PRIORITY STANDARDS & SAFETY TARGET CATEGORIES

The following list of engineering suggestions is a reference tool for mine operators to use in eliminating or mitigating conditions which are known to contribute to serious accidents.

The list is organized first by reference to the general related activity and, when applicable, into subsets of more specific activities. To use the list, just click on the highlighted key word associated with the topic of interest, which will take you to a web page with more information. Some suggestions do not have highlighted keywords – they are provided for reference.

MSHA District Offices will determine the acceptability of engineering suggestions proposed by the mine operator.

Operating Equipment on the Surface

Priority Standards:

Coal- 77.404 (c); 77.1607 (g); 77.1607 (n); 77.1710 (i)
M/NM- 56.9101; 56.14101 (a); 56.14105; 56.14205; 56.14130 (g); 56.14131 (a); 56.20011

Engineering Suggestions:

A wide variety of equipment is used at surface mines. Each type of equipment and its use can pose different hazards to equipment operators. Here are suggestions that may reduce these hazards:

Dump point over travel

- May be prevented using rear cameras.
- Much research has been conducted to develop State of the Art Collision Avoidance and Proximity Detection Systems. Some of these systems may be beneficial for preventing dump point over travel and other accidents. A Single Source Page contains references to virtually all such systems.
- A Falconer dump point light beam system, dump point warning light may be beneficial at fixed dump locations.
- Dump point layout and procedures can enhance safety.
- Dumping short avoids over travel.
- A dump neutralizer switch stops reverse power when dumping.
- Operator restraint systems help protect operators in the event of a dump point over travel. These restraint systems can use seatbelt interlocks, buckle up

alarms, high visibility belting materials, and in-use lights mounted outside the cab to ensure restraints are used.

Injuries from dozer rollovers and traveling over highwalls may be prevented by

- Installation of prominent emergency shutdown/motion arresting switches/palm buttons;
- Seatbelt interlocks, high visibility belt materials, in use lights; and/or
- High back seats with head rest support.

Surgepiles pose similar hazards to highwalls. Many safety features are available to prevent related injuries.

Operator error / misjudgment / traveling too fast for conditions
Excessive speed, grades, and loads reduce the amount of forgiveness available to equipment operators when the unexpected occurs. To ensure safe equipment operation:

- Operation manuals should be placed and secured in the cabs of all mobile equipment with weather protection as necessary and operators should be required to read and understand them before operating the equipment.
- Training equipment operators on how to examine and use fire suppression systems can prevent serious injuries.
- All miners should be trained in explosion hazards created by tires exposed to heat.
- Equipment access step points should be kept clean of debris to avoid slip and fall injuries.
- All mobile equipment should be properly parked when left unattended.
- When towing or hoisting equipment, use the correct hoisting and towing safety slings to eliminate injuries.
- Ensure equipment is properly maintained and consider using in-cab brake adjustment monitoring systems.
- Always use Operator restraints regardless of whether specifically required by law for a particular type of equipment.
- Provide warning signs well ahead of upcoming hazards, and consider using solar powered signs for improved night warnings.
- Do not load equipment above the limits established by the manufacturer, and never operate equipment beyond its design limits/capacity.
- Design in center berms, runaway ramps, grade and radius of curvature limitations when laying out haul roads.
- Establish appropriate mine haul road grade limits incorporating engineering safety precautions for grades above 10 percent and completely eliminate grades exceeding 15 percent.
- Verify the travel path is clear before moving equipment. If unsure, get out and look.
- Always try to position a truck that is being loaded so that the driver can see the loader operator.
- Avoid tipping hazards when dumping loads, including roll-off containers.
- Be aware that overhead power lines present serious hazards when dumping loads and as well as operating cranes. Body- up indicators and marking power lines help mitigate these and other hazards created when truck bodies are unknowingly left in the raised position.

- Standardize crane hand signal standardization to help eliminate confusion when operating cranes under all circumstances, including around power lines.
- Make all personnel aware of safety steps to take if a power line is torn down.
- Determine and verify the location of buried utility lines before disturbing surface areas.
- Determine and verify the location of gas and oil wells before mining.
- Take positioning precautions when positioning equipment to reduce operator exposure to falling materials hazards at highwalls.
- Use remote controlled LHD design considerations and operator training to prevent many related injuries.
- Install boom side barriers on rough terrain forklifts to prevent operators from exiting operators stations on the boom side and into pinch point areas.
- Lock out the high speed on lift trucks, tractors, and other normally slow speed equipment to prevent speeding and associated loss of control.
- Install missing bucket tooth detection systems on shovels and loaders to help prevent the creation of projectiles at crushers.
- Use appropriate de-icing materials and lubricants and effective operation to ensure wire rope integrity/safety for lifting, hoisting and elevator applications.
- Perform weekly maintenance and thoroughly clean of bulk truck augers to improve detonation characteristics and reduce the possibility of fires and explosions.

Drill entanglements can be prevented by:

- Two handed drill rotation control logic;
- A drill station man in position switch; and/or
- Panic bar installations ergonomically positioned at drill head area.

Additional drilling safety enhancements include:

- Good driller/blaster communication;
- Special precautions when working near the edge of highwalls;
- Preblast lighting;
- Using borehole probes;
- Using face profiling; and/or
- Drill dust control.

Roof and Rib Falls

Priority Standards:

Coal- 75.202 (a); 75.220 (a)(1)
M/NM- 57.3360

Engineering Suggestions:

Roof and rib falls are one of the major causes of fatalities in underground mining. Hazards exist in both supported and unsupported areas. Knowing and following

the approved roof control plan is critical to preventing related fatalities. Here are suggestions that may reduce related hazards:

Supported top
- Beam straps

Unsupported top
- Roof support jack release rope

Falls between ATRS jacks
- Roof bolter outby rocker pad deflector

Extended cut mining
- Install additional supports in the last row to act as a precautionary breaker point.
- Hang second row streamers.

Retreat mining
- Collapsible cable hangers

Falls from Elevation

Priority Standards:

Coal- 77.1710 (g)
M/NM- 56.15005; 56.16002 (c); 56.20011

Engineering Suggestions:

Falls from Elevation are a leading cause of mining fatalities. Falls can be prevented by a variety of engineering controls and work practices. Each of the engineering suggestions here must be tailored to the specific jobsite. Here are some suggestions that may reduce these hazards:

Failure to Tie Off - Failure to tie off when operating manlifts, working around access openings in floors or walls, roof scaffolds, bins, hoppers, bulk tankers and other equipment all present significant hazards.
- Establish dedicated tie off points and designate their use for particular activities.
- Install properly-sized working platforms when performing maintenance of jaw crushers to serve as a safe work surface and prevent unintended movement.
- Position ladder lLanding Areas away from stairways to prevent falls.
- Take safety precautions when working from suspended work platforms.
- Carefully mount and dismount heavy equipment, particularly during adverse weather conditions.
- Install a designed platform for tarping trucks.
- Provide access to chutes and bins without spill hazards.

Improper Tying Off – It is important to use the correct equipment and procedures when tying off. Tie-off methods should be suited to the task and prevent interference, while fully protecting the miner against falls.
- Shock absorbing and retractable lanyards;
- Full body harnesses;
- 100 percent tie off fall protection systems;
- Portable tie off systems on skid mounts;

- Tanker truck fall protection system;
- Folding truck bed ladders;
- Remotely operated tanker truck manhole cover;
- Driller fall protection;
- Avoiding fall suspension trauma;
- Fall protection during shaft inspections;
- Skylight screen guard to prevent falling through skylights.
- Prevent falls through roof panels and skylights with guarding.
- Properly guard, barricade or cover floor access openings to eliminate hazards and provide safe access. Establish highly visible dedicated tie off points and equipped fall protection equipment lockers close by.

Falls Into Water - In addition to trauma from falls onto hard surfaces, miners must take additional precautions when they work around water on work boats, barges or dredges. Miners working around water should be strong swimmers and should be equipped with a water- activated alarm that transmits a distress signal to a dispatcher/operations station. Life jackets or other special personal floatation devices should be worn any time there is a danger of falling into water.

Maintenance

Priority Standards:

Coal- 75.1725 (a); 75.1725 (c); 77.404 (c); 77.1607 (g)
M/NM- 56.14105; 56.14130 (g); 56.14205; 56.16002 (c)

Engineering Suggestions:

Maintenance activities pose a wide variety of hazards to miners. Suggestions to reduce hazards associated with stationary and mobile equipment repair include: Drawing on work experience around machinery, providing a convenient way to solicit safety suggestions and identify safety concerns along with effective maintenance communication accountability. Maintain first aid kits to ensure items are available.

Electrical Safety

- Ensure there is electric arc protection where arc flash hazards may exist.
- Never make connections to energized receptacles.

Battery Safety

- Implement and follow good battery safety procedures when working around batteries, including battery charging procedures and properly vented charging stations for battery powered equipment.
- Examine and repair as necessary battery compartments and connections when performing battery charging and related maintenance.

Fire Safety

- Ensure threads on fire hoses and standpipes are compatible.
- Ensure adequate water for fire fighting is guaranteed to be available.

Cutting and Welding Safety

- Always follow universally accepted torch safety procedures.
- Know and understand the unique hazards of acetylene gas.
- Reduce the potential for electrocution when welding by installing voltage interruption devices on welders and following safe welding procedures.
- Use required specific safety procedures when welding or cutting on borehole casings.
- Take required additional precautions to safely weld or cut tanks.
- Take protective measures from flying objects when cutting oldboard bolts.

Hydraulics and Lubrication Safety

- Hydraulic hoses can be the source of many dangers.
- Effectively conduct hydraulic hose maintenance, including paying attention to hose service life to eliminate many of these dangers.
- Properly fabricate hose assemblies and configure them into longwall and other installations to eliminate potential problems.
- Longwall hydraulic systems maintenance requires special training and precautions.
- Examine staple lock fittings to ensure their continued integrity.
- Lubrication system engineering enhancements improve safety and productivity.
- Take required safety measures before removing pressurized grease fittings, including using grease pressure release guns.

Pumps and Pressurized Lines Safety

- When the inlet and or discharge lines to a pump become plugged, the pump will heat up, internal pressure increases and the pump will eventually explode. Several devices are readily available to eliminate this potential hazard.
- Never heat the blind ends of pump impellers or any other closed chambers on equipment or they may explode.
- Follow correct procedures to remove slurry line blockage.
- Follow correct safety procedures to safely transfer tanker fuel.

Rail Safety

- Use rail coupler inspection templates to help proper coupler inspection.
- Use powered lifting aids for track installation to make handling sections of rail and ties easier. Hand operated ratchet hoists are helpful if safely used.

Continuous Mining Machine Safety

- Continuous mining machine cutter-head manual rotators safely permit bit replacement.
- Jammed continuous miner conveyors can create serious hazards.

Conveyors, Crushers, Chutes, and Bins Safety

- Jaw crusher access platforms provide safe access and remove crushing hazards.
- Use chutes and bins spillage prevention methods.
- Use conveyor belt skirt boards to save on clean up maintenance and reduce hazard exposure.
- Always follow proper conveyor belt speed safety precautions.

- Conveyor clean up mechanisms reduce hazard exposure.
- Conveyor safety features should not be options.
- Use conveyor belt slippage protection to help prevent belt fires.
- Use prepackaged belt moves to help prevent lifting injuries and improve productivity.
- Follow these safety procedures when moving a stacking conveyor.
- Always follow torque Arm hazard prevention and safety precautions.

Tire Safety

- Multi-piece rim wheel safety.
- Do not create exploding tire hazards by using oxygen or flammable compounds to fill tires or heating mounted tire assemblies, even if the valve cores are removed.

Haul Truck and Other Rubber-Tired Mobile Equipment Safety

- Use out of adjustment indicator systems for on-highway truck brakes to provide real time feedback of brake adjustments within the cab.
- Inspect accelerator linkages routinely.
- Use available systems to prevent underground diesel exhaust filter fires.
- Follow proper strut charging and inspection procedures on haul trucks.
- Always test brakes after repair.
- Position equipment as far away from highwalls as possible during operation and maintenance.

Lock and Tag-Mechanical

Priority Standards:

Coal- 75.1725 (a); 75.1725 (c); 77.404 (c)
M/NM- 56.14105; 56.16002 (c)

Engineering Suggestions:

Mechanical energy is as dangerous as electrical energy if it is not effectively removed or controlled before performing maintenance. Here are some simple suggestions help to ensure this energy is removed or, effectively controlled prior to performing maintenance activities:

- Many persons have been entangled in equipment because it was not de-energized before performing maintenance. Always Tag Out equipment and take the keys if possible.

Lock and Tag- Electrical

Priority Standards:

Coal- 75.511; 75.1725 (a); 75.1725 (c)
M/NM- 56.12017; 56.14105

Engineering Suggestions:

Removing the electrical energy before working on circuits is critical to the prevention of electrical accidents. Here are some suggestions to help affirmatively ensure that electrical energy is removed before beginning work and removing associated hazards:

Power center

- Use auxiliary power source interlocks to prevent electrical power from electrical shock hazards on draglines and other equipment that use auxiliary motor generators.
- Use ground fault current interrupters (GFCIs) to prevent electrical shock and help identify faults.
- Non-contact AC voltage detectors are a quick and easy tool to prevent electrical shock.

Working on trailing and overhead cables

- Use sensitive ground fault relays and shielded cables where possible to reduce trailing cable shock hazards.
- Include these five simple steps in lock and tag procedures.
- Always follow best practices for electrical testing safety.
- Never make connections to energized receptacles.
- Always closely follow overhead power line safety techniques when working near overhead electrical lines.

Block Against Motion

Priority Standards:

Coal- 75.1403; 75.1725 (c); 77.404 (c); 77.1607 (n)
M/NM- 56.14105; 56.20011

Engineering Suggestions:
Any object or equipment component in a raised position is constantly being pulled down by gravity. Here are some suggestions on how to block these items from movement:

- Best practices for blocking equipment against motion include proper blocking procedures, using safety props and safely using jacks.

Struck by Equipment-Surface

Priority Standards:

Coal- 77.1607 (g); 77.1607 (n)
M/NM- 56.14105; 56.16009; 56.14207

Engineering Suggestions

There are many practical measures that can be taken to prevent being hit by equipment operating on the surface at mining operations. They include:

- Be seen and be safe: glow in the dark paint helps make people and equipment visible.
- Best practices for pedestrian safety include communicating to equipment operators, ensuring the communication is two-way, using personal safety lighting, designating processing plant red zones, and establishing rules requiring persons to stay inside equipment cabs.
- Never assume the equipment operator sees you.
- Adopt visitor communication and safety procedures.
- Maintain continual positive two-way communications at all times for crew safety.
- Designate a signals person to avoid mixed signals to equipment operators.
- Use high visibility vests to identify explosives handlers and other designated persons.
- Implement and follow best practices when working around rail haulage.
- Use telescopic poles and flags to improve support vehicle visibility.
- Use traffic control measures including designating pedestrian areas to help alert equipment operators pedestrians.
- Improve rail crossing safety by adopting a stop, look, and listen policy.

Struck by Equipment -Underground

Priority Standards:

Coal- 75.220 (a) (1); 75.1403; 75.1725 (a)
Engineering Suggestions:

Close quarters, lack of sufficient lighting, and relatively slow moving equipment create circumstances that significantly increase the danger of being struck by equipment underground. Here are suggestions that may reduce these hazards:

- Use glow in the dark paint and reflective clothing to better identify equipment and persons.
- Use switchman safety best practices and other rail haulage safety measures to reduce associated hazards.
- Remain seated until mantrips come to a complete stop.
- Use hanging streamers on the last row of bolts to raise awareness of supported roof boundaries when working in low coal.
- Check curtain safety best practices help avoid equipment pinch point hazards from equipment movement.
- Use of permissible warning lights to warn equipment operators of pedestrians working in a equipment travelway.
- Use mechanical proximity warning devices as an inexpensive way to alert continuous mining machine operators of pinch point areas.

- Consider using continuous mining machine electronic proximity protection devices, which are also commercially available.
- Do not ever approach a continuous mining machine if the radio signal is lost.
- Use armrest interlocks and other man-in-position type switches to ensure pinch point protection for MBC operators.
- Follow established safe procedures when crossing MBCs.
- Involve both new and experienced miners in ensuring a safe working environment, honing their safety senses.
- Provide appropriate task training and mentor fellow miners.

Operating Equipment-Underground

Priority Standards:

Coal- 75.202 (a); 75.1403-10; 75.1725 (a)
M/NM- Note: Category did not exist in M/NM

Engineering Suggestions:

Operators of underground equipment are exposed to specific hazards created by the unique environments they work in. Here are suggestions that may reduce these hazards:

- Use underground rail haulage best practices, including installing derails at airlocks, properly use and maintain brake cars, and use convex mirrors to aid visibility.
- Travel with the loaded end of scoops as the trailing end when possible.
- Secure operator compartment door latches.
- Familiarize operators with the nuances of remote controls for LHD's, including additional precautions necessary when operating them.
- Shuttle cars require traffic control when more than two are operating on a section.
- Small nicks and cuts can create trailing cable shock hazards.
- Follow best practices for roof bolter operation safety.
- Equip remote controlled continuous miner operation safety with the latest safety features to improve safety.
- Follow best practices, including maintaining the remote control orientation to the machine, staying outside the turning radius, and recognizing the middle of the machine is not a safe place to be.
- Never approach the machine if the radio signal is lost.
- Follow safe cable handling procedures.
- Frequently inspect and replaced damaged cutter bits to prevent bit shrapnel.
- Follow safe shield transport practices for longwall moves.
- Use reversing prevention rollers to prevent conveyor reversing on slopes.
- Chutes and bins can be accessed without creating spillage hazards.
- Barricade dangerous areas to ensure access is prevented.
- Add more pre-blast lighting to improve safety.

The general engineering suggestions on this website should provide you with some ideas for eliminating hazards at your mine site. Since every mine is unique, these suggestions will not necessarily apply to every mine. The information presented here is not exhaustive. There may be many other ways to address a particular situation.

For additional suggestions and guidance please refer to the Do's and Don'ts sections of the MSHA Safety Targets Packages for these activities categories.