Whole Body Vibration Exposures:
Comparison of a passive and active vibration cancelling semi-truck seat.

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Sources and Controls for Vehicle Vibration

Comparison of Seat Suspension Technologies

Shortcomings of Air-Ride Suspensions

Air-Ride vs EM-Active Seat
Truck Exposure Measurement Study

16 subjects
- Mean age 49 years
- Mean experience 28 years
- Mean weight 102 kg (260 lbs)

Drove two loaded flatbed semis
- Identical trailers and loads
- Electromechanically (EM-Active) Seat
- Conventional Air-Ride (Passive) Seat
- Seats swapped mid-study

Measured WBV at seat and floor
- Average vibration
- Normalized to 8 hours of driving - A(8)
- Difference between seats
- Difference between seat and floor

Vibration Transmitted to Operator

<table>
<thead>
<tr>
<th>Whole Route</th>
<th>EM-Active</th>
<th>Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>x-axis (fore-aft)</td>
<td>1.4</td>
<td>1.3</td>
</tr>
<tr>
<td>y-axis (side-to-side)</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td>z-axis (up-and-down)</td>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>% Transmission</td>
<td>100%</td>
<td>100%</td>
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</tbody>
</table>

Performance difference in z-axis, passive seat transmits majority of WBV

Standardized Route
(Framingham, MA, USA)

Vehicle Speed and Driving Duration

No difference in speed and duration between seating conditions

Vehicle Vibration Transmitted to Operator
Driving Time to A(8) Action Limits

<table>
<thead>
<tr>
<th></th>
<th>Passive</th>
<th>EM-Active</th>
<th>&lt;0.0001</th>
<th>&lt;0.0001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Route</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Freeway</td>
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<tr>
<td>Highway</td>
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<tr>
<td>Stop and Go</td>
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<tr>
<td>Rough Road</td>
<td>&lt;0.0001</td>
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</table>

Drivers limited to 11 hours/day by law.

University of Washington Ergonomics Program

Work Going Forward

- Recruitment
- Randomize & Install New Seats
- Intervention Period
  - 4 weeks
  - 9 months
  - 9 months

Old Seats (n=120)
- Air-Ride Seat (Control, n = 20)
- EM-Active Seat (Intervention, n = 20)

4 Weekly Pre-Intervention Surveys
12 Weekly Post-Intervention Surveys
1 Year WBV Assessment

Intervention Period
- 3mo-WBV Assessment
- 9mo-WBV Assessment
- 1 Year WBV Assessment

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