AR Products Mod III Damper
Dynamic Characteristics Test

AR Products, Inc.

NEETRAC Project Number: 02-230

August, 2002

A Center of
The Georgia Institute of Technology

Requested by: Mr. Al Richardson
AR Products

Principal Investigator: ______________________
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Reviewed by: ______________________
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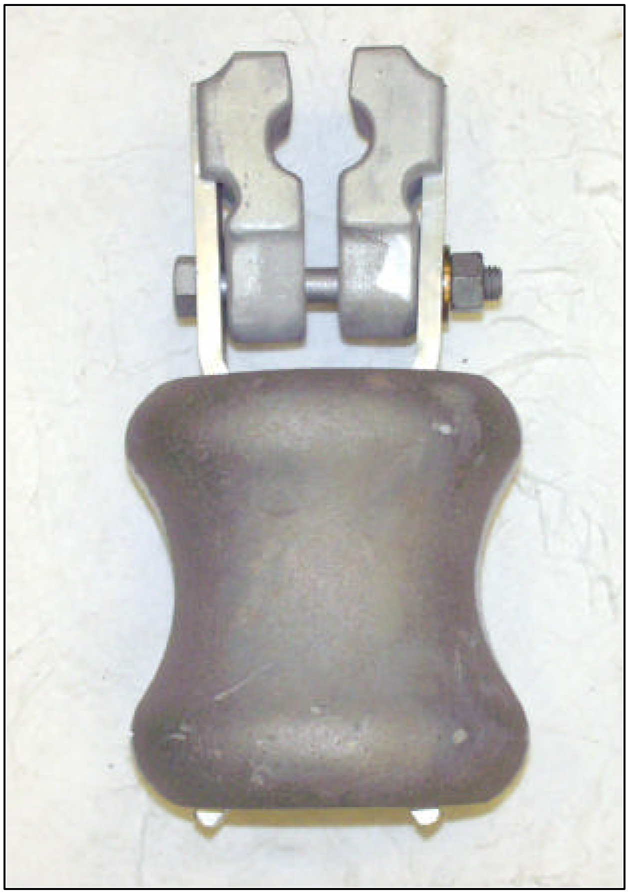
Summary:

Mr. Al Richardson of AR Products requested dynamic response testing for one (1) Mod III single-cable vibration damper. The damper was vibrated at clamp velocities of 100 mm/sec and 200 mm/sec over a frequency range from 3 to 50 Hz. Test data are used to plot damping and the damper impedance curves.

Samples Received for Evaluation:

a) AR Products Mod III single-cable vibration damper. See photograph below.



Photograph 1
AR Mod III Single-cable Vibration Damper

Equipment Required:

Manufacturer	Model #	Control #/ Serial #	Description, Use
Team	520/10	196	Servohydraulic shaker table system
Team	1532	671	Compressor, controls shaker level
Team	1530	670	Vibration Monitor, used for reading Kistler accelerometer
Hewlett Packard	33120A	CR0016	Function Generator
Metrox	LP101	CN0166	Strain gage load pin, used to measure force input to damper
Unholtz Dickie	D22PMB	CN0023	Dynamic strain amplifier, used to condition Metrox load cell
Unholtz Dickie	TF22-K-F1	CN0018	Phase-and gain-matched tracking filter, used to filter acceleration data
Unholtz Dickie	TF22-K-F1	CN0019	Phase-and gain-matched tracking filter, used to filter force data
Kistler	8604A	CN3025	Quartz accelerometer, used for closed-loop control of shaker table velocity, and for clamp acceleration data
Fluke	97	CR0033	Two channel digital oscilloscope
Nat'l Instruments	AT/MIO-16XE-50		Computer interface for automated damper test control and data acquisition

Test Procedure and Results:

The damper's cable clamp was bolted to a load pin designed to measure the force required to move the clamp. The shaker table controls were adjusted to provide sinusoidal motion in the vertical direction.

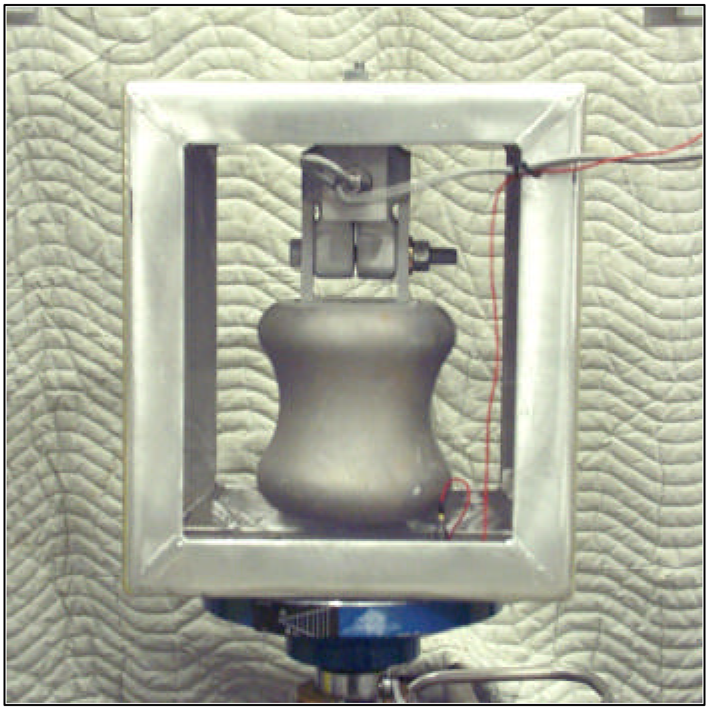
The test was run over a frequency range of 3 to 50 Hz under computer control. Data are recorded every 0.25 Hz. At each frequency, there is a 2-second settling time to permit the damper to reach steady state before recording data.

A matched set of tracking filters is used to filter the acceleration and force signals. Five readings of force, acceleration, and phase are taken at each frequency. The highest and lowest readings are discarded, and the remaining three are averaged. Experience with this test over several years shows the results are repeatable with a wide range of single-conductor damper and spacer/damper designs. The test does not simulate the interaction of a damper with the cable. Analytical techniques beyond the scope of this project are needed to predict damper and cable interaction. The test is an economical way to observe the dynamic response of the damper, and to measure changes in the dynamic response after damper fatigue tests or damper field aging.

Impact dampers in particular need averaging, because the impact events are short-duration relative to the vibration cycle, and are somewhat random. The averaged response is the appropriate parameter to use in a power balance to predict damper performance.

The test was run at zero-to-peak velocity of 100 mm/second, followed by a sweep at 200 mm/sec. Mathematical relationships provided in IEEE 664 were used to calculate the power consumption (damping power) of the damper. The resistive and reactive components of mechanical impedance are simply the mechanical impedance (F/V) times the cosine if the phase between the force and velocity signal. Accurate phase data is insured by running the system with a dead weight on the load pin. The phase angle must be zero for a pure mass (zero damping). The measured phase angle from the dead weight test is used to correct the damper test data for the frequency-dependent phase errors inherent in the transducers and signal conditioning equipment.

Figure 1 shows the power dissipation characteristics of the damper as a function of frequency and clamp velocity. Figure 2 shows the resistive and reactive (real and imaginary) components of the impedance. Photograph 2 shows the damper in the test platform.



Photograph 2
AR Mod III Damper Under Test

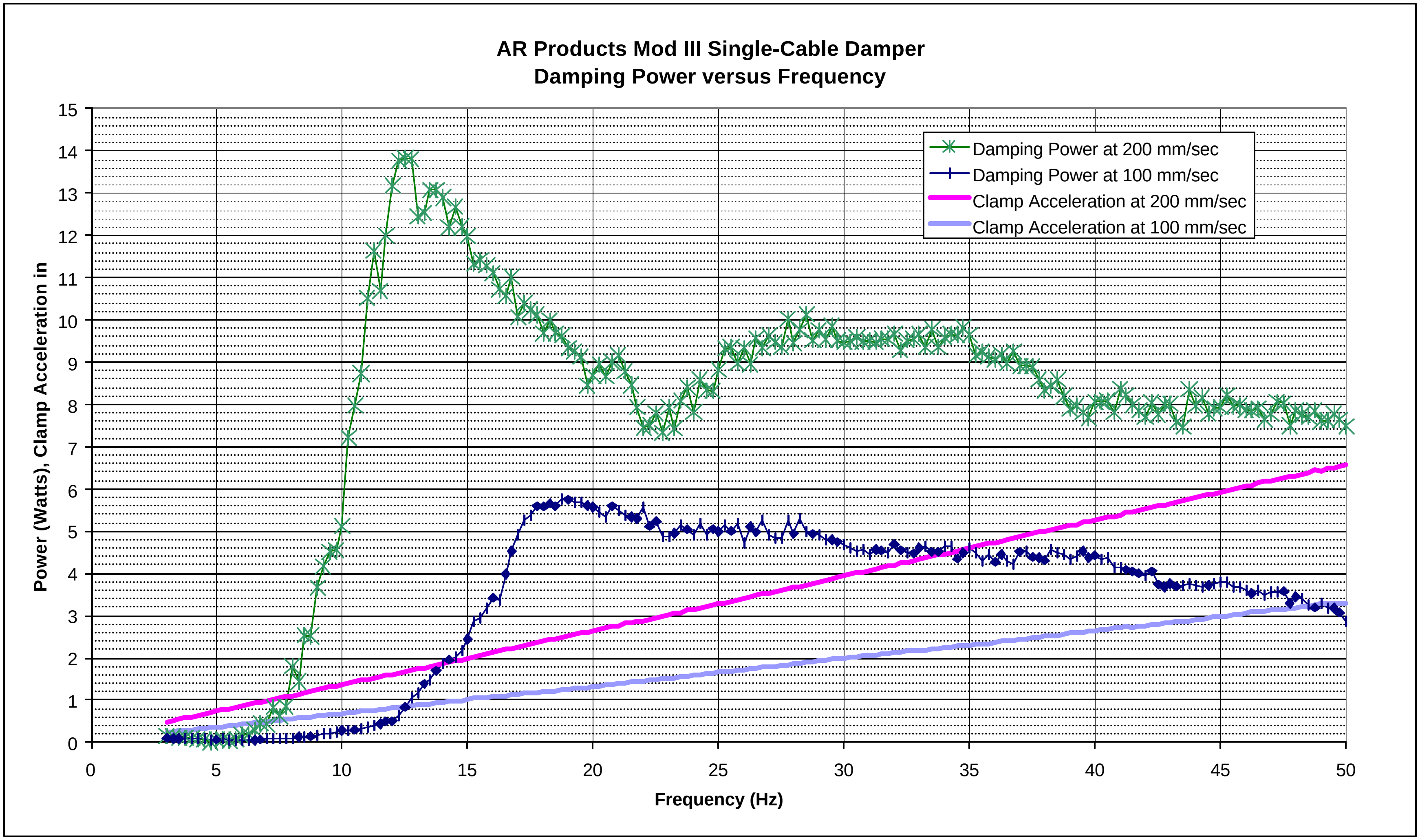


Figure 1
Damping Power versus Frequency

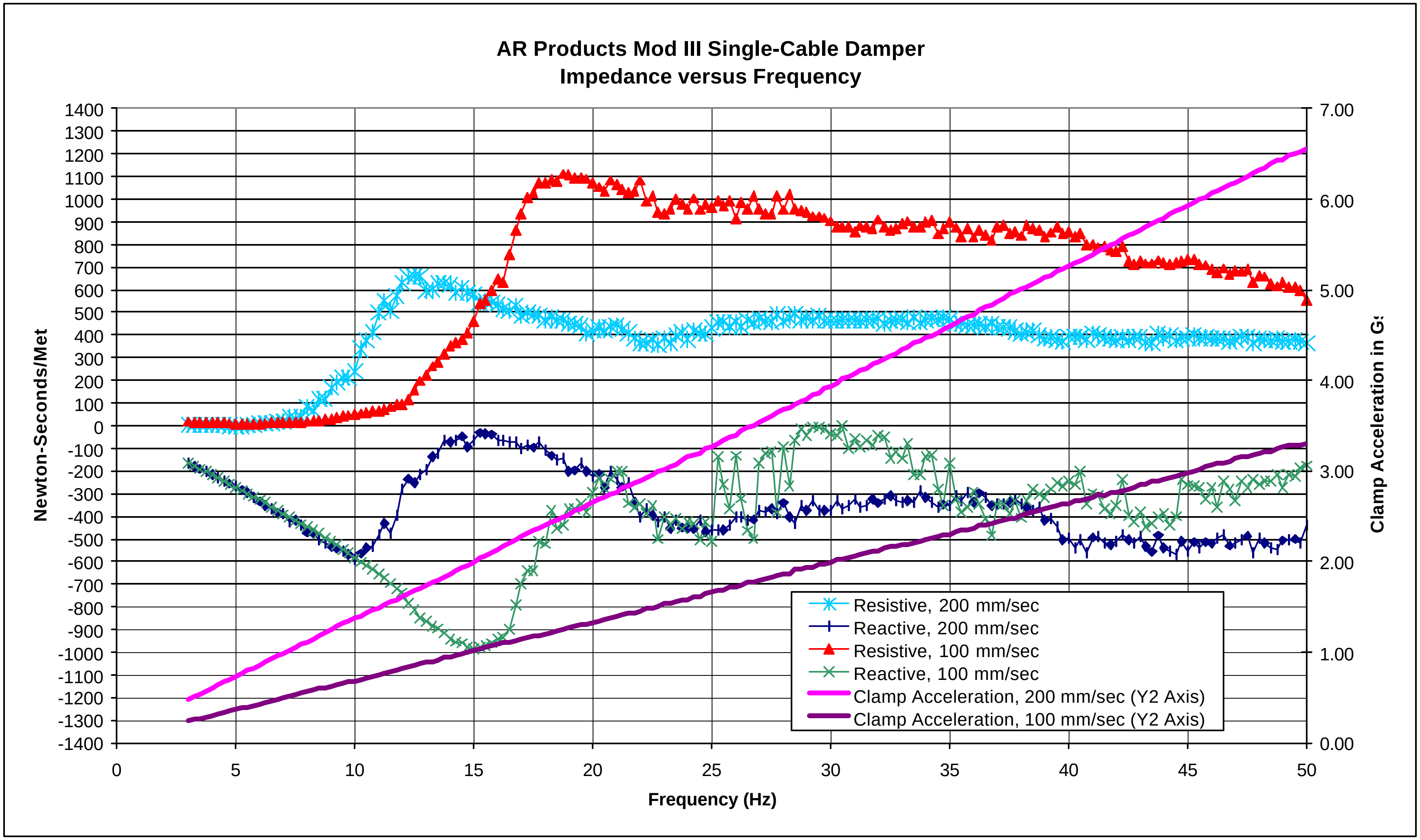


Figure 2
Mechanical Impedance versus Frequency