

**Review of the Mine Shields' Mine Safety Unit™ Manufactured by Mine Shields, LLC for Adherence to WV
Legislative Rule Title 56, Series 4
Rules Governing Protective Clothing and Equipment**

February 8, 2010

WV Requirement	Finding	Justification
<p>§8.4.1. Provide a minimum of 48 hours life support (air, water, emergency medical supplies, and food) for the maximum number of miners reasonably expected on the working section;</p> <p>-----</p> <p>In addition shelters were reviewed against the recent MSHA PIB 07-03 that makes a federal standard for refuge chambers that has different assumptions than used for the WV standard. The major items are --</p> <ul style="list-style-type: none"> • 96 hours breathable air • 25 ppm instead of 50 ppm on the maximum CO₂; • 4 gasses to be detected in the chamber (O₂, CO₂, CO, and CH₄); • 0.62297 LPM oxygen per man, not 0.5; • 0.5097 LPM CO₂ scrubbing capability, not 0.4; • 3 fold chamber volume purge air requirement. <p>http://www.msha.gov/regs/compliance/PIB/2007/ptib07-03.aspxSome.</p>	<p>Meets Requirement</p>	<p>The independent professional engineer, Kevin Houston PE (WV 17591) and the manufacturer presented reviewers with documentation and addressed inquiries such as to demonstrate that the Mine Shields' Mine Safety Unit™ meets individual elements contained in §8.4.2. through §8.4.15. Meeting these requirements satisfies §8.4.1.</p> <p>The Mine Shields' Mine Safety Unit™ design reviewed was scalable for 10 to 33 people with life support for at least 96 hours. The independent professional engineer and manufacturer presented detailed computational analysis and evidence from testing supporting their claims that the Mine Shields' Mine Safety Unit™ meets or exceeds all applicable Title 56, Series 4 requirements and those applicable from MSHA PIB 07-03.</p> <p>It is the consensus judgment of the reviewers that the Mine Shields' Mine Safety Unit™ meets applicable requirements in Title 56, Series 4, §8.4.1. through §8.4.15</p>
<p>§8.4.2. Be capable of surviving an initial event with a peak overpressure of 15 psi for 3 seconds and a flash fire as defined by National Fire Protection Association standard NFPA-2113 of 300 degrees Fahrenheit for 3 seconds;</p>	<p>Meets Requirement</p>	<p>The independent professional engineer and the manufacturer presented reviewers documentation and addressed inquiries regarding the results of detailed individual component analysis of the Mine Shields' Mine Safety Unit™ that demonstrated its ability to sustain a 15 psi overpressure for 3 seconds without failure of structural components or deformation that would affect the operation of the unit. The analysis was done by Kevin Houston PE using a combination of computational techniques and experimental testing.</p> <p>The demonstration of survivability of flash fire requirement was accomplished through experimental testing and a review of detailed construction drawings and the material specification of all external components.</p>

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<p>§8.4.3. Be constructed such that it will be protected under normal handling and pre-event mine conditions;</p>	<p>Meets Requirement</p>	<p>The independent professional engineer and the manufacturer presented reviewers documentation and addressed inquiries concerning the detailed construction drawings and material specifications for the Mine Shields' Mine Safety Unit™ that demonstrated to the reviewers the ability of the Mine Shields' Mine Safety Unit™ to survive normal handling conditions in an underground mine and the ability of the manufacturer to address mine-specific operational capacity.</p>
<p>§8.4.4. Provide for rapidly establishing and maintaining an internal shelter atmosphere of oxygen above 19.5%, carbon dioxide below 0.5%, carbon monoxide below 50 ppm, and an apparent-temperature of 95 degrees Fahrenheit;</p>	<p>Meets Requirement</p>	<p>The independent professional engineer and the manufacturer presented reviewers with documentation and addressed inquiries that demonstrated the ability of the Mine Shields' Mine Safety Unit™ to comply with applicable requirements in WV 56-4 and the MSHA PIB 07-03.</p> <p>The 96 hour supply of oxygen and removal of CO2 were demonstrated both computationally and through experimentation. The maintenance of CO was addressed through the design of the airlock for which experimental data was provided, through the use of purge air for which experimental and computational analysis were supplied.</p> <p>The maintenance of an apparent temperature below 95 F was demonstrated through computation and experimentation.</p>
<p>In addition shelters were reviewed against the recent MSHA PIB 07-03 that makes a federal standard for refuge chambers that has different assumptions used for the WV standard. The major items are --</p> <ul style="list-style-type: none"> • 96 hours breathable air • 25 ppm instead of 50 ppm on the maximum CO; • 4 gasses to be detected in the chamber (O₂, CO₂, CO, and CH₄); • 0.62297 LPM oxygen per man, not 0.5; • 0.5097 LPM CO₂ scrubbing capability, not 0.4; • 3 fold chamber volume purge air requirement. <p>http://www.msha.gov/regs/complan/PIB/2007/pib07-03.aspSome.</p>	<p>Meets Requirement</p>	<p>The independent professional engineer and the manufacturer presented documentation and addressed inquiries demonstrating the ability of monitoring applicable gases inside and outside the Mine Shields' Mine</p>
<p>§8.4.5. Provide the ability to monitor carbon monoxide and oxygen inside and outside the shelter/chamber;</p>	<p>Meets Requirement</p>	<p>The independent professional engineer and the manufacturer presented documentation and addressed inquiries demonstrating the ability of monitoring applicable gases inside and outside the Mine Shields' Mine</p>

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In addition shelters were reviewed against the recent MSHA PIB 07-03 that requires monitors for 4 gasses to be detected in the chamber (O2, CO2, CO, and CH4); http://www.msha.gov/regs/compliance/PIB/2007/pib07-03.asp Some.		Safety Unit™.
§8.4.6. Provide a means for entry and exit that maintains the integrity of the internal atmosphere;	Meets Requirement	The independent professional engineer and the manufacturer presented documentation and addressed inquiries that demonstrated the ability to enter and exit the Mine Shields' Mine Safety Unit™ without violating the integrity of the internal atmosphere through computational and experimental means.
§8.4.7. Provide a means for MSHA certified intrinsically safe power if power required;	Meets Requirement	The independent professional engineer and the manufacturer verified that no electrically powered systems were required for the operation of the Mine Shields' Mine Safety Unit™.
§8.4.8. Provide a minimum eight quarts of water per miner;	Meets Requirement	The independent professional engineer and the manufacturer presented documentation that sufficient water would be provided for 96 hours – 16 quarts.
§8.4.9. Provide a minimum of 4,000 calories of food per miner;	Meets Requirement	The independent professional engineer and the manufacturer presented reviewers with documentation that 96 hours of food would be provided – 8,000 calories per miner.

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<p>§8.4.10. Provide a means for disposal of human waste to the outside of the shelter/chamber;</p>	<p>Meets Requirement</p>	<p>The independent professional engineer and the manufacturer presented reviewers with documentation and addressed inquiries demonstrating that a means would be provided to meet this requirement.</p>
<p>§8.4.11. Provide a first aid kit as defined at W. Va. Code Chapter 22A Article 2-59(3)(b) independent of the section first aid kit required by W. Va. Code Chapter 22A Article 2-59(3) and 2-60(f);</p>	<p>Meets Requirement</p>	<p>The independent professional engineer and the manufacturer presented reviewers with documentation that required first aid materials would be provided.</p>
<p>§8.4.12. Have provisions for inspection of the shelter/chamber and contents;</p>	<p>Meets Requirement</p>	<p>The independent professional engineer and the manufacturer presented reviewers with documentation and addressed inquiries that demonstrated that sufficient provisions had been made for inspecting the Mine Shields' Mine Safety Unit™.</p>
<p>§8.4.14. Provide a battery-powered occupant-activated strobe light of a model approved by the Director that is visible from the outside indicating occupancy;</p>	<p>Meets Requirement</p>	<p>The independent professional engineer and the manufacturer presented reviewers with documentation and addressed inquiries that demonstrated that once MSHA approved strobes are available they will be provided for the Mine Shields' Mine Safety Unit™.</p>
<p>§8.4.15. Provide provisions for communications to the surface; and</p>	<p>Meets Requirement</p>	<p>The independent professional engineer and the manufacturer presented reviewers with documentation and addressed inquiries that demonstrated the ability to of the Mine Shields' Mine Safety Unit™ to support existing</p>

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		and emerging communication options and that each would be equipped to support the mine's communication system.
