

MTS Damper Software

Designed to satisfy a full range of damper testing requirements

Full-featured MTS Damper Software is engineered to fulfill all of your damper performance, durability and quality assurance testing needs. Working in concert with your test system's FlexTest® Controller, it provides capabilities for testing up to four user-programmable channels simultaneously, including axial, lateral, rotational, and active damper channels. Torsional damper testing capabilities are achieved with a rotational input channel.

The software can be used to conduct temperature-dependent performance tests, position-dependent gas force evaluation, noise characterization (NVH), and friction force testing. Scalable durability test capabilities enable users to create simple predefined cycle counts that ensure components meet their required fatigue life, as well as more complex specimen failure

characterizations. Quality assurance tasks are made simple with easy-to-understand graphics displaying specimen information and pass/fail data.

The software's standard waveform generation capabilities include: sine, ramp, square, sine-on-sine, sine sweep, dual rate sine, dual rate ramp, arbitrary (profile), and more. The arbitrary, or profile, command waveform enables the generation of user-defined block cyclic waveforms. Optional RPC Time History Playback is also available.

With MTS damper software, tests can be set up easily and stored for use at any time. Data acquisition is flexible and comprehensive, and test data reports can be automated and include standard force-displacement and force-velocity curves, as well as numerous other methods of presentation and analysis.

be certain.

Performance Testing

MTS damper software enables you to accurately simulate a damper's true working environment and meet a full spectrum of damper performance testing requirements – from basic to advanced.

Building a basic test to characterize a damper's performance is a simple matter of clicking through a few setup windows. Just select the type of waveform required to excite the specimen, define the number of test cycles, choose the number of cycles to collect data, and decide on the type of test results you want displayed. You're ready to begin testing.

For more advanced performance testing, MTS damper software allows you to easily modify the type and shape of excitation applied to the specimen, change the cycle frequency or velocity, and define end levels. For example, you can create steps within the test with sinusoidal excitation followed by steps with more complex excitation such as dual rate sine, dual rate ramp, and even sine sweep.

Incremental Temperature Testing

MTS damper software allows you to predefine the temperatures at which performance data is acquired, enhancing your ability to characterize the effects of temperature on damper performance. With this feature you can more accurately simulate damper performance in its true working environment.

Friction Seal and Gas Force Measurement

MTS damper software enables you to measure friction seal force and gas force at a specified position. In addition, the user has the flexibility to run a multi-position gas force test as a function of shock displacement – the level of test complexity is totally up to you.

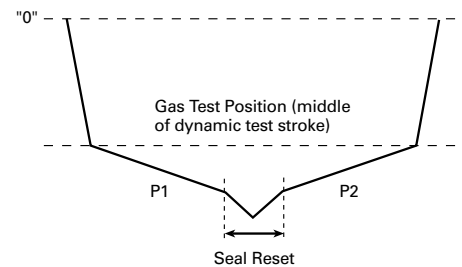
Flexible Data Acquisition

The software's Test Results window allows you to select from among several ways to gather data during testing. MTS damper software calculates the selected test results upon completion of each of the performance steps. You can also select upper and lower limits for each test result and whether to show results with gas force subtracted from the test results.

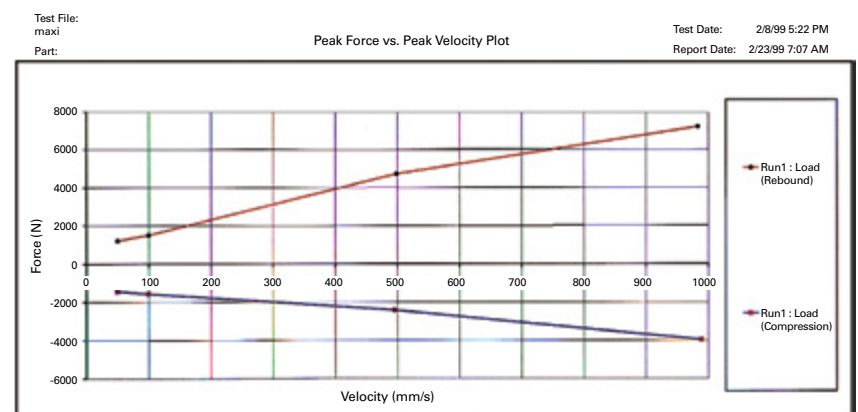
MTS damper software provides you the flexibility to analyze the data during the test. You can pop up graphs for review during the test, display curves for the last performance step, show cycle counts, and display specimen temperature.

Test data, calculated results, and test information are saved to a test workbook for review and further analysis. Every test workbook created includes a worksheet for each data file and a batch file. A test workbook can include multiple reports because each report is stored on a separate sheet in the workbook.

There are many options for displaying the data stored in a test workbook. These include: showing all test runs versus all test conditions; showing multiple runs at selected conditions; or showing one specimen at all conditions.



This drawing shows the seal reset portion of the stroke where the seal is distorted in the proper direction prior to data acquisition. This is a critical step in any seal friction force testing. With MTS software, it's automatic.

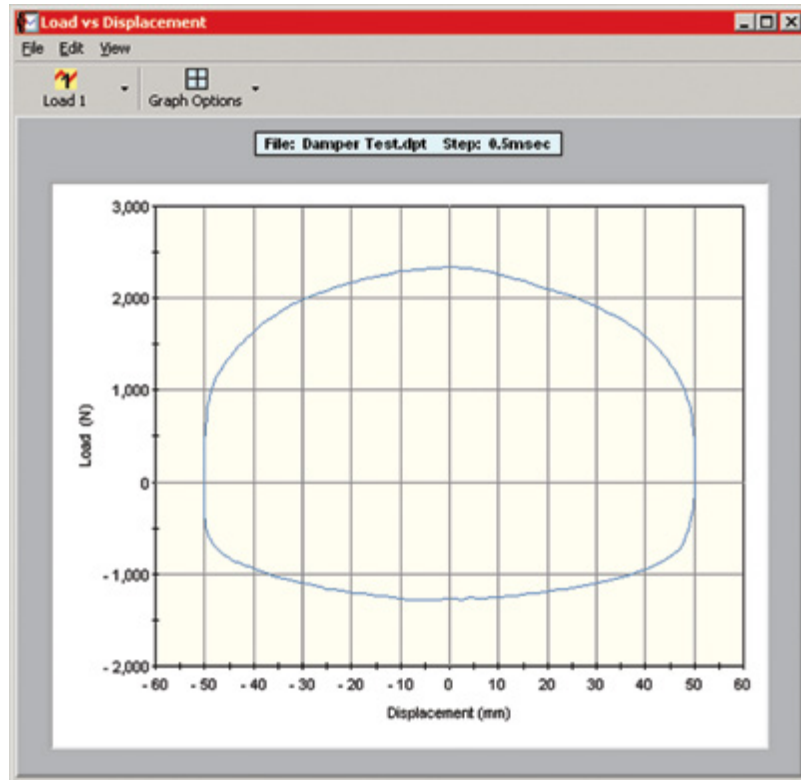


This graph contains a plot of Peak Force vs. Peak Velocity

OPTIONAL PERFORMANCE TESTING FEATURES

- » **Temperature Monitoring** – measure specimen temperature while under test
- » **Hydraulic Side Load** – apply a controlled force on a specimen to more accurately simulate field conditions
- » **Velocity Preservation** – achieve commanded sinusoidal velocity end levels more precisely
- » **Noise Vibration & Harshness** – measure noise associated with dampers

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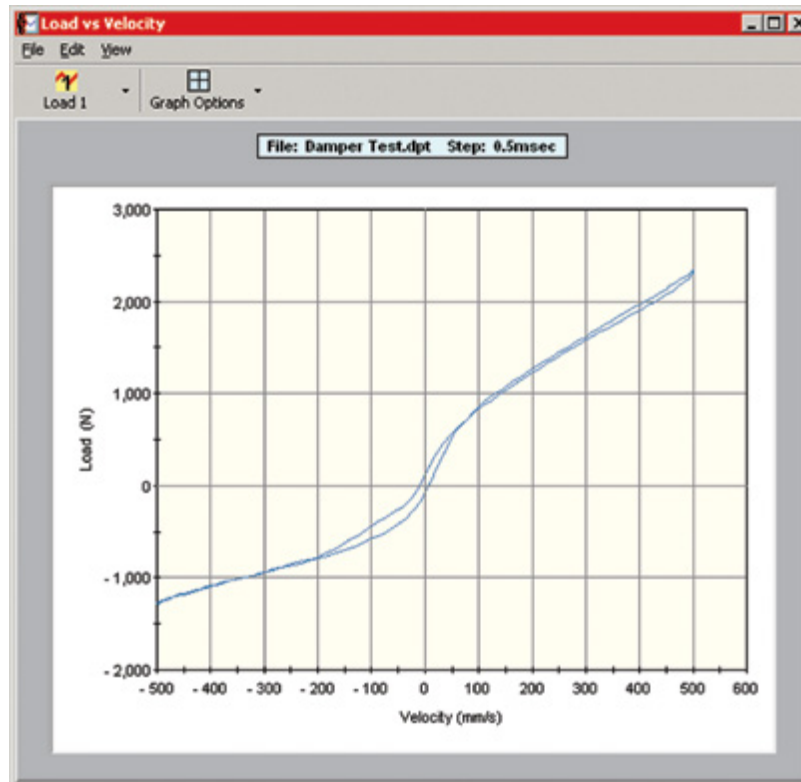
Force vs. Displacement

Test Results Selection

- Peak Rebound Force
- Peak Compression Force
- Peak Rebound Velocity
- Peak Compression Velocity
- Force at Peak Rebound Velocity
- Force at Peak Compression Velocity
- Average Peak Rebound Force
- Average Peak Compression Force
- Average Peak Rebound Velocity
- Average Peak Compression Velocity
- Average Rebound Force
- Average Compression Force
- Average Rebound Velocity
- Average Compression Velocity
- Amplitude Total Harmonic Distortion
- Velocity Total Harmonic Distortion
- Energy
- Rebound Spring Rate
- Compression Spring Rate
- Dynamic Stiffness
- Storage Stiffness
- Loss Stiffness
- Phase
- Damping
- Tan Delta
- Temperature Monitor
- Temperature Chamber
- Force-Displacement Envelope

OK Cancel

Descriptions of test results that are achieved during the data acquisition portion of the test



Force vs. Velocity

Durability Testing

Scalable to Your Requirements – Simple to Complex

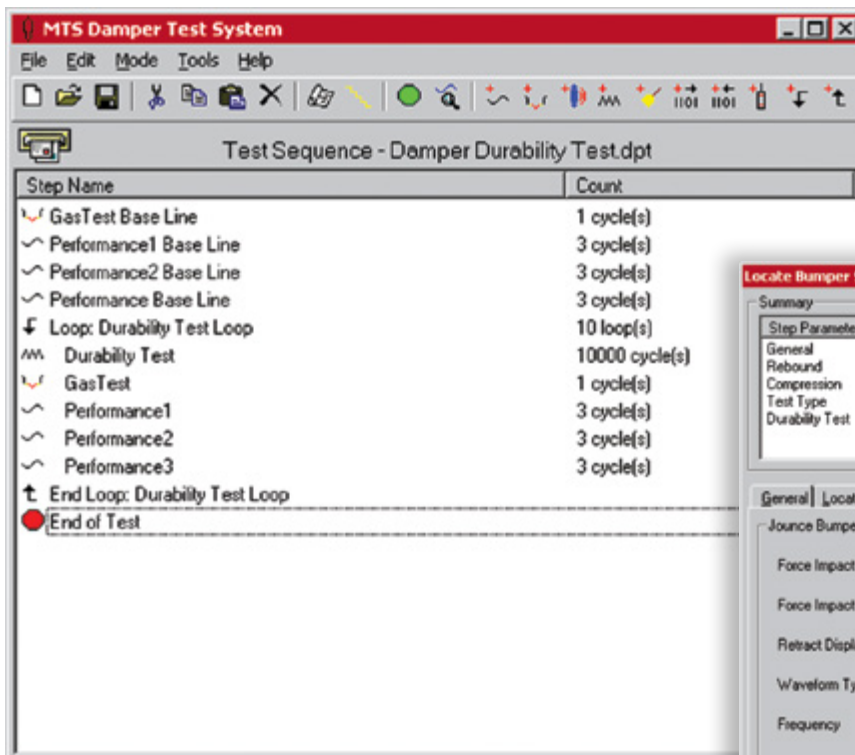
MTS damper software enables you to easily scale a durability test to meet your specific requirements. You can perform the simplest durability test, running to a predefined cycle count to ensure fatigue life, or conduct more complex specimen failure studies using preset limits on calculated results, force degradation, or specimen temperature monitoring.

Full Set of Command Waveforms

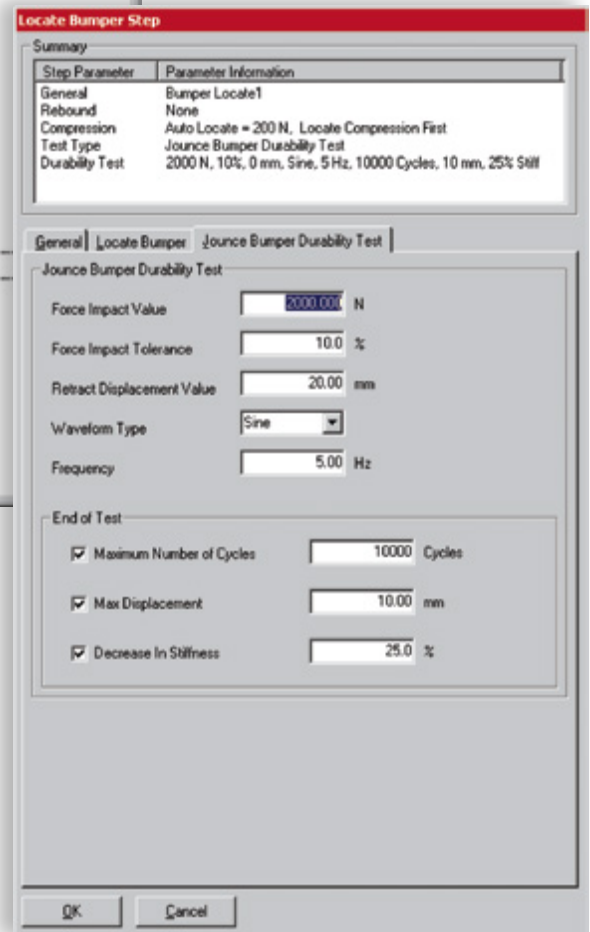
MTS damper software includes a full set of typical command waveforms, such as sinusoidal, ramping, sine-on-sine, ramp-on-ramp, and block cyclic. It also offers more advanced optional command waveforms, such as user-defined profiles and time history play-out. The software can provide several methods of waveform compensation designed to enhance the user's ability to meet programmed velocity end levels; these include peak valley compensation, amplitude phase control, and peak valley phase.

Jounce Bumper Durability Testing

MTS damper software is the first in the industry to feature optional Jounce Bumper Testing, which enables more realistic testing of jounce bumper interaction with the damper. A jounce bumper is an elastic material within a shock absorber that is used to gradually stiffen as the shock approaches the end of its compressive travel; characterizing its behavior facilitates better analysis of damper durability over its full range of displacement. The jounce bumper testing feature enables you to quickly and accurately replicate a specific jounce bumper impact force over a predefined number of cycles. The software automatically stops the test after it reaches a specified bumper displacement or reduction in stiffness.



MTS damper software provides flexibility so that you can create a test sequence tailored to your needs.



With its easy-to-use Windows® interface, a jounce bumper durability test provides even greater functionality.

DURABILITY TESTING OPTIONS

- » **E-mail Paging** – alerts the operator of specimen failure or test completion
- » **Multiple Specimen Testing** – test multiple specimens in a single test
- » **Water Cooling** – ensure temperature stabilization throughout the entire test sequence
- » **Hydraulic Sideload** – apply a controlled force on a specimen to more accurately simulate field conditions
- » **Jounce Bumper Durability** – achieve more realistic testing of jounce bumper interaction with the damper
- » **MTS 793.71 Time History Playback** – run RPC time history files to better simulate field conditions for durability testing
- » **MTS 793.11 Profile Editor** – easily create and edit user-defined waveform files



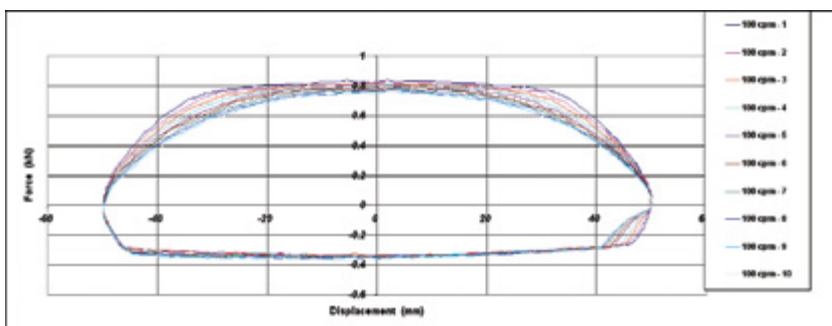
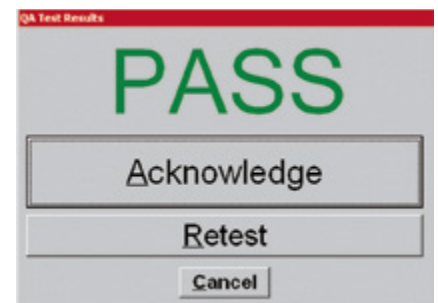
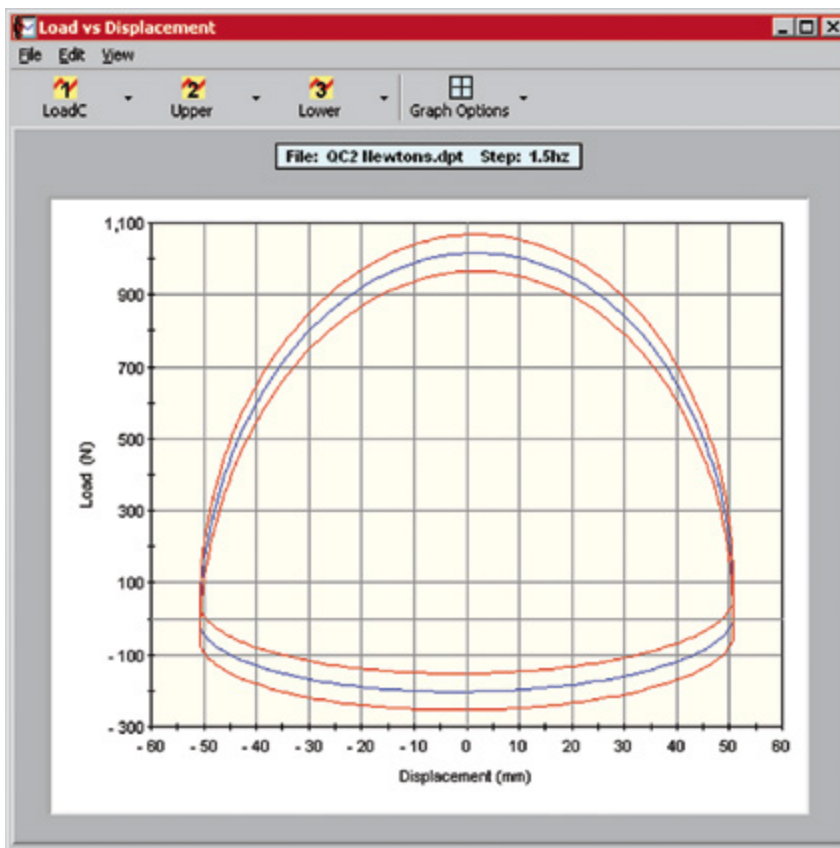
If you are responsible for determining damper component fatigue life, MTS damper software provides you with a full arsenal of tools to meet your durability testing needs.



Quality Assurance Testing

Pass/Fail Quality Auditing Made Easy

- » MTS damper software allows you to create an intuitive, easy-to-use operator workspace. Pass or Fail criteria can be based upon the values of the selected test results or the curve of the force vs. displacement plot. The QA runtime screen features simple operator prompts and clearly displays failing test results. Pass/Fail data for each damper test is stored as a tab delimited data file, and can include:
 - » Specimen name
 - » Time stamp
 - » Overall pass/fail
 - » Pass/fail result for each programmed test result
 - » Pass/fail for the envelope curve



A force displacement plot with upper and lower limits enables the operator to see if a specimen passes (data within the envelope) or fails (data outside the envelope).

Automated Test Results

Test data reports can be automated and include standard force-displacement and force-velocity curves, as well as numerous other methods of presentation and analysis.

Damper Analysis Functions

PLOT FUNCTIONS:

- » Force vs. Displacement
- » Force vs. Velocity
- » Gas Force vs. Displacement
- » Peak Force at Peak Velocity
- » Force at Peak Velocity
- » Velocity at Peak Force
- » Displacement vs. Time
- » Force vs. Time
- » Velocity vs. Time
- » Condition vs. Time
- » Peak Force vs. Temperature
- » Combined Time-Displacement-Velocity
- » Test Results

TABULAR REPORT FUNCTIONS:

- » Individual Damper Report
- » Statistical Report

MTS damper software gives you increased data analysis flexibility

Statistical Report

Test File: Damper Performance Test
Part Description: Left Front Damper

	0.05m/sec	0.12m/sec	0.25m/sec	0.4m/sec	0.5m/sec	0.8m/sec	1m/sec
Peak Rebound Force (N)							
Specimen 1	24.70	260.65	620.62	786.49	918.07	1282.93	1498.26
Specimen 2	7.56	249.56	631.21	862.62	944.60	1224.86	1540.71
Specimen 3	2.02	378.92	529.45	789.51	955.55	1282.42	1416.77
Specimen 4	18.68	255.61	602.47	785.06	940.76	1226.62	1518.53
Specimen 5	8.07	241.49	618.93	784.47	912.07	1289.98	1516.51
Mean	10.49	235.85	602.37	791.63	927.25	1213.21	1512.18
Sigma	8.49	36.44	36.44	7.33	14.27	11.52	20.68
Max. Value	24.70	260.65	631.21	862.62	944.60	1226.62	1540.71
Min. Value	2.02	378.92	529.45	784.47	955.55	1282.42	1416.77
Mean - 3sigma	-18.39	126.52	492.44	763.65	884.43	1170.64	1450.05
Mean + 3sigma	35.96	345.18	712.30	813.61	970.68	1247.78	1574.20
Dispersion %	84.91	20.51	7.84	1.14	1.57	1.00	1.78

	0.05m/sec	0.12m/sec	0.25m/sec	0.4m/sec	0.5m/sec	0.8m/sec	1m/sec
Peak Comp. Force (N)							
Specimen 1	-124.43	-250.32	-466.35	-618.92	-708.05	-875.23	-1090.76
Specimen 2	-182.21	-288.80	-518.22	-683.24	-745.82	-925.09	-1109.96
Specimen 3	-155.65	-282.58	-590.86	-635.04	-727.69	-906.96	-1121.47
Specimen 4	-164.21	-298.86	-528.79	-695.97	-783.59	-959.83	-1153.29
Specimen 5	-160.18	-288.54	-525.77	-656.19	-777.26	-996.38	-1108.38
Mean	-152.54	-285.24	-506.06	-653.87	-749.48	-912.78	-1109.75
Sigma	16.45	18.23	25.46	28.33	27.09	21.93	22.84
Max. Value	-124.43	-250.32	-466.35	-618.92	-708.05	-875.23	-1090.76
Min. Value	-164.21	-298.86	-528.79	-695.97	-783.59	-959.83	-1153.29
Mean - 3sigma	-203.36	-336.34	-586.43	-741.86	-824.16	-1008.48	-1187.27
Mean + 3sigma	-101.72	-236.35	-435.69	-565.88	-656.90	-816.91	-1032.23
Dispersion %	-13.78	-6.72	-4.27	-5.86	-5.86	-4.88	-2.78

Statistical Report – View all specimens in one comprehensive report

Individual Damper Report

Test File: Damper Performance Test
Part Description: Left Front Damper

	Gas Force (P1-P2) (N)	Seal Friction1 (P2-P1) (N)	Seal Friction2 (P2-P1) (N)		
Gas Test	-46.204	12.39	24.80		
0.05m/sec	Peak Rebound Force (N)	Peak Comp. Force (N)	Peak Rebound Velocity (mm/s)	Peak Comp. Velocity (mm/s)	Monitor Temperature (C)
	24.7008	-124.43	50.43	-50.43	23.8
0.12m/sec	Peak Rebound Force (N)	Peak Comp. Force (N)	Peak Rebound Velocity (mm/s)	Peak Comp. Velocity (mm/s)	Monitor Temperature (C)
	260.65	-250.32	109.27	-109.27	23.8
0.25m/sec	Peak Rebound Force (N)	Peak Comp. Force (N)	Peak Rebound Velocity (mm/s)	Peak Comp. Velocity (mm/s)	Monitor Temperature (C)
	620.62	-466.35	255.45	-255.45	23.8
0.4m/sec	Peak Rebound Force (N)	Peak Comp. Force (N)	Peak Rebound Velocity (mm/s)	Peak Comp. Velocity (mm/s)	Monitor Temperature (C)
	786.49	-618.92	318.21	-318.21	23.8
0.5m/sec	Peak Rebound Force (N)	Peak Comp. Force (N)	Peak Rebound Velocity (mm/s)	Peak Comp. Velocity (mm/s)	Monitor Temperature (C)
	918.07	-708.05	314.91	-314.91	23.8
0.8m/sec	Peak Rebound Force (N)	Peak Comp. Force (N)	Peak Rebound Velocity (mm/s)	Peak Comp. Velocity (mm/s)	Monitor Temperature (C)
	1282.93	-875.23	313.91	-313.91	23.8
1m/sec	Peak Rebound Force (N)	Peak Comp. Force (N)	Peak Rebound Velocity (mm/s)	Peak Comp. Velocity (mm/s)	Monitor Temperature (C)
	1498.26	-1090.76	302.56	-302.56	23.8

Individual Damper Report – View the specific results of a single specimen

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Digital I/O Capabilities

MTS damper software features digital signal I/O, which compensates for external devices that may need to pause between steps, while triggering other operations or during the loading and unloading of specimens.

Remain Up-to-Date with Software Support Plan (SSP)

As damper testing requirements evolve, the easiest, most cost-effective means to keep your lab on the forefront is through an MTS SSP agreement. Over time, this agreement costs less than purchasing upgrades and updates separately and makes your budget easier to manage with a low fixed cost. But an SSP agreement offers much more than simple cost savings. It also features:

AUTOMATIC UPDATES

- » New features added to your software in response to demands from the testing community
- » All software updates that become available after initial program purchase
- » New capabilities added to your previously purchased software packages
- » New software that stays compatible with evolving PC operating systems

PREFERENTIAL TECHNICAL ASSISTANCE

Receive preferential access to technical assistance by telephone from MTS software experts at no additional cost.

A PLAN TO FIT YOUR SPECIFIC NEEDS

Agreements are purchased at the time of equipment purchase or shortly thereafter. They are sold in 12-month coverage increments; however, you can buy up to 48 months of coverage at the same low annual rate. You can qualify for discounts if you have multiple MTS hardware systems.

For More Information

To learn how MTS damper software can optimize your damper performance, durability, and quality assurance testing, contact your local MTS sales engineer, visit www.mts.com or e-mail info@mts.com.



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