acquisition Processor to operate in parallel with the Pentium based Microprocessor
- 19" Rack Mount analog and digital interface for sensing and controlling digital inputs and outputs

### **Software:**

**TMSI's** data acquisition/reduction program is used to operate the on-site **ServoTrac Data Acquisition and Control System**, control tests according to the required standards, reduce and present tabular and graphical reports, and archive test results to the hard drive or removable media.



## The TMSI Card Cage

### Components:

- 19" Rack-mountable 16-slot chassis
- 16-Slot printed circuit board backplane
- Dual Switching DC Power Supplies
- Backplane to Rear Panel Interface harness
- Rear panel with appropriate Bendix connectors



### Description:

The *TMSI* Card Cage System is a flexible laboratory test platform which accepts modular card units designed to gather data and provide control during testing. Such modular cards include Airbag Squib Fire, Sensor Amplifier, Time Zero, and Control Unit. Typical applications include crash test laboratories, static testing of automotive components, and tire uniformity testing.

The Card Cage System is a 16-slot rack-mountable chassis with a custom backplane that interfaces with a host of computer through a digital interface card. It also contains the necessary power supplies and external connections on the rear panel needed for testing. It is available in two versions: the crash test laboratory version contains rear panel connections to interface with an umbilical cable that leads to a crash vehicle or sled carriage. The instrumentation version contains a more general rear panel that can accommodate a variety of laboratory testing configurations.

There are seven types of cards that can be installed in the Card Cage:

- **Squib Fire Card** - used to precisely deploy an air bag and gather data concerning the electrical characteristics of the squib while it is deploying.
- **Sensor Amplifier Card** - used to excite, amplify, and filter most sensor types to a usable level.
- **ICP Amplifier Card** - used to excite, amplify and filter ICP type transducers, such as load cells and accelerometers.
- **Servo Amplifier Card** - used to output servo valve drive current that is proportional to input command Voltage.
- **Time Zero Card** - used to monitor sensors and generate an output that synchronizes multiple devices to the same point in time.
- **Frequency Generator Card** - used to generate a variable-frequency TTL square wave.
- **Control Unit Card** - the interface between the Card Cage and the host computer.

A variety of combinations are possible with these cards. For example, a typical crash test laboratory version would contain up to ten Squib Fire Cards, four Sensor Amplifier Cards, one Time Zero Card, and a Control Unit Card. A static airbag test system would contain up to ten Squib Fire Cards, up to ten Sensor Amplifier Cards (the total Squib Fire and Sensor Amplifier Cards cannot exceed fourteen), and a Control Unit Card. A tire uniformity system would contain at least six and up to fourteen Sensor Amplifier Cards, a Frequency Generator Card, and a Control Unit Card.

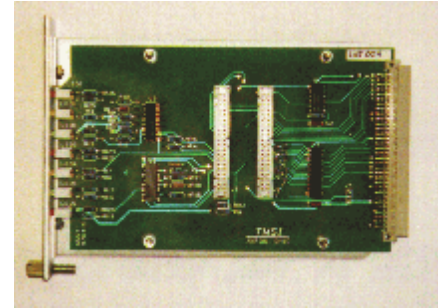


## Control Unit Card

### Features:

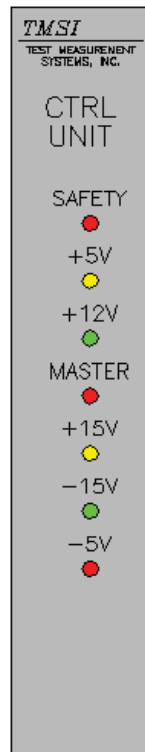
- Communication between the host computer and all Card Cage cards.
- Monitoring of all power supply states.
- Buffering of external switches to the backplane.

### Description:



The *TMSI* Control Unit Card is used to interface the Card Cage backplane to the digital communications interface in the host computer. The card is installed into slot 16 in the 16-slot Card Cage and is controlled through the digital interface. One Control Unit Card must be installed in the Card Cage.

The Control Unit Card is the necessary link between the host computer and all of the cards in the Card Cage. It directs the digital inputs and outputs of the interface card in the host computer to the address bus and bi-directional data bus on the backplane.



The Control Unit Card also monitors the power buses in the Card Cage. The power buses include the  $\pm 15$  volt power for all analog circuits, the +5 volt power for all digital circuits, the -5 volt supply for analog switching circuits, and the +12 volt supply needed for the capacitor banks in the Squib Fire Cards. The monitors indicate if a power supply is on or off.

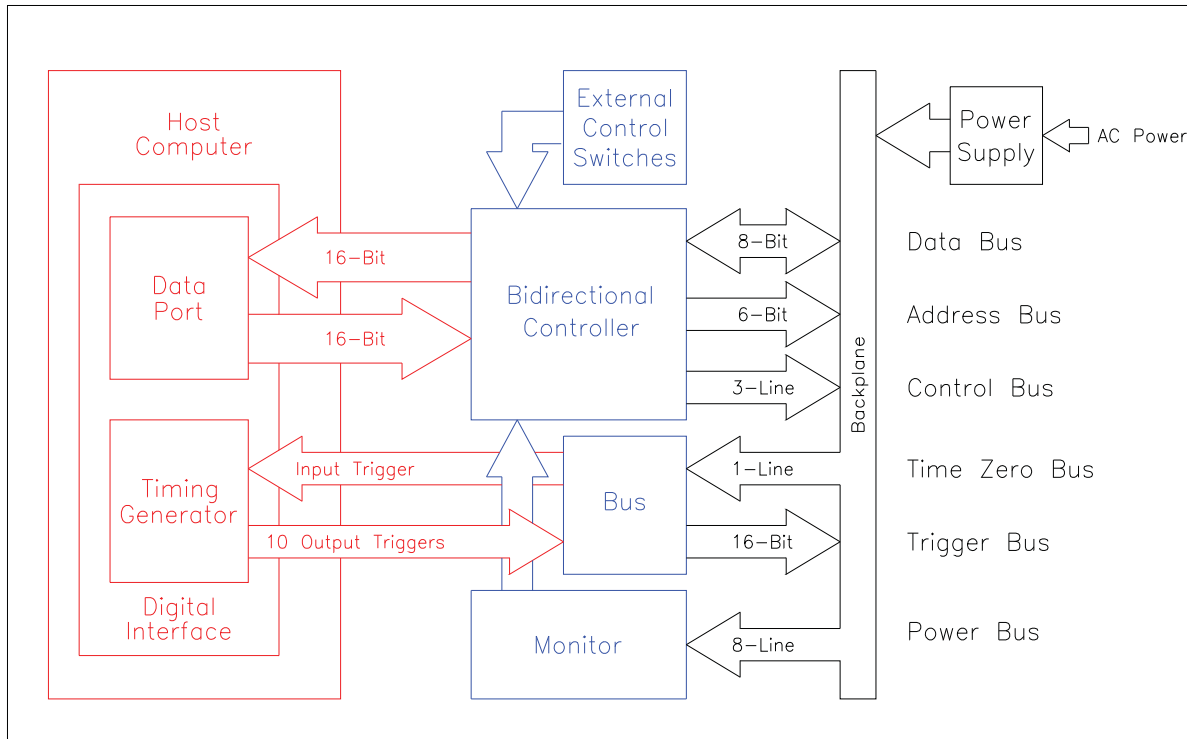
Two external switches are buffered by the Control Unit Card and sent through to the backplane at TTL level. These are the “Master Arm” and “External Safety” switches. Usually, both functions are combined in one switch. They are optically-isolated on the Control Unit Card to separate the external voltages on these switches from the backplane. The “External Safety” switch inhibits all Squib Fire Cards and the Time Zero Card on the backplane. The “Master Arm” switch applies charging voltage to all Squib Fire Cards on the backplane.

The following status functions appear on front-panel LED's:

- Safety indicates the “External Safety” switch is in the safe position.
- +5V confirms +5 volt power is present on the backplane.
- +12V confirms +12 volt power is present on the backplane.
- +SQ indicates the “Master Arm” switch is in the “Armed” position.
- +15V confirms +15 volt power is present on the backplane.
- -15V confirms -15 volt power is present on the backplane.
- -5V confirms -5 volt power is present on the backplane.



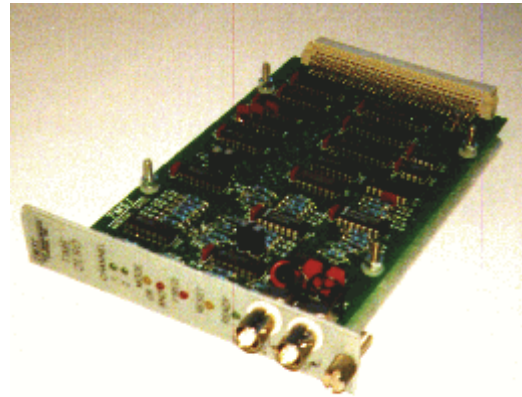
## Functional Diagram: Control Unit Card:





### Features:

- Digital input channels for triggering with an event.
- Analog input channels for comparing a signal with a threshold reference.
- Threshold reference programming for two separate analog inputs.
- Threshold Reference source selection between internal and external.
- Switchable DC Blocking control for both analog signal inputs.
- Programmable polarity inversion control of each channel.
- Both channels combined using programmable logic 'AND' or logic 'OR' function.
- Buffered time-zero outputs.
- Status of card inputs, logic mode, output, readiness, and inhibition.



### Description:

The *TMSI* Time Zero Card is used to generate simultaneous time-zero outputs after external triggering is received. The card is installed into slot 15 of the 16-slot Card Cage and is programmed and controlled through the Card Cage backplane. Only one Time Zero Card can be installed in the Card Cage.

The Time Zero Card contains two identical channels. Each channel can be programmed to trigger on either a digital or analog input. The digital input can be a switch or a TTL source. The analog input originates in an Amplifier Card in the same Card Cage. The Amplifier Card is programmed to send its output to that Time Zero Card channel.

The analog signal is compared with a threshold reference to generate a trigger for that channel. The reference can be obtained from an internal programmable source or an external source. Both internal reference sources are programmable from 0.00 to 5.00 volts in 200 steps of 25mV each.

Each analog input has a 2Hz high pass DC blocking filter that can be programmed on or off. If the associated amplifier card already has the DC blocking on, the Time Zero Card DC Block is not necessary.

Each channel has a programmable polarity reversal switch. This can be used to invert the output of the analog comparator or the digital input. This is convenient if the external switch connected to the digital input is normally-closed instead of normally-open.

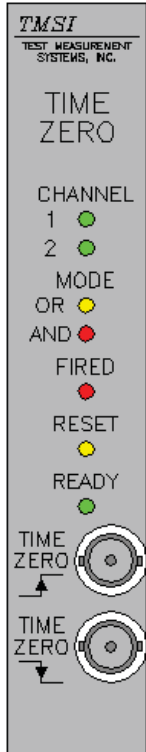
The two channels are triggered and latched independently from each other. The outputs from these two latches are combined into one output using a logic function. This programmable function is either '1' OR '2' or '1' AND '2'. The 'OR' mode causes the two trigger channels to operate in parallel.



# Time Zero Card

Continued

This is desired for backup trigger operation in case one channel fails. The 'AND' mode causes the two trigger channels to operate in series. This is desired for confidence operation so false triggering is less likely to happen. The output of this logic function is the time-zero signal used to synchronize all devices to 0.0 seconds.

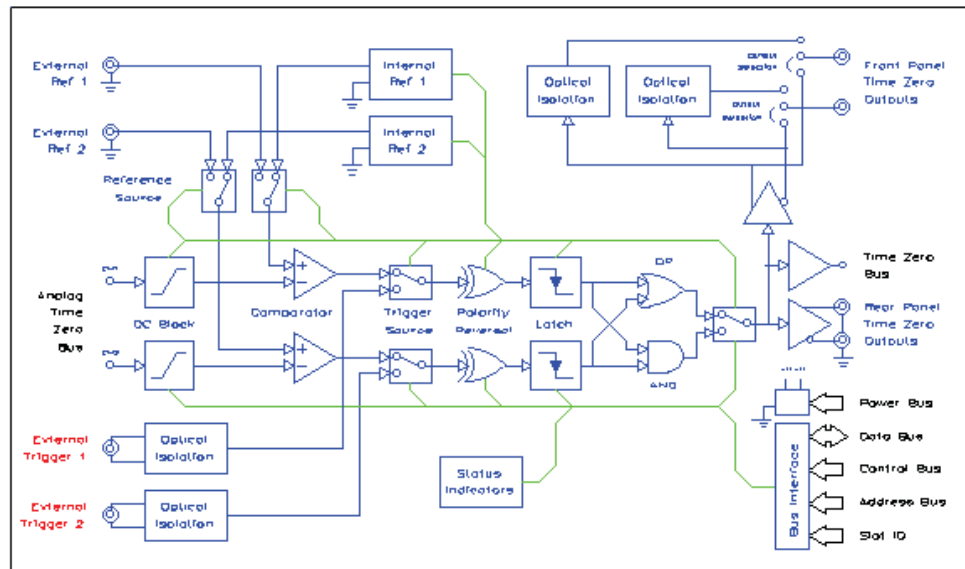


The Time Zero Card generates multiple outputs simultaneously with the time zero signal. Two BNC connectors on the rear panel are buffered TTL outputs capable of driving coaxial cable. One is the complement of the other. Two BNC connectors on the front panel are configurable with jumpers on the card. Either buffered TTL outputs or floating optically-isolated outputs can be chosen. These two BNC Connectors are also complements of each other. A main TTL time-zero signal is also sent down the backplane for initiating the timing sequence for the Squib Fire Cards.

The following status functions appear on front panel LED's:

- Channel 1 indicates the state of either Analog Input 1 or Digital Input 1.
- Channel 2 indicates the state of either Analog Input 2 or Digital Input 2.
- OR indicates the time-zero output will be either channel 1 or channel 2.
- AND indicates the time-zero output will be both channel 1 and channel 2.
- Fired displays the state of the time-zero signal.
- Reset displays the state of the control signal which inhibits and resets the Time Zero.
- Ready confirms both channel 1 and channel 2 are ready to be triggered.

**Functional Diagram:  
Time Zero Card**

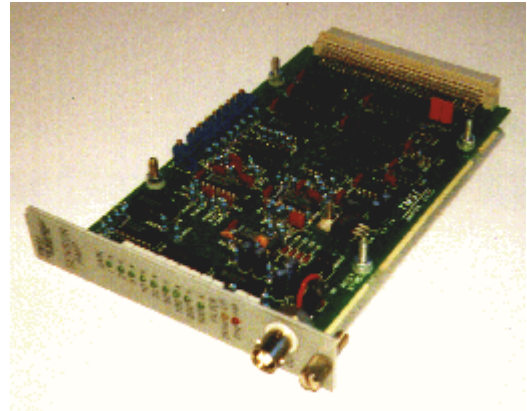




## Sensor Amplifier Card

### Features:

- Excitation voltage output control for bridge type sensors.
- External sensing feedback for the excitation supply.
- Gain control of the instrumentation amplifier.
- Protection of the amplifier input from electrostatic overload.
- Switchable DC Blocking of the amplifier output.
- Switchable Lowpass Filtering of the amplifier output.
- Offset control of unbalanced bridge-type sensors.
- Shunt Calibration control of bridge type sensors.
- Identification of connected sensor through Card Cage System.
- Output of amplified sensor signal on card front BNC connector and on rear panel of the Card Cage chassis.
- Time Zero card compatibility in the Card Cage System.



### Description:

The *TMSI* Sensor Amplifier Card is used for programmable amplification of sensors. The card is installed into one of fourteen(14) slots in the 16-slot Card Cage and is programmed and controlled through the Card Cage backplane. Up to fourteen(14) Sensor Amplifier Cards can be installed in one instrumentation Card Cage.

The excitation source on the card supplies regulated DC voltage to bridge sensors. It is programmable from 0.0 volts to 10.0 volts in 100 steps of 100mV. The maximum current available is 200mA. The excitation source can use an optional external sensing feedback loop to provide exact excitation levels at the sensor.

The Sensor Amplifier Card uses a programmable instrumentation amplifier. The amplifier can be programmed to use one of eight preset gain factors or unity gain. The preset gain factors are 2, 5, 10, 20, 50, 100, 200, and 500. The instrumentation amplifier has unusually high input impedance and is protected by metal-oxide varistors and overvoltage protection diodes.

A 2Hz one-pole RC highpass filter acts as a DC blocking filter. It operates on the output of the amplifier and can be programmed on or off through the Card Cage System.

A 2 kHz six-pole Butterworth lowpass filter acts as an anti-alias filter for data acquisition systems. It operates on the output of the amplifier and can be programmed on or off through the Card Cage System.



# Sensor Amplifier Card

Continued

**TMSI**  
TEST MEASUREMENT SYSTEMS, INC.

**SENSOR AMP**


GAIN

- 1 ● x
- 2 ● x
- 5 ● x
- 10 ● x
- 20 ● x
- 50 ● x
- 100 ● x
- 200 ● x
- 500 ● x

FILTER

- 2KHz ● LP
- 2Hz ● HP

SIG OUT



A DC offset compensation network is provided for bridge-type sensors. The series resistance, offset deviation percentage, and application of this network can be programmed through the Card Cage System. There is also a momentary shunt calibration simulation with multiple equivalent resistance steps to check linear response of the sensor and amplifier chain.

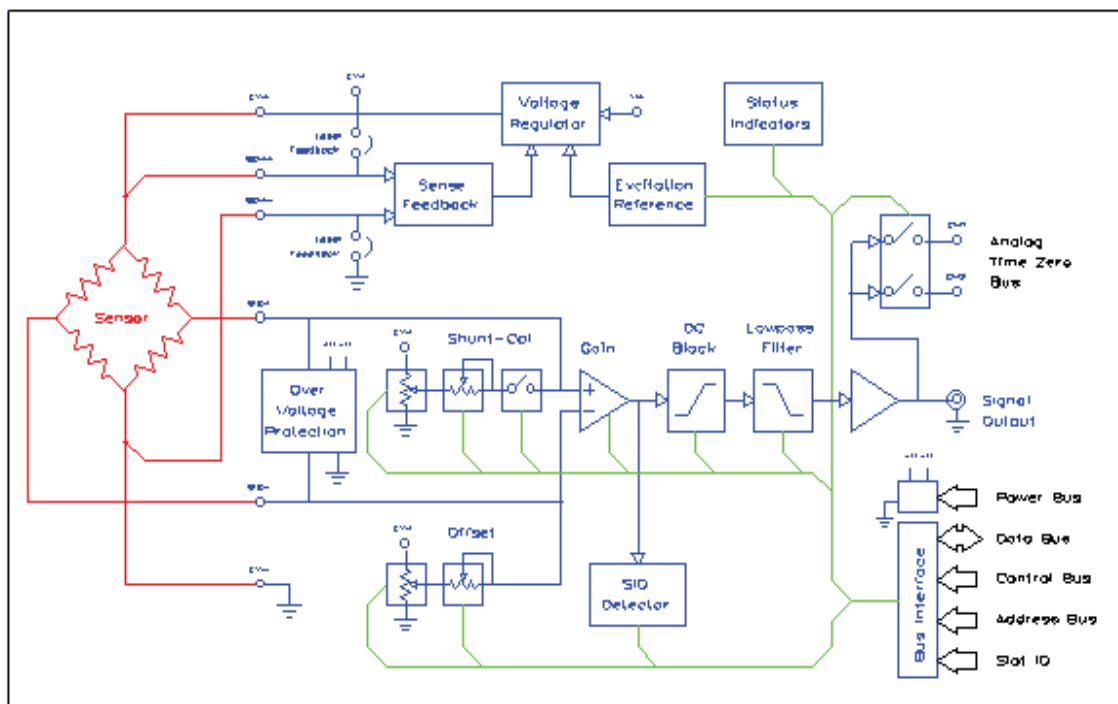
Identification of the connected sensor can be performed through the Sensor Amplifier Card in conjunction with the Card Cage System and a Sensor Identification Module attached to the sensor. The digital identification data stored in the module can be transmitted through the amplifier, detected on the card, and passed to the Card Cage System for interpretation.

The output of the card may be selected as a source of triggering for the Time Zero Card in the same Card Cage. One of two Time Zero analog channels is selected for routing the signal from the Sensor Amplifier Card output to the Time Zero Card input.

The following status functions appear on the front panel LED's:

- Gain selection is displayed on one of nine 'Gain' LED's.
- LP indicates the 2 kHz anti-alias filter is engaged and filtering the amplifier signal.
- HP indicates the 2Hz DC blocking filter is engaged and filtering the amplifier signal.

**Functional Diagram: Sensor Amplifier Card:**



# JK & HASETRI

## showcase the 'First in the World' - On LEVEL™ TyreTest Machine

**A**t a Press Conference in Faridabad near Delhi, JK Tyre & Industries Ltd., one of the world's leading tyre manufacturers, in collaboration with HASETRI (Hari Shankar Singhania Elastomer and Tyre Research Institute), launched The TMSI OnLEVEL™ Tire Test System, the first in the world to provide real data in real time for a wide range of tests. The System on a single test station measures. Force and movements, rolling resistances, high speed uniformity, revolutions per kilometer, and other factors to streamline data generation.



Dr. RP Singhania inaugurating the OnLEVEL™ Tyre Testing machine by clicking the mouse

Dr. R.P.Singhania, Vice Chairman & Managing Director, JK Tyres & Industries Ltd. and President of Hasetri inaugurated the OnLEVEL™ tyre testing machine. Speaking on the occasion he recounted that JK had established HASETRI (Hari Shankar Singhania Elastomer & Tyre Research Institute) to fulfill the ever challenging need, of the rubber and allied industry in the Asian region, to keep pace, with the rapidly growing automobile industry.

HASETRI is recognized as a Scientific & Industrial Research Organization (SIRO), by India's Department of Scientific & Industrial Research (DSIR). It is actively involved in research, advanced testing, education and training in the field of Rubber Science and Technology.

HASETRI has consistently been, in the fore front in introducing state-of-the-art, advanced testing techniques, and in creating facilities, for elastomer, tyre & vehicle mechanics to support the many development activities of JK Tyre, and also the requirements of elastomeric components, for different strategic Govt. organizations like Atomic Energy, Defence etc.

As is well known, JK pioneered the introduction of Radial Tyre Technology in the early 70s, inspite of the scepticism of others in the tyre industry. Like all pioneers JK stuck to the courage of its conviction and established its leadership

position ever since well in both commercial vehicles and passenger radial tyres. In keeping with it's pioneering spirit and to meet the ever growing technology needs of India and Asia, the company has consistently enhanced its knowledge capability together with advanced evaluation methods. With this objective in mind, JK's Hasetri has been working with Test Measurement Systems Inc. (TMSI), USA to establish such a machine for a specific test. These efforts led TMSI to develop this OnLEVEL™ Tyre testing machine which is the very first of its kind in the world.

The OnLEVEL™ testing machine can measure on a single platform:

- Force & Moments
- Ply steer Residual Aligning Torque
- Rolling resistance
- Conicity Residual Aligning Torque
- High Speed Uniformity
- Rolling Radial Spring Rate
- Conicity & Plysteer
- Revolutions per Kilomer (RPK)

OnLEVEL™ does all this on a realistic flat road surface with computer-controlled speed, load, inflation pressure, steer angle, and camber angle, while capturing tire performance data, for instant analyses. Engineering reports, and data archival are immediately available upon the completion of each test, using built-in report generation system.



OnLEVEL™ tyre testing machine

Moving from one type of test, to another, while the same tyre remains mounted, is as easy as, a few keystrokes and mouse clicks, enabling increased productivity, in acquiring data on each tire design, for immediate feedback to our designers, engineers, and valued OEM customers, ensuring, very quick response & data transfer to our customers.

HASETRI, which today has 4 centres, namely at Jaykaygram (Kankroli, Rajasthan), "Centre of Excellence

for Tyre & Vehicle Mechanics", at IIT Madras, a first of its kind Academia-Industry venture, the Test Track at Chennai, and at this Faridabad Campus. This location also houses J.K.'s nerve centre for Product Development-JK Tyre Tech Centre.

During October '09, the Indian automobile market has shown highest automobile growth in the world. Today HASETRI with JK Tyre's Product Development Centre, is poised to meet the challenges, posed by the automobile industry in India. Dr. R.P. Singhania is confident, that with continuous advancement, in evaluation technology at HASETRI, and JK Tyre Tech Centre, high performance needs of modern automobiles will be fulfilled.



**Dr. R P Singhania (VC&MD JK Tyre & Industries Ltd and President-HASETRI) and Dr. Gerald R Potts (President, TMSI, USA) jointly cutting the ribbon**

Dr. Singhania thanked, Dr. Gerald Potts, TMSI, USA and his team for developing the OnLevel™ Tyre testing machine together with J.K.'s Scientists & engineers. He also showed his special appreciation to J.K.'s Team Tech Centre, Tyre Plants and HASETRI for having worked relentlessly and to ensure the perfect commissioning & installation of the machine.



**Dr. R Mukhopadhyay, (Director & CE-HASETRI) and Dr. Gerald R Potts (President, TMSI, USA) addressing the media.**



**(L/R) Dr. R Mukhopadhyay, Arun K Bajoria, Anshuman Singhania, V Sivaramakrishnan, Dr. Gerald R Potts & Dr. RP Singhania after the inauguration of the machine**

Speaking at the Press Conference, Dr. Gerald R. Potts, President of TMSI, USA an inventor of the OnLevel™ Tyre Test Systems stated that "TMSI supplies a wide range of test and measurement products for a number of industries. Our products are designed to enhance productivity and provide significant competitive advantages to our clients. This particular product has been designed for JK Tyre which has proved to be the first and the only product in the world to



**Dr. R P Singhania (VC&MD JK Tyre & Industries Ltd. And President-HASETRI) and Arun K Bajoria (President, JK Tyre & Industries Ltd.) with the Maruti Suzuki team**

complete several tests on a single machine enabling an unrivaled level of streamlined data generation." He added, "We are happy to be associated with JK Tyre and feel this product will revolutionise the tyre industry's simulation testing in the world."

Dr. R. Mukhopadhyay, Director & CEO, HASETRI, said, "JK Tyre is the pioneer in bringing technology to tyres in India. We did it in 1977 with radialisation of truck and bus radials and again after 32 years we bring the technology that will soon revolutionise the simulated testing in the world. The biggest advantage of the machine is that moving from



(L/R) Anshuman Singhania, Prof. AK Bhowmick (Director, IIT Patna), Dr. James Jacob (Director RRII, Rubber Board) & Arun K Bajoria (President, JK Tyre & Industries Ltd.)



(L/R) Dr. R P Singhania with Prof. R. Krishnakumar (IIT Madras), Anshuman Singhania and Dr. Gerald R Potts

one type of test to another, while the same tyre remains mounted is as easy as a few keystrokes and mouse clicks. This would enable increased productivity in acquiring data on each tire design for immediate feedback to your designers, engineers, and customers. This will bring about a revolution in testing technology and would drastically reduce the New Product Development cycle time.

OnLEVEL's flat roadway surface, operating at speed, is the principal feature that makes this set of tests more accurate and more realistic than data generated on traditional round-wheel machines. It gives tire technologists and vehicle analysts real stresses and strains rather than those artificially induced by a round road wheel. The measurement head and computer data system's hardware and software are designed to run many different tests, all on the same machine.

## JK Tyre & Industries Ltd.

JK Tyre & Industries Ltd. has been ranked as No. 1 in JD Power Customer Satisfaction Index in 2009 in India and is the first and only Tyre Company to be awarded 'Superbrand'. It is the flagship Company of JK Organisation known for manufacturing leading tyre brands - JK Tyre, Vikrant and Tornel. JK Tyre is India's leading four-wheeler tyre manufacturer and the 22nd largest tyre manufacturer in the world. As the pioneers of radial technology in India since the mid seventies, the Company has taken forward the radial revolution in the Truck and the Bus segments. Over the years, JK Tyre & Industries has achieved innumerable feats including the top honours such as "The Brand Equity Award", "Rajiv Gandhi National Quality Award", "CII - Exim Bank Award" and several other awards. With a distribution network of over 4000 dealers and over 120 stocking points, the Company has left a mark across every Indian road treading into every nook and corner of the country.

## HASETRI (Hari Shankar Singhania Elastomer and Tyre Research Institute)

HASETRI is an independent Research Institute, promoted by JK Tyre & Industries Ltd. and a very first of its kind in Asia (Estd. Oct. 1991). The institute has two centers at Kankroli, Rajasthan and Faridabad-Haryana. The institute is engaged in research, testing, education, and training in the field of Elastomer, Tyre and rubber products. To foster the Industry Academia Research, the institute jointly with JK Tyre and Industries Limited and IIT-Madras, has established Ragupati Singhania Center for Excellence in Vehicle Dynamics and Tyre Mechanics at IIT-Madras, Chennai.



HASETRI Faridabad Centre



## *Just a Few of Our Customers . . .*

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- Akron Standard / ITWRQP
- Apollo Tyre Co. (India)
- Birla Tyre Co. (India)
- Bridgestone Tire Co. (Japan, Europe)
- Bridgestone/Firestone (Brazil and USA)
- Central Inst. For Road Transport (India)
- Continental Tire Co.
- Cooper Tire & Rubber Co.
- Dae Bu Seat Co. (Korea)
- Daewoo Motor Co. (Korea)
- Dayton Tire Co.
- Detroit Test Laboratory
- Dongsung Seat Co. (Korea)
- Dunlop Tire Co. (Africa)
- Ford Motor Co.
- General Motors Corp.
- Goodyear Tire & Rubber Co.
- Han Yil Seat Co. (Korea)
- Hanil Ehwa Seat Co. (Korea)
- Hankook Tire Co. (Korea, USA, China)
- Honda Motor Co.
- Hoosier Tires
- Hyundai Motors (USA)
- JCI Seating Co. (Korea, China)
- JK Tyre Co. (India)
- Kia Motor Co. (Korea)
- Korean Automotive Technical Center
- Kumho Tire Co. (Korea, USA, China)
- Lear Seating Co.
- Magna/Intier Testing Co.
- Mando Machinery Corp. (Korea)
- Michelin Tire Co. (Mexico, USA)
- MRF Tyre Co. (India)
- Myungbo Seat Co. (Korea)
- Nexen Tire Co. (Korea)
- Nissan Motor Co.
- PCC Airfoils
- Pirelli Tire Co.
- RBC Linear Bearing Co.
- Samsung Motor Co. (Korea)
- ServoCon Alpha Valve Co.
- Smithers Scientific Services
- SsangYong Motor Co. (Korea)
- Sungwoo Corp. (Korea)