

## Ergonomic Seat Reduces Shock for Low-Seam Shuttle Car Operators

### Objective

To improve seats on mine shuttle cars with ergonomic design and by reducing shock impact transmitted through the mine vehicle seat to the vehicle operator.

### Background

Operators of underground mobile equipment, particularly shuttle cars, are often exposed to significant levels of shock and whole-body vibration. Past studies have reported that as many as one-third of underground equipment operators could be exposed to adverse levels of shock and whole-body vibration. Moreover, seats on mining equipment, historically, are inadequate relative to the ergonomic needs of the equipment operator. In the extreme, a mine vehicle seat has sometimes consisted of blocks of wood or a bent steel plate bolted to the machine frame. Also, the lack of sufficient vertical clearance in some underground mines is an impediment to providing adequate shock isolation systems on mine equipment seats.

### Approach

The NIOSH Pittsburgh Research Center (PRC) is conducting research with viscoelastic foams to improve seats on mine shuttle cars. Viscoelastic foams were used in an ergonomically designed seat to reduce the amount of shock transmitted through the mine vehicle seat to the vehicle operator. Data on selected viscoelastic foams were analyzed from laboratory shock tests at PRC. Using information from the analysis, two ergonomic seats incorporating selected foam were constructed for in-mine testing on a shuttle car (Joy 21SC) in eastern Kentucky. The shuttle car operated in a 35-in-thick coal seam with an approximate mining height of 43 in. Operational data were recorded on the ergonomic and original seats. Further, the shuttle car operator was asked to compare these seats.

### Results

When comparing the original seat (figure 1) with the ergonomic seat (figure 2), the shuttle car operator described the ergonomic seat as generally "much better" than the original seat. The operator explained, "It's just easy to adjust. And it's got the lower lumbar support. And the pad is thicker. It's just much better all the way around." He added, "It does support you more and [there is] less shock when you hit a hole...I liked the lower lumbar support. That's where most of your shock is at, in your lower back."

The operational data supported the operator's comments. In the full-load case, significant improvements in isolation were achieved (down to 15 Hz) with the ergonomic seat. Additional laboratory testing of seven viscoelastic foams was done to further improve the level of isolation from shock and better characterize the material properties of each foam. Data from this testing were used in an analytical model of the seat pan isolation system. Results showed that two of the viscoelastic foams, SUN-MATE EXTRA-SOFT and PUDGEE, gave the most effective shock isolation of the seven materials tested. A composite of EXTRA-SOFT and PUDGEE foams improved the isolation characteristics of the seat pan to approximately 4 Hz. Similarly, EXTRA-SOFT by itself provided isolation to 5 Hz. These results will be validated with future in-mine measurements.

### Cooperative Research Opportunity

NIOSH is seeking cooperators to assist in further research and development of this technology. Additional information on cooperative research may be obtained by contacting Jacqueline H. Jansky, Technology Transfer Officer, NIOSH Pittsburgh Research Center, P.O. Box 18070, Cochrans Mill Rd., Pittsburgh, PA 15236-0070, phone: (412) 892-6615, fax: (412) 892-6678, e-mail: [jgj7@cdc.gov](mailto:jgj7@cdc.gov)



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## For More Information

For more information regarding this new technology, contact Alan G. Mayton or Sean Gallagher, NIOSH Pittsburgh Research Center, Cochrans Mill Rd., P.O. Box 18070, Pittsburgh, PA 15236-0070, phone (412) 892-4078 or (412) 892-6445, fax (412) 892-6567, e-mail: [anm9@cdc.gov](mailto:anm9@cdc.gov) or [sfg9@cdc.gov](mailto:sfg9@cdc.gov)

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To receive additional information about mining issues or other occupational safety and health problems, call **1-800-35-NIOSH (1-800-356-4674)**, or visit the NIOSH Home Page on the World Wide Web at <http://www.cdc.gov/niosh/homepage.html>

As of October 1996 the safety and health research functions of the former U.S. Bureau of Mines are now located in the National Institute for Occupational Safety and Health (NIOSH).



Figure 1.—Original seat.

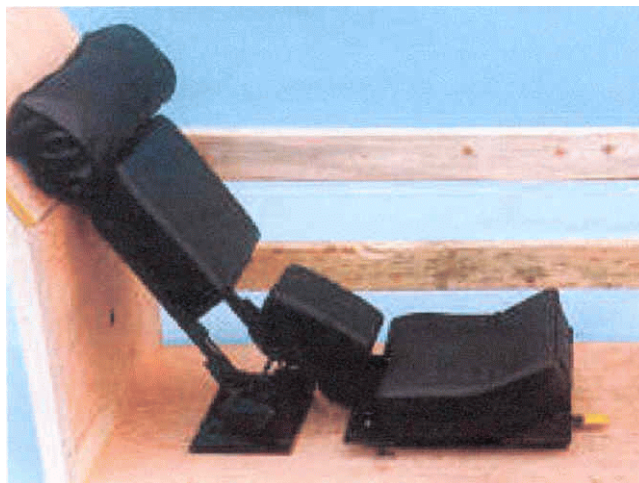


Figure 2.—Ergonomic seat.