

APPLICATION NOTES

MTS Kinematic And Compliance Deflection Measurement System Provides Information On Suspension Performance

Automotive engineers use the MTS K&C System to measure the kinematics and compliance (K&C) deflections of an automotive suspension. Suspension deflections are important because they affect the ride and handling characteristics of a vehicle. Deflections as small as 0.54 mm and 0.03 degrees are significant to the vehicle designer.

The MTS K&C System applies precisely controlled displacements and forces to the vehicle tires through four independent loading platforms while holding the body fixed. The resulting wheel displacements are measured with a six axis optical wheel motion sensor. At the same time, the forces produced at each tire are measured with a six axis load cell. The measured displacements and forces provide information to the suspension designer that will help achieve handling, ride and durability objectives.

MTS has engineered its K&C System to accurately measure vehicle characteristics, manage large amounts of test information and automate the testing process. The result is more efficient vehicle suspension analysis and development.

Kinematics and compliance measurement treats the suspension as a black box by applying known displacement or force inputs to the suspension and measuring the position changes at the wheel center.

Kinematics tests measure wheel position changes that occur due to



K&C Deflection System

vehicle position changes (such as roll and ride height) while horizontal forces are zero. Compliance tests measure wheel position changes due to horizontal force inputs. By performing kinematics tests, compliance tests and combinations of both, suspension designers and vehicle dynamicists obtain important vehicle suspension parameters.

K&C System Features

Here are a few of the key features of the MTS K&C System.

First, each platform has a six axis

strain gage load cell that gives you zero reference stability and accuracy of data. It will also aid in installation of the vehicle on the test system.

The MTS design features active control of the horizontal platform forces to zero. This is superior to passive mechanical system technology because it is insensitive to friction, and allows mode switching in mid test.

Optical Wheel Motion Sensors provide six axes of displacement measurement without contact, as well as easy visual set-up.

The digital controller offers automatic sequencing, data management, test monitoring and user programmability.

Four Elements

The K&C System consists of four major elements:

- **Platform Modules** apply displacement forces at the tire patch
- **Structural Base and Body Clamp** for alignment and rigidity of the platform modules
- **Control and Instrumentation** provide up to 79 channels of data acquisition and force inputs plus 25 servocontrol channels for a four corner system
- **Wheel Motion Sensor** measures six degrees of motion at each vehicle spindle to accurately measure its kinematics.

Here are some details on each of these elements

Platform Modules

Either two or four platform modules can be used. While the four platform version is superior and faster, you can get nearly as much information from a two platform system, testing one axle at a time and repositioning the vehicle between tests.

Each pair of platforms, front or rear, has the following control parameters:

- Vertical Motion
- Roll Motion
- Longitudinal Force and Displacement
- Lateral Force and Displacement
- Aligning Torque and Steer Displacement
- Steering Wheel Displacement

During testing, data from six axes of spindle displacement and six axes of force and moment are acquired for each wheel under test.

Both height and roll attitude of each load platform are individually controlled. Typically, both platforms

on the same axle are coordinated during roll or ride height changes. Individual wheel steer-ride characteristics can be investigated with noncoplanar motion.

This system provides complete determination of forces and moments at the tire patch.

Base And Body Clamp

This steel base provides automatic wheel base and track adjustment of the platform modules. It also aligns the modules correctly and provides rigid support.

An hydraulically and electromagnetically actuated system clamps and restrains the vehicle body during testing.

Controls And Instrumentation

The four-platform version of the MTS K&C Deflection Test System has 79 channels of data acquisition and force inputs and 25 channels of servocontrol.

MTS Model 497 and 498 Digital Controllers provide real-time control

and data acquisition. The data is manipulated, converted to engineering units and stored on disk for transmission to the analysis computer for storage and later analysis.

Test Control

The controller interface allows operators to start and interface with the test as it is running.

Seven automatic test sequences are provided in the system, as well as the capability to create nearly any customer test sequence.

- Vertical Motion
- Roll Motion
- Contour Tests
- Steering (lock to lock)
- Longitudinal Braking Compliance
- Longitudinal Acceleration Compliance
- Lateral Compliance
- Aligning Torque Compliance

You may create your own test scripts, or edit existing scripts to suit your needs.

Data may be displayed during a test, or exported to a separate computer for detailed analysis.

An open data file format, with data reduced to engineering units, allows user flexibility for customer analysis.



The following parameters may be derived from test data to critically study suspension behavior.

1. Vertical Motion Test Output

- Toe Curves
- Camber Changes
- Caster Changes
- Track Changes
- Wheel Base Change
- Wheel Vertical Rate
- Ride Rate
- Tire Radial Rate

2. Roll Test Output

- Roll Steer
- Axle Steer
- Camber Change

• Roll Moment

- Roll Stiffness
- Roll Couple Distribution
- Roll Center Height vs. Roll Angle
- Wheel Loads

3. Steering Test Output

- Front Wheel Angle vs. Steering Wheel Angle
- Overall Steering Gear Ratio

4. Longitudinal Compliance Test Output

- Toe Compliance
- Axle Steer Compliance

• Caster Compliance

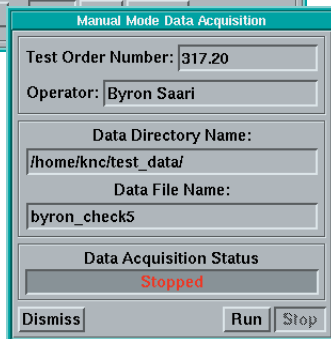
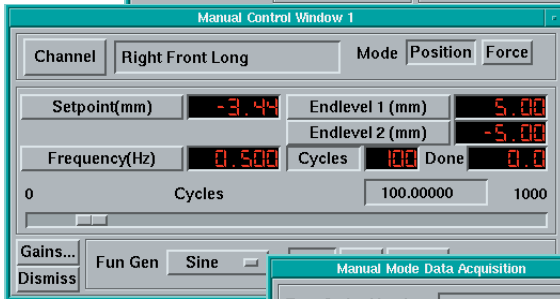
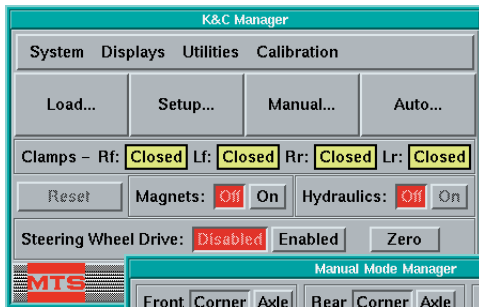
- Camber Compliance

5. Lateral Compliance Test Output

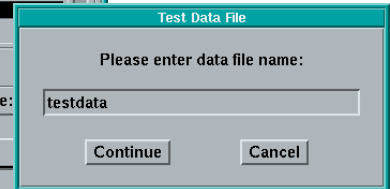
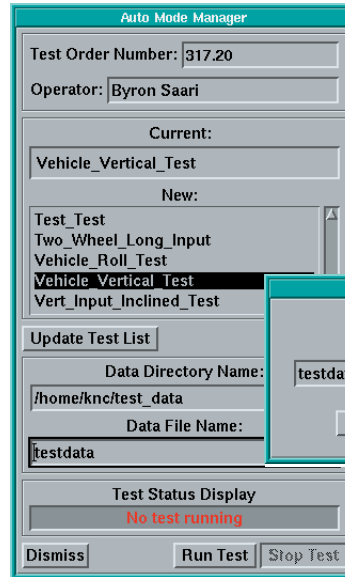
- Compliance Steer
- Axle Steer Compliance
- Track Change
- Camber Compliance

6. Aligning Torque Compliance Test Output

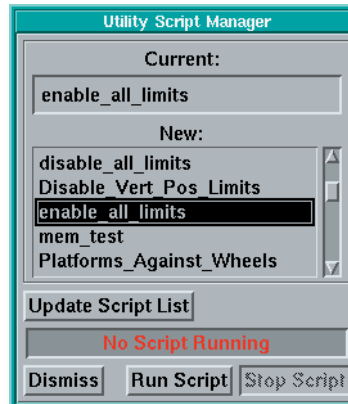
- Aligning Torque Steer
- Axle Steer Compliance
- Camber Compliance



Manual mode operation



Running automated test scripts



Utility script manager window - used to run small, automatic programs. Scripts include: zeroing scripts, force limit scripts, position limit scripts, as well as scripts for full test procedures.

System Specifications Each Platform Module

Item	Range
Platform Motions	
Angular	±45 deg
Longitudinal	±75 mm
Lateral	±75 mm
Roll Angle	±12 deg
Vertical Motion	±200 mm
Wheel Motion at Wheel Center	
Longitudinal	±50 mm
Lateral	±50 mm
Vertical	±162 mm
Angular (Steer)	±45 deg
Camber Angle	±10 deg
Spin Angle	±20 deg
Platform Loads	
Longitudinal Force (X)	±9000 N
Lateral Force (Y)	±9000 N
Vertical Force (Z)	0-30000 N
Aligning Torque (Mz)	±500 N-m
Steering Wheel Rotation Control	
Steering Wheel Angle	±1080 deg
Torque Capacity	±40 N-m
Base Adjustments	
Wheelbase	2000 - 3500 mm
Track Width	1100 - 1800 mm
Platform Surface Diameter	350 mm

Specifications are subject to change without notice.

For More Information

If you would like more information on the MTS K&C System for suspension testing, contact your local MTS Sales Engineer, or call or write the company.



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