A LABORATORY INVESTIGATION OF UNDERSIDE SHIELD SPRAYS WITH A SHEARER-CLEARER WATER SPRAY SYSTEM TO IMPROVE DUST CONTROL ON LONGWALL FACES

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Introduction

- The longwall shearer is known to be the highest contributor to respirable dust exposures on the longwall face
- Overexposure to respirable dust can lead to black lung
  - Required longwall face ventilation of 30,000 ft^3/min to mitigate this
  - Water sprays are also used to combat overexposures
- Longwall underside shield sprays
  - 20% of longwalls used sprays (2011 NIOSH study)
  - Sprays are mounted on the underside of longwall shields and directed towards the mining face
  - These sprays create a moving curtain of water, preventing dust from reaching the personnel walkway
  - Can have a negative impact on respirable dust control if improperly sequenced

Introduction

- Research goal: Create a traveling water curtain to prevent the formation of a dust cloud from reaching the walkway
- Properly installed and aligned sprays can expand the overall effective zone of the shearer's directional spray system
- Sprays are automatically activated & deactivated based upon the shearer location
- Laboratory testing performed in the NIOSH Pittsburgh Mining Research Division's longwall gallery

NIOSH Longwall Shields

Previous Testing

- Previous testing was completed without a shearer-clearer system
- Needed to determine if the shearer-clearer water sprays had a positive or negative interaction with the splitter arm and underside shield sprays
- Underside shield sprays decreased respirable dust concentrations, while splitter arm sprays alone did not help lower dust concentrations
- This previous testing helped to determine the best parameters for minimizing dust concentrations, which were used for these tests

Testing Parameters

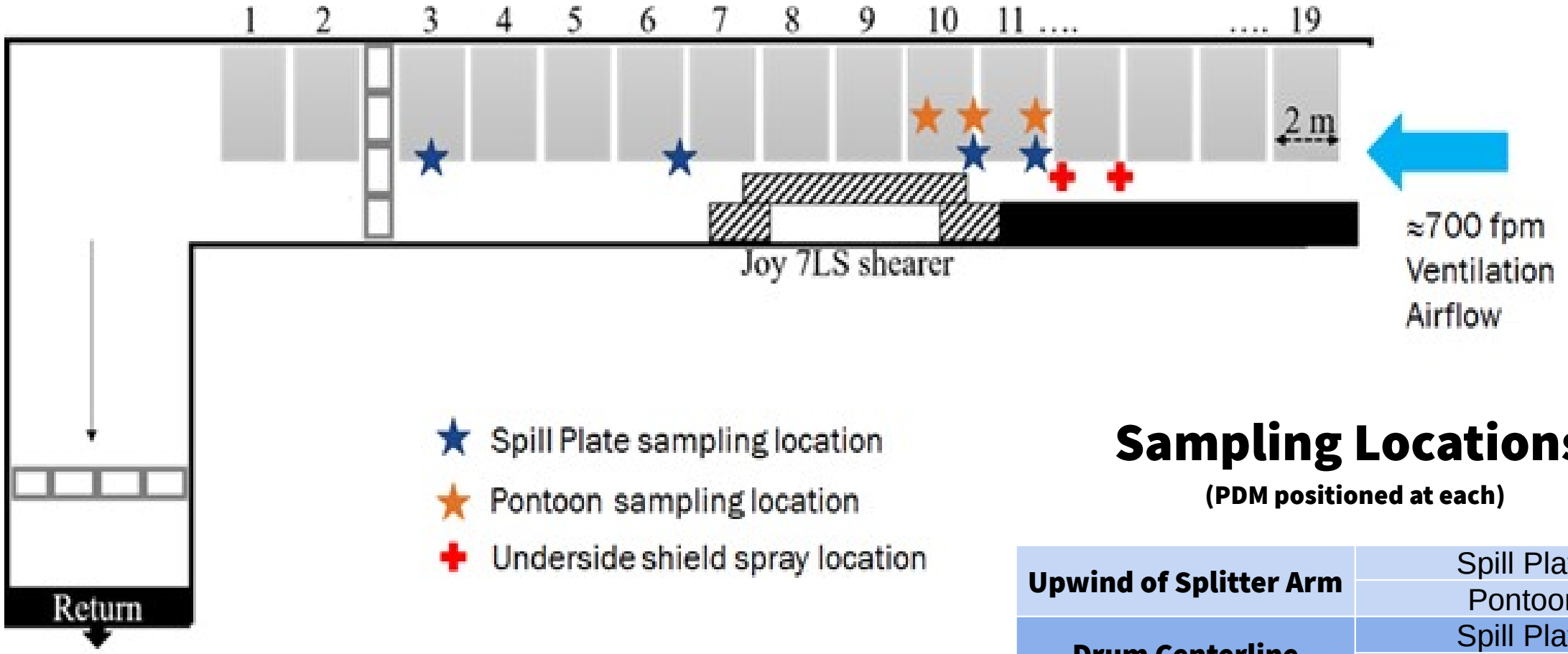
Block #	Testing Conditions/Sprays Used
1	Dust Only (No Sprays)
2	Dust + Shearer-Clearer + Splitter Arm Sprays
3	Dust + Shearer-Clearer + Splitter Arm + Tailgate Sprays
4	Dust + Shearer-Clearer + Splitter Arm + Tailgate + Underside Sprays
5	Dust Only (No Sprays)

Each block includes a 3-min stabilization period followed by a 15-min test

Test #	Angle	Distance	Pressure	Tailgate Sprays
1	75 deg	4.5 ft	100 psi	Splitter Arm
2	75 deg	4.5 ft	150 psi	Splitter Arm
3	75 deg	4.5 ft	200 psi	Splitter Arm
4	75 deg	4.5 ft	100 psi	Manifold
5	75 deg	4.5 ft	150 psi	Manifold
6	75 deg	4.5 ft	200 psi	Manifold
7	60 deg	5.0 ft	100 psi	Splitter Arm
8	60 deg	5.0 ft	150 psi	Splitter Arm
9	60 deg	5.0 ft	200 psi	Splitter Arm
10	60 deg	5.0 ft	100 psi	Manifold
11	60 deg	5.0 ft	150 psi	Manifold

Each test was repeated a minimum of three times


Underside
Shield Sprays
Dust Injection
Tubes
Splitter Arm
Sprays



Sampling Locations

(PDM positioned at each)

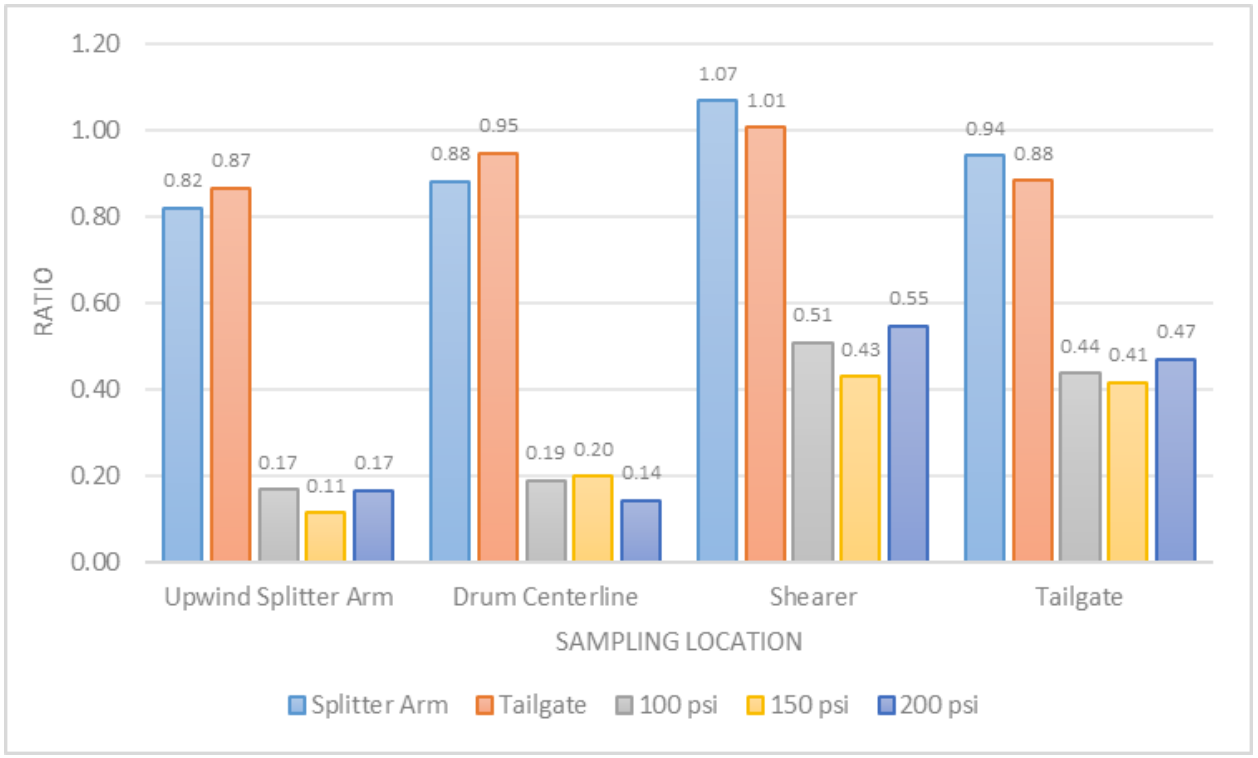
Upwind of Splitter Arm	Spill Plate
	Pontoon
Drum Centerline	Spill Plate
	Pontoon
Ranging Arm Motor	-
	Pontoon
Shearer	Spill Plate
	-
Tailgate	Spill Plate
	-

Evaluation of Results

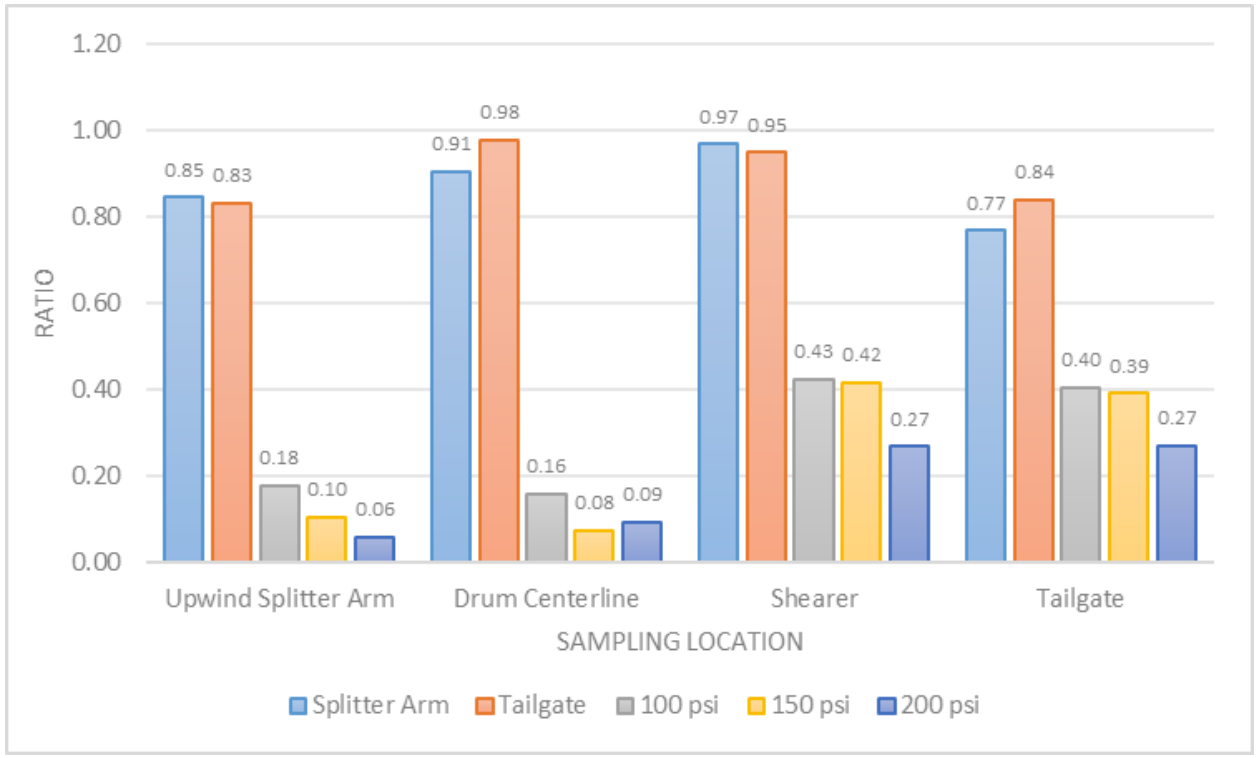
- Baseline dust concentrations varied due to:
  - Sampling location
  - Air properties
  - Ventilation variations
- Need to normalize for baseline dust concentration at each location

- Ratios used for data comparison
  - Ratio > 1.0 = dust increase
  - Ratio < 1.0 = dust decrease

Results – Spill Plate, 75 degrees, 4.5 ft

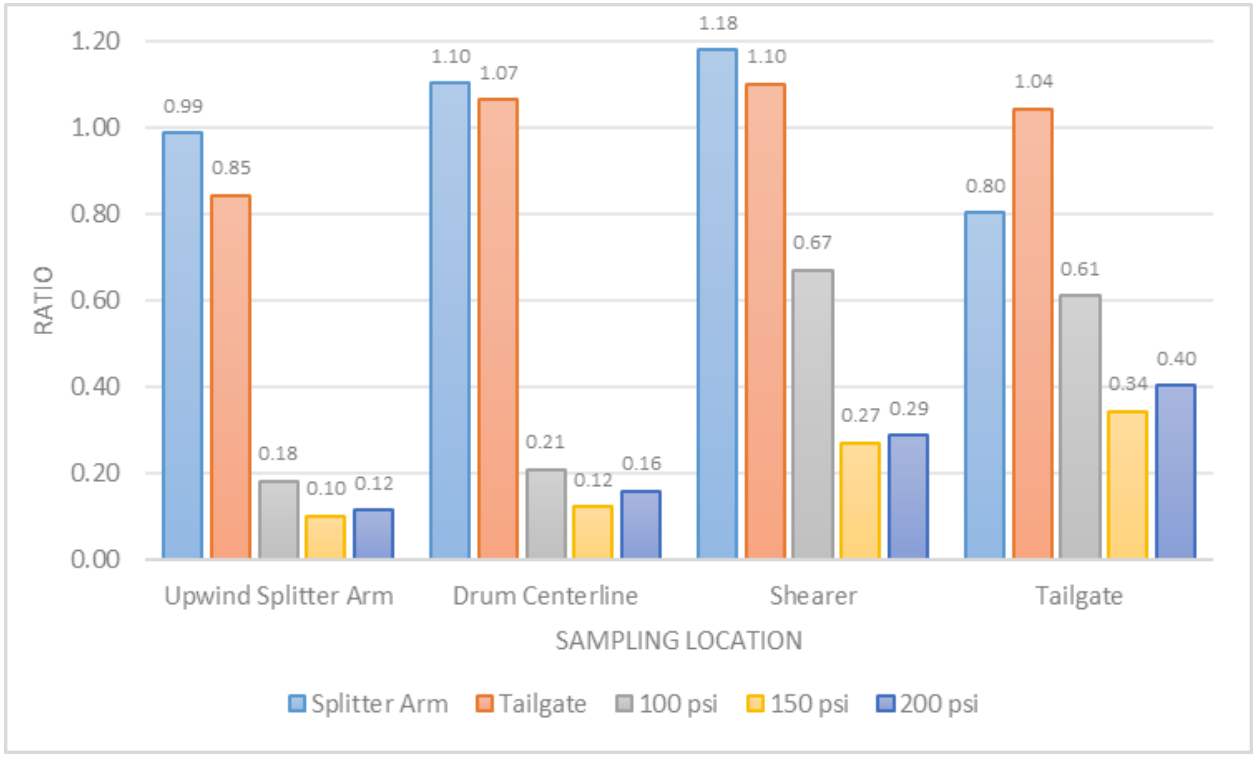


Splitter Arm Tailgate Sprays

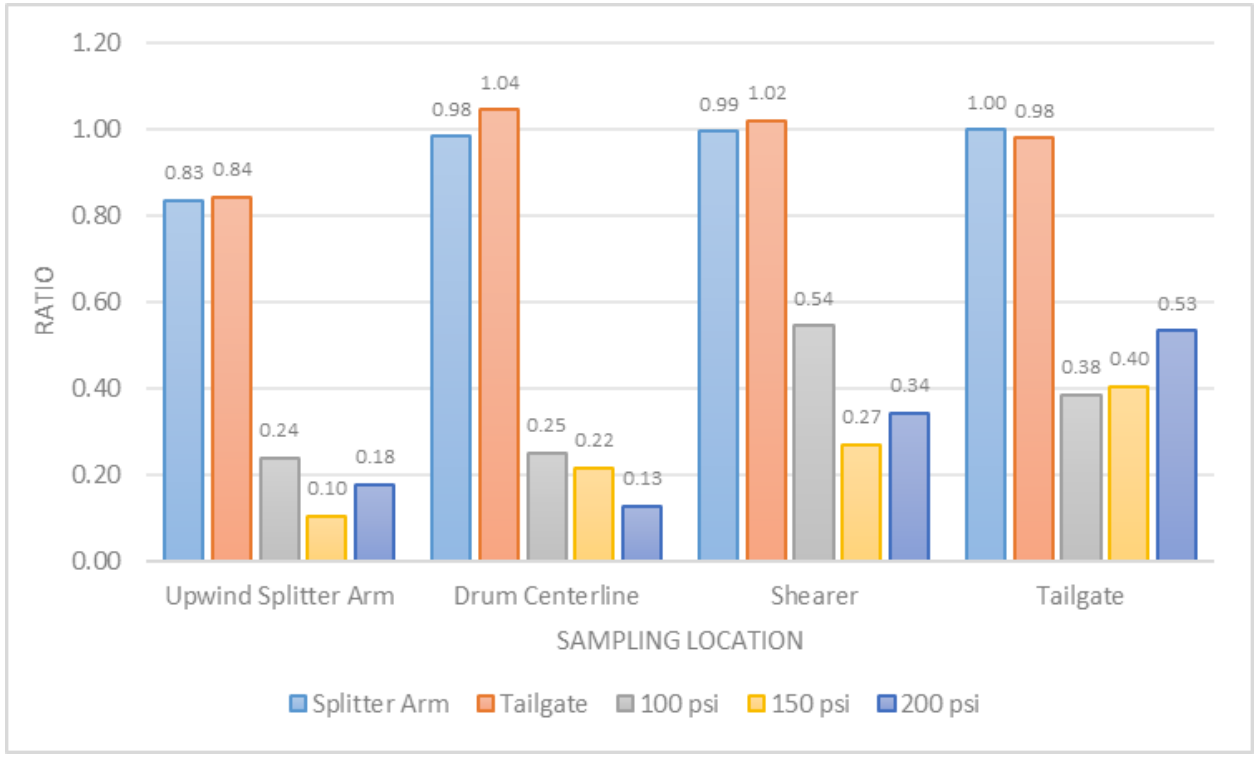


Manifold Tailgate Sprays

Results – Spill Plate, 60 degrees, 5.0 ft

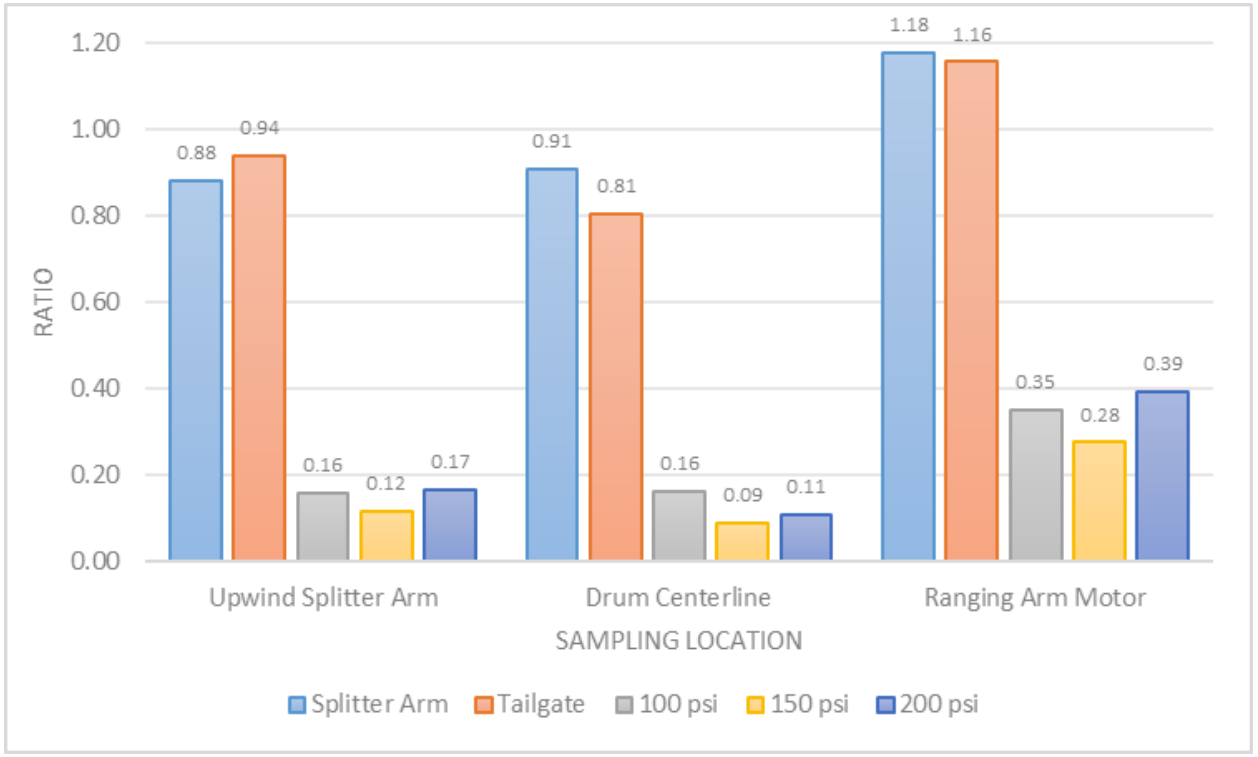


Splitter Arm Tailgate Sprays

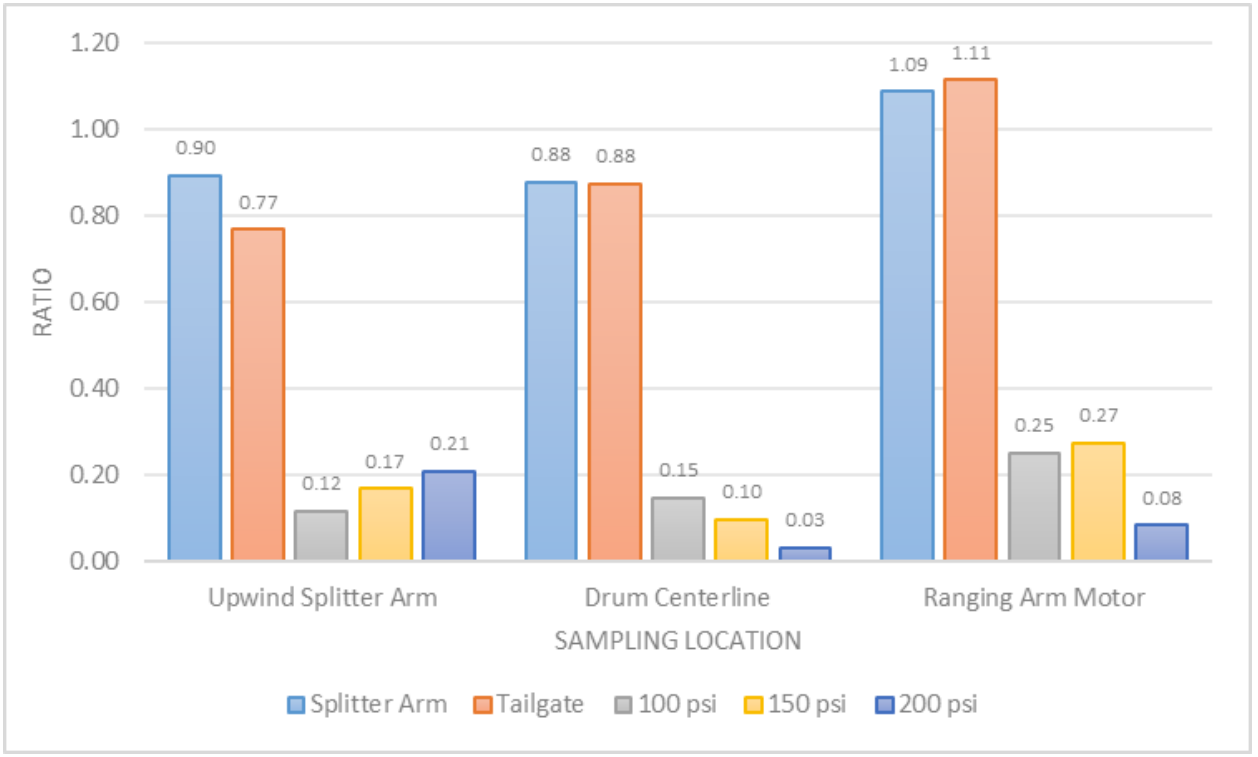


Manifold Tailgate Sprays

Results – Pontoon, 75 degrees, 4.5 ft

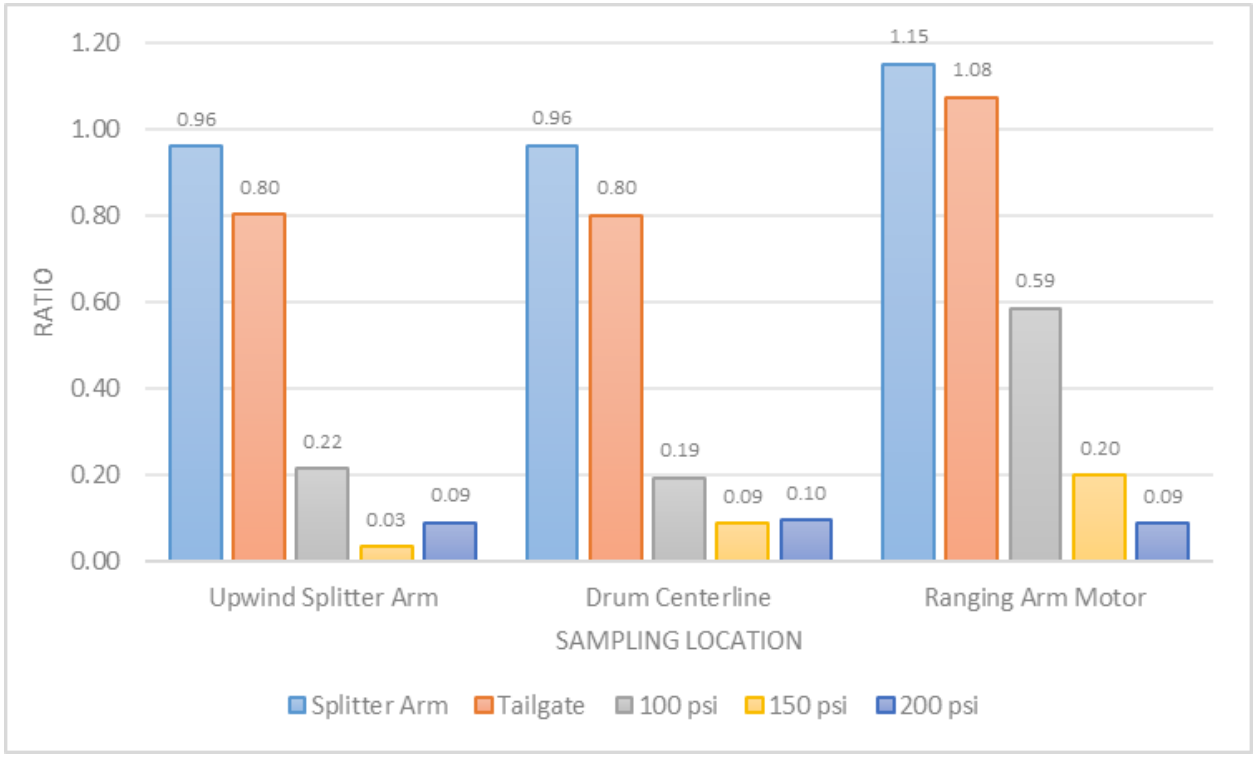


Splitter Arm Tailgate Sprays

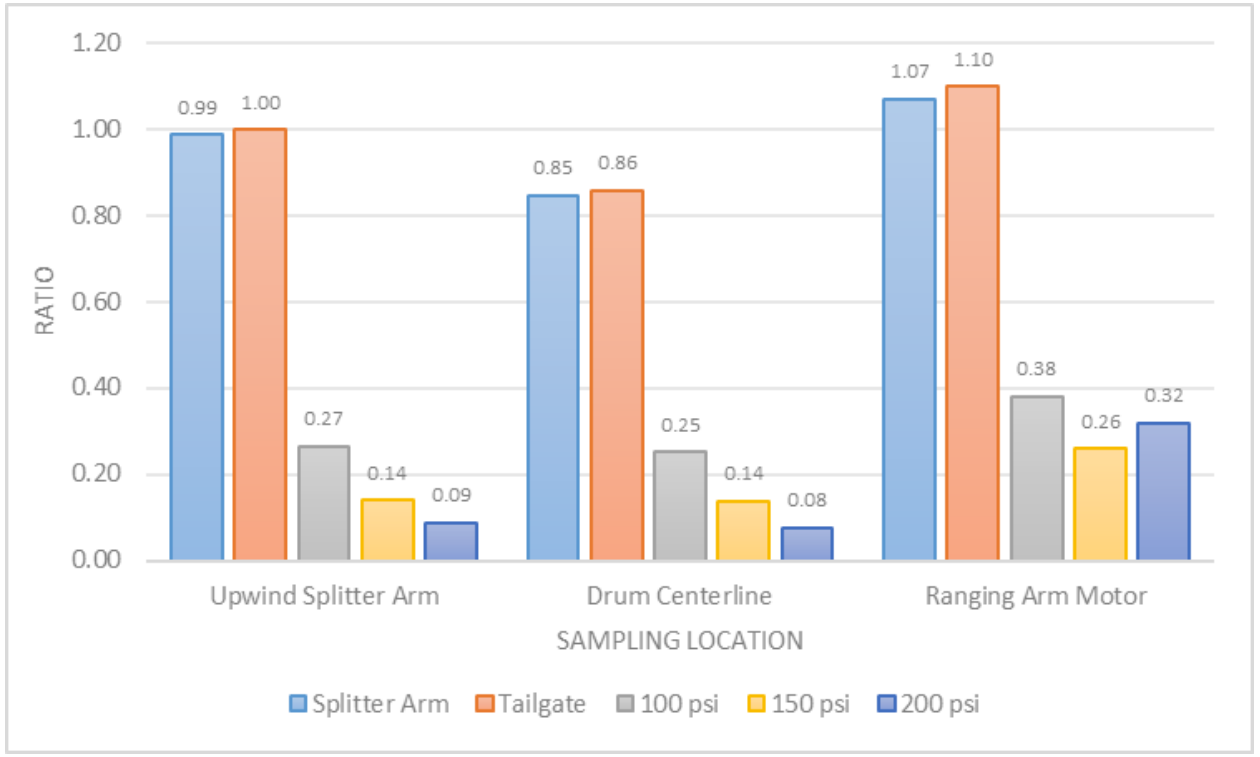


Manifold Tailgate Sprays

Results – Pontoon, 60 degrees, 5.0 ft



Splitter Arm Tailgate Sprays



Manifold Tailgate Sprays

Conclusion

- As with previous testing, underside shield sprays can decrease respirable dust exposure for mining personnel on the longwall face
- Proper alignment of all longwall water sprays is critical toward effectively decreasing respirable dust exposure
- Mining personnel are best protected at:
  - Upwind splitter arm
  - Drum centerline
  - Both spill plate and pontoon locations
- Splitter arm sprays continue to be ineffective when used alone
- Tailgate spray type did not appear to have an impact on dust concentrations observed during testing
- Key takeaway: any combination of parameters for underside shield sprays provided improved conditions on the longwall face for mining personnel

Questions?

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