Summary of Seal Evaluation Methods at NIOSH’s Lake Lynn Experimental Mine

Eric S. Weiss
Manager, Lake Lynn Laboratory
Mining Engineer
U.S. Regulations

- Requires all worked out areas to be ventilated or sealed (explosion isolation)
All coal mine seal designs must be “deemed suitable” by MSHA.

Part of the suitability determination is based on full-scale explosion tests conducted within NIOSH’s Lake Lynn Experimental Mine.
Prior to July 19, 2006, all seals were required to:

- Withstand a 20 psi static explosion overpressure
- Must not leak more than 100 ft³/min at 1 in H₂O pressure differential across the seal
Lake Lynn Laboratory
Lake Lynn Experimental Mine
The unconfined explosion test method addressed the 30 CFR-horizontal “STATIC” pressure requirement.
Construction of seals in crosscuts
Typical Methane Ignition
Post-Explosion Outcome
LLEM Results:

11 alternative types of seals (over 30 designs) have ‘passed’ this suitability determination through the unconfined explosion tests (side-on pressure loadings)
Chamber Approach for Evaluating Seals

Develop an alternative methodology for evaluating the strength characteristics of mine seals that was consistent with the intent of 30 CFR 75.335
Chamber Approach for Evaluating Seals

- Compare results between current approved method (LLEM) and alternative methodology
- Determine seal design safety factor
- Develop geometric seal sizing relationships
- Determine as-built strength in coal
Chamber Approach

Two - Chambers
Smaller - 21 ft wide X ~8 ft high
Larger - 30 ft wide X 16 ft high
Pressure Loading Methods for Closed Chamber Studies

- Compressed air
- Methane-Air Explosions
- Water
Chamber Evaluations
Chamber Results:

- In-situ pressure loading with water shows promise as an alternative to full-scale explosion testing of mine seals
- Results comparable with LLEM explosion test
Chamber Results:

- Technique also allows for the determination of the ultimate strength or design safety factor
- In-situ validation of seal/strata interface within 'unique' coal mine geologies
2006 Mine Disasters

MSHA and WVOMHST requested NIOSH assistance in the investigations of seal failure at the Sago Mine
‘Head-on’ Pressure Loading

- Confined explosion
  - Longer duration – higher impulse
- Uniformly loaded across entire seal face
- Developed a reflected pressure pulse
  - ~3 times the approaching pressure pulse
New LLEM Test Configuration

**Diagram Key**

- **Data Gathering Panel**
- **Stopping**
- **Seal**
- **Crosscut No. 5**

**Scale**

- 0, 10, 20, 30 m (0, 50, 100 ft)

Locations:

- **A-Drift**
- **B-Drift**
- **C-Drift**
- **E-Drift**
- **Gas Ignition Zone**
- **Bulkhead Door**
Seal Across C-Drift (Inby Side)

Static & total pressure sensors

Bi-direction pressure sensor
Results of ‘head-on’ explosions

20-psi overpressure

50-psi overpressure
NIOSH is evaluating ‘generic methods’ to improve the strength of in-situ seals.
Thank you

Eric S. Weiss
Manager, Lake Lynn Laboratory

EWeiss@cdc.gov
412-386-5050