AUBURN UNIVERSITY
Program for Advanced Vehicle Evaluations

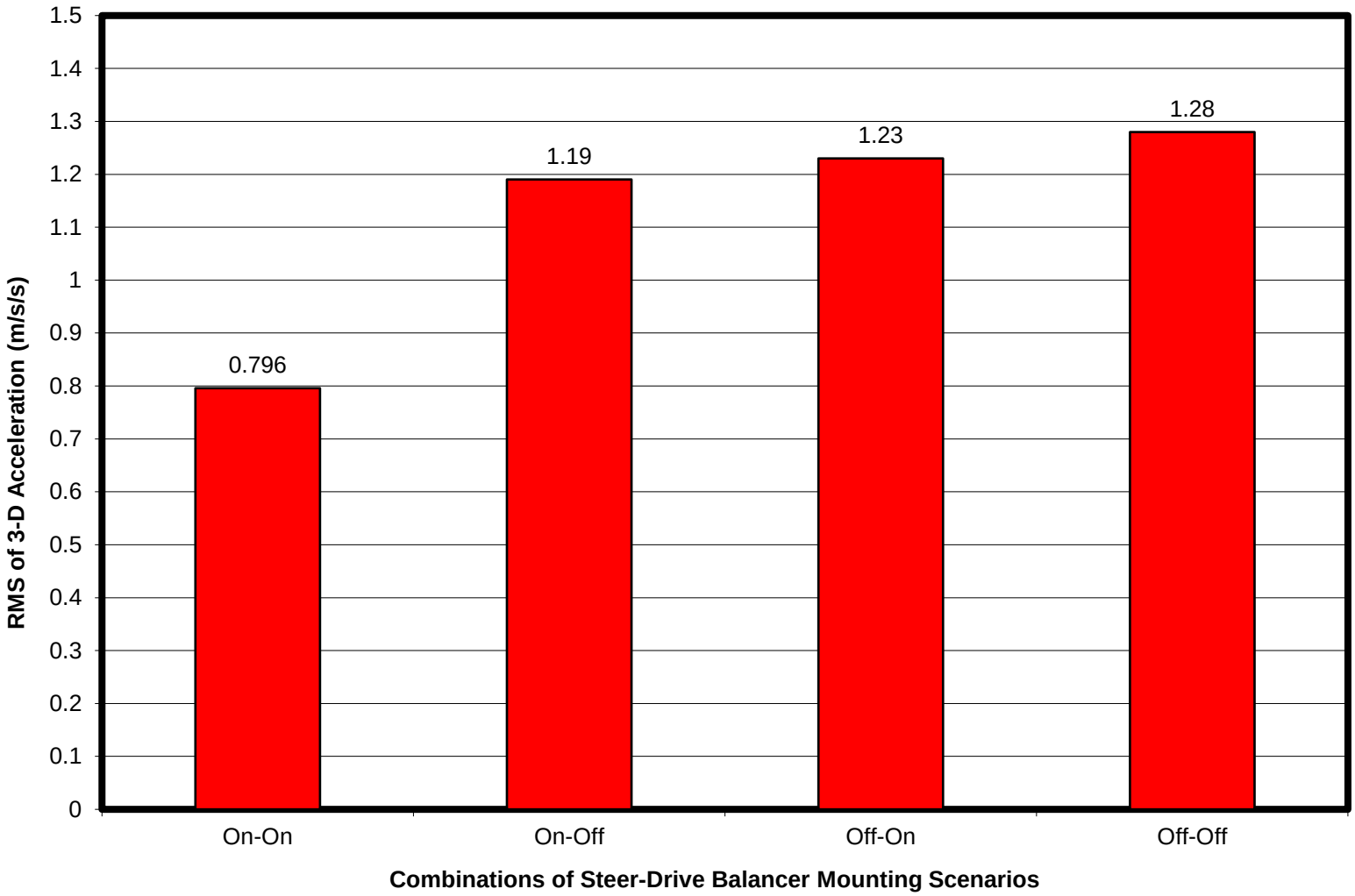
The National Center for Asphalt Technology, Auburn University, is a 1.7 mile track which test experimental sections of asphalt from around the world and programs for advanced vehicle evaluations. Centramatic was honored to be selected among other nationally recognized coach/truck parts manufactures to prove our product would not only extend tire mileage but reduce the fatigue and stress levels their drivers endure under the repetitious and grueling lap conditions required.

Centramatic Balancers were shipped and installed in May 2004 and are still running on the five Class 8 tractor trailers 18 hours per day five days a week and have exceeded all expectations.

The Auburn University DOCUMENTED TEST RESULTS showed a 37% reduction in vibration to vehicles with the Centramatics compared to the same vehicles without the balancers.

Needless to say Centramatic is performing as advertised, extending tire mileage, reducing vibration and driver fatigue.

Auburn University Test Data



		X- Axis	Y-Axis (in m/s2)	Z-Axis	RMS	Condition	For data recognition
hand arm vibration	**steering vibration**	0.499	0.521	0.339	**0.796**	**with both balancers on**	23:14
whole body vibration	**seat vibration**	2.01	2.35	5.35	6.16	**with both balancers on**	23:29
whole body vibration	**seat vibration**	1.13	1.92	2.89	3.63	**remove balancers from steer axles**	23:59
hand arm vibration	**steering vibration**	0.673	0.67	785	**1.23**	**remove balancers from steer axles**	0.11
hand arm vibration	**steering vibration**	0.742	0.605	0.85	**1.28**	**remove balancers from drive axles**	0.45
whole body vibration	**seat vibration**	1.84	1.64	3.96	4.65	**remove balancers from drive axles**	0.56
whole body vibration	**seat vibration**	1.7	2.33	3.28	4.36	**install balancers on steer axles**	1.22
hand arm vibration	**steering vibration**	0.608	0.656	0.788	**1.19**	**install balancers on steer axles**	1.35

Calculations

Vibration on the steering
We can see that vibration (RMS) on the steering wheel is highest with both the steer axle and drive axle balancers removed (1.28 m/s2), then with only the drive axle balancers (1.23 m/s2), then with only steer axle balancers (1.19 m/s2) and the lowest with both the balancers on.

Vibration on passenger seat
Vibration pattern on the seat show a highest RMS value with both the balancers on (6.16 m/s2), then with both the balancers removed (4.65 m/s2), then with only steering balancers on (4.36 m/s2) and the lowest with only drive axle balancers (3.63 m/s2).

	X- Axis	Y-Axis (in m/s2)	Z-Axis	RMS	Condition	
steering vibration	0.499	0.521	0.339	**0.796**	**with both balancers on**	23:14
steering vibration	0.673	0.67	0.785	**1.23**	**balancers from steer axles removed**	0.11
steering vibration	0.742	0.605	0.85	**1.28**	**balancers from drive axles removed**	0.45
steering vibration	0.608	0.656	0.788	**1.19**	**install balancers on steer axles**	1.35

	X- Axis	Y-Axis (in m/s2)	Z-Axis	RMS	Condition	
seat vibration	2.01	2.35	5.35	6.16	**with both balancers on**	23:29
seat vibration	1.13	1.92	2.89	3.63	**balancers from steer axles removed**	23:59
seat vibration	1.84	1.64	3.96	4.65	**balancers from steer axles removed**	0.56
seat vibration	1.7	2.33	3.28	4.36	**install balancers on steer axles**	1.22

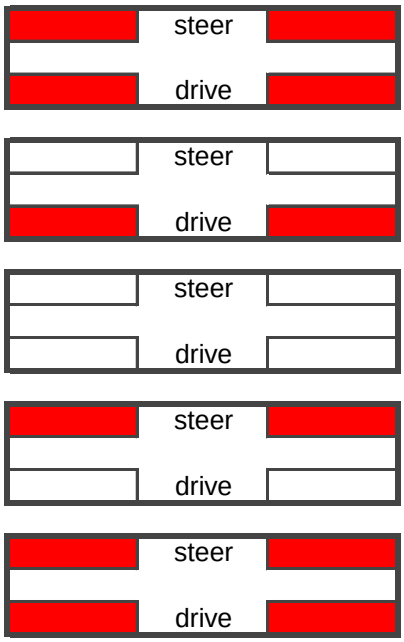
	Steer On	Steer Off	Drive On	Drive Off
Steering Column				
Seat Pad				

Steer-Drive	On-On	On-Off	Off-On	Off-Off
Steering Column	0.796	1.19	1.23	1.28
Seat Pad	6.16	4.36	3.63	4.65

Time	Description of Action Item
30	remove triple box and install single box on #5
30	mount accelerometer to steering column
12	run 5 laps to make steering measurements over 3 laps
5	swap cable from accelerometer to seat
12	run 5 laps to make seat measurements over 3 laps
30	remove balancers from steer axles
12	run 5 laps to make seat measurements over 3 laps
5	swap cable from seat to steering
12	run 5 laps to make steering measurements over 3 laps
50	remove balancers from drive axles
12	run 5 laps to make steering measurements over 3 laps
5	swap cable from steering to seat
12	run 5 laps to make seat measurements over 3 laps
30	install balancers on steer axles
12	run 5 laps to make seat measurements over 3 laps
5	swap cable from seat to steering
12	run 5 laps to make steering measurements over 3 laps
50	install balancers on drive axles
30	remove single box and install triple box on #5
0	testing is completed
366	total minutes, or

6 hours 6 minutes

Balancer Configuration (Red is On)



Notes and questions:

Does the testing need to be conducted on Monday, and if so who can drive with tires changing?
Using only the box trailer (Monday assumed), what is the maximum safe speed for this study?
Send Shaman final plan after discussing with Blake at "ahujash@auburn.edu."
Shaman will satisfy the University's requirement for disclosure with human subjects if needed.
The accelerometer will be mounted on the steering column just before it enters the firewall.
The lead wire will be wrapped loosely around the steering column to prevent binding during turns.
Plastic zip ties will be used to provide loose guide loops for the accelerometer lead.
The pad in the loaded passenger seat will be used to avoid dismounting the steering accerometer.
Datalogging should start at the passage of the E2 sign, then stop at the same point after 3 laps.
It takes 5 driven laps to make 3 test laps if the starting and stopping point is the E2 sign.
Effect of balancers on steer and seat vibration will be quantified.
Relationship between roadway roughness and vehicle vibration will be determined.