

PROTECTING MINERS
POWERED HAULAGE EQUIPMENT SAFETY GUIDANCE
MSHA Guidance on Mitigating and Preventing
Powered Haulage Equipment Accidents

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Introduction

Miners, mine operators, and contractors have important roles to play in mine safety. Mine safety can be substantially improved by preventing accidents that involve powered haulage equipment. Accidents involving powered haulage equipment have historically accounted for a large number of the fatalities and serious injuries in mining. Powered haulage equipment is a broad category that includes haul trucks, service trucks, front-end loaders, personnel conveyances, shuttle cars, scoops, load-haul-dumps (LHDs), locomotives and rail cars, and all types of belt conveyors.

Powered haulage accidents are preventable. This guidance¹ is intended to help miners, mine operators, and contractors prevent accidents caused by working with, on, or near powered haulage equipment. The guidance contains best practices, links to video and training resources, and other additional materials that will help miners, mine operators, and contractors recognize, control, and abate hazards that cause powered haulage accidents.

Resource Materials

Video Resources

[Introduction to Powered Haulage Safety](https://www.youtube.com/watch?v=kyLgMPP8AMg&list=RDCMUCAiRVU84Si6YHoe8LCn54WA)

<https://www.youtube.com/watch?v=kyLgMPP8AMg&list=RDCMUCAiRVU84Si6YHoe8LCn54WA>

[Powered Haulage - Get Them on Board](https://www.youtube.com/watch?v=E8r4mtH5lis&t=4s)

<https://www.youtube.com/watch?v=E8r4mtH5lis&t=4s>

[Preventing Powered Haulage Accidents at Surface Mines](https://www.youtube.com/watch?v=q_4q8lm0tCs)

https://www.youtube.com/watch?v=q_4q8lm0tCs

¹ This guidance represents MSHA's current thinking on powered haulage equipment safety. This is not a standard or regulation and it creates no new legal obligations. This guidance is advisory in nature and is intended to assist miners, mine operators, and contractors prevent accidents that involve powered haulage equipment.

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Powered Haulage Safety at Surface Mines

Improving visibility, communication, traffic management, use of seat belts, and safe dumping practices are key to enhancing mine safety and reducing accidents.

1. Improving Visibility

Blind Areas

The lack of visibility is a problem inherent to the use of large haulage trucks in the mining industry. There are areas around equipment in which the equipment operator cannot see other miners, equipment, or structures (i.e., “blind areas”). These blind areas have contributed to equipment operators colliding with other equipment and striking miners.

Know Your Blind Areas - Best Practices

- Do not assume large equipment operators can see you or your vehicle. Stay in the line of sight.
- Do not pull into or park in the blind area of a haulage truck.
- Position yourself in a safe location away from the blind areas around haulage equipment.
- If an equipment operator is not certain of his/her surroundings, or does not know that the travelway immediately ahead is clear, radio others and get an ALL CLEAR signal before moving.
 - Verify that the work area is clear before moving haulage equipment.
- Ensure all persons are trained to recognize the limited visibility and blind areas inherent to the operation of haulage equipment.

Ways to Improve Visibility

There are a number of technological solutions to improve an equipment operator’s ability to see objects near the equipment. These solutions could include:

- Adding strobe lights or high-visibility flags attached to a long flexible rod or a whip antenna on smaller vehicles.
- Outfitting equipment with a video camera that provides an equipment operator a visual or audible warning of blind areas around the equipment.
- Installing collision warning or collision avoidance systems on haulage equipment.

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Resource Materials

Training Presentations

[Construction Vehicle and Equipment Blind Area Diagrams](#)

<https://www.cdc.gov/niosh/topics/highwayworkzones/bad/pdfs/catreport2.pdf>

MSHA Standards²

Training and Retraining of Miners

New miner training: [46.5/48.25](#)

New task training: [46.7/48.27](#)

Annual refresher training: [46.8/48.28](#)

² MSHA's standards are in Title 30 of the Code of Federal Regulations, Mineral Resources, Chapter I.

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2. Communication

Because of limited visibility, effective communication with equipment operators is vital. The lack of effective communication has led to many preventable accidents.

Communication best practices include:

- Establish and follow communication protocols that require verbal verification for all equipment operators.
- Communicate and verify with all equipment operators planned movements and locations upon entering a work area.
- Before approaching large equipment, make eye contact or radio contact with the equipment operator.
- Convey clear intentions and confirm both parties clearly understand communications. There is no room for misinterpretation.
- Sound your horn to warn miners that you are about to move and wait to give them time to get to a safe location.
- Wear high visibility clothing when working around powered haulage equipment.

Resource Materials

Training Presentation

[Reducing Surface Mobile Equipment Accidents Through Technology](https://www.msha.gov/sites/default/files/Training_Education/Collision%20Warning%20TRAM%2025JAN2019.pdf)

https://www.msha.gov/sites/default/files/Training_Education/Collision%20Warning%20TRAM%2025JAN2019.pdf

MSHA Standards

Metal and Nonmetal Mine Safety Standards

Notifying the equipment operator: [56.9316/57.9316](#)

Horns and backup alarms: [56.14132/57.14132](#)

Warnings prior to starting or moving equipment: [56.14200/57.14200](#)

Warning devices: [56.14208/57.14208](#)

Coal Mine Safety Standards

Mobile equipment; automatic warning devices: [77.410](#)

Notifying the equipment operator: [77.1607\(f\)](#)

Warnings prior to starting or moving equipment: [77.1607\(g\)](#)

Warning devices: [77.1607\(o\)](#), [\(t\)](#)

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3. Traffic Management

Traffic management is an essential part of assuring safe conditions at a mine. The design and maintenance of roadways and dumping locations play an important role in surface haulage safety. Consider the following best practices.

Placement and Visibility of Signs

- When placing signs, consider the time it takes for an equipment operator to see, read, and react to a sign, as well as braking and stopping distances of each type of equipment in operation at the mine site.
- Size, height, lateral placement, and lighting are important factors in determining whether signs are visible to the equipment operator.
- Too many signs at one location may cause confusion and lead to accidents.
- Signs should be in the language understood by miners and equipment operators.

Be aware of signs that are:

- Placed too close to a hazard and do not provide sufficient time for equipment operators to react and stop their equipment;
- Outdated or posted for a condition that no longer exists;
- Unclear with respect to right-of-way rules and control;
- Inaccurate regarding berms, grade, or steep sections of the roadway; and
- Placed in locations where they are frequently covered by mud or other debris from traffic in the area.

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Roadway Design and Maintenance

Well designed and maintained haul roads are essential to minimizing on-road hazards. When haul roads are well designed and maintained, trucks and haul equipment run safely and more efficiently.

When designing a roadway consider:

- **The widest equipment used at the mine.** A basic rule of roadway design is that each lane of travel should provide clearance on both sides equal to one-half the width of the widest vehicle using the roadway, plus additional width around curves.
- **Grades of a road.** The grade of a roadway can have a significant effect on the equipment operator's ability to control a vehicle. The grade should be compatible with the braking capabilities of the equipment. Maintain all roadways as level as possible.
- **Use proper material to prepare and maintain the haul road.** Use material that can adequately support the weight of equipment traffic. The materials that make up the road surface and road base should provide adequate traction and support, under a variety of weather conditions, to avoid excessive rutting. Rutting of a soft road can create a safety hazard by affecting the equipment operator's ability to control the vehicle.
- **Maintain and Repair Roads.** Maintain and repair roads so that they do not develop bumps, ruts, or potholes which may make it difficult to control or stop the vehicle.
- **Use berms and guardrails along the outer edges of elevated roads.** Roadside berms and guardrails provide equipment operators a visual indication of the outer edge of a roadway, and deflect equipment back onto the roadway.

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Other Best Practices Include:

- Establish and follow the site traffic plan that identifies traffic routes and traffic flow, access points, parking areas, and other traffic control areas:
 - Communicate the traffic plan to all site employees, contractors, and visitors.
 - Update the traffic plan to reflect changing conditions at the mine.
- Know mine traffic patterns and stay on your side of the road.
- Operate mobile equipment at speeds consistent with conditions of roadways, grades, visibility, curves, weather, and traffic.
- Avoid driving in reverse whenever possible.
- Avoid parking in load and dump zones.
- Establish safe zones around large equipment.
 - Park only in established safe zones.
- Train miners and other pedestrians on mobile traffic patterns and policies.

Resource Materials

Video Resources

[Traffic Control for Surface Mining Operations](#)

<https://arllib2.msha.gov/awweb/pdfopener?md=1&did=75683>

[Traffic Control for Surface Mining Operations \(Spanish\)](#)

<https://arllib2.msha.gov/awweb/pdfopener?md=1&did=82396>

[Brakes, Grades and Runaways Off-Road Trucks](#)

<https://arllib2.msha.gov/awweb/pdfopener?md=1&did=75696>

[Brakes, Grades and Runaways Highway Trucks](#)

<https://arllib2.msha.gov/awweb/pdfopener?md=1&did=75697>

Recent MSHA Fatality Alerts

[April 19, 2021](#)

[February 8, 2021](#)

[January 19, 2021](#)

[October 14, 2020](#)

[September 16, 2020](#)

[February 27, 2020](#)

[November 5, 2019](#)

[August 2, 2019](#)

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MSHA Handbook Series

[Roadways and Dumping Locations](#)

<https://arlweb.msha.gov/READROOM/HANDBOOK/PH20-I-1.pdf>

MSHA Standards

Metal and Nonmetal Mine Safety Standards

Traffic control: [56.9100/57.9100](#)

Operating speeds and control of equipment: [56.9101/57.9101](#)

Roadway maintenance: [56.9313/57.9313](#)

Dust control: [56.9315/57.9315](#)

Barricades and warning signs: [56.20011/57.20011](#)

Parking procedures for unattended equipment: [56.14207/57.14207](#)

Coal Mine Safety Standards

Traffic control: [77.1600](#)

Control of equipment and operating speeds: [77.1607\(b\), \(c\)](#)

Dust control: [77.1607\(i\)](#)

Parking procedures for unattended equipment: [77.1607\(n\)](#)

Roadway maintenance: [77.1608\(a\)](#)

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4. Seat Belt Use

One of the easiest things an equipment operator can do is properly wear a seat belt. Wearing a seat belt protects against injury or death in the event of a serious accident. It is the single most effective action equipment operators can do to protect themselves in a collision, tip-over, or rollover.

Seat Belt Safety Best Practices

- Always wear your seat belt.
- Wear your seat belt to the job, at the job, and from the job.
- In the event of a collision, tip-over, or rollover your seat belt will keep you in the protected space of the machine cab or vehicle.
- Never jump from a moving vehicle. Remain in the seat with your seat belt secured.
- Inspect the seat belt and mounting hardware before operating the equipment.
- Replace damaged or worn parts.
- Install advanced systems that restrain miners during a rollover.

Resource Materials

Training Presentations

[Seat Belt Usage on Mobile Equipment](https://www.msha.gov/sites/default/files/FINAL%20TRAM%20Seat%20Belt%20Presentation%2010-10-2018.pdf)

<https://www.msha.gov/sites/default/files/FINAL%20TRAM%20Seat%20Belt%20Presentation%2010-10-2018.pdf>

[MSHA Alliance with AEM Whitepaper on Seat Belt Use on Mobile Equipment](https://www.aem.org/AEM/media/docs/Safety/Seat-Belt-Use-Mobile-Equipment.pdf)

<https://www.aem.org/AEM/media/docs/Safety/Seat-Belt-Use-Mobile-Equipment.pdf>

Safety Alerts

[MSHA Alliance with AEM Safety Alert - Seat Belt Use on Mobile Equipment](https://www.msha.gov/news-media/alerts-hazards/mnm-safety-alert-seat-belt-use-mobile-equipment) (English and Spanish versions) - <https://www.msha.gov/news-media/alerts-hazards/mnm-safety-alert-seat-belt-use-mobile-equipment>

[MSHA Safety Alert-Seat Belt Tampering](https://www.msha.gov/news-media/alerts-hazards/mnm-safety-alert-seat-belt-tampering)

<https://www.msha.gov/news-media/alerts-hazards/mnm-safety-alert-seat-belt-tampering>

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MSHA Standards

Metal and Nonmetal Mine Safety Standards

Roll-over protective structures and seat belts: [56.14130/57.14130](#)

Seat belts for haulage trucks: [56.14131/57.14131](#)

Coal Mine Safety Standards

Mobile equipment; rollover protective structures: [77.403-1](#)

Machinery and equipment; operation and maintenance (including seatbelts)
[77.404\(a\)/77.1710\(i\)](#)

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5. Dumping Practices

Many haulage fatalities involve trucks going over the edge of piles or dumping points. Dumping short of the edge or moving to another location when potentially unsafe conditions arise can prevent dumping accidents.

Berms

Properly constructed and maintained berms will protect miners and equipment operators. To prevent over-travel or overturning, earthen berms should have a steep inside slope, sufficient height, width, and firmness. Berms constructed of broken rock may offer increased strength due to the interlocking and frictional resistance of the rock. Berms should be constructed at least as high as the mid-axle height of the largest piece of self-propelled mobile equipment traveling the roadway.

Stability Near the Dump Edge

The ground near dump edges or outslopes can be unstable, have steep-sided slopes, and may be unable to support heavy equipment. Moisture, thawing of frozen material, or removing material from the bottom edge of a material pile can create hazards by reducing the stability of the dump location. A crack or a settled area near a dump edge, outslope, or highwall bench is a warning sign of an insufficiently stable slope.

Dumping Best Practices

- Always dump material in a safe location. If ground conditions aren't stable, dump a safe distance back from the edge and push the material over the edge manually or use other equipment that does not need to be close to the edge.
- Never load material from the bottom edge of a material pile directly below an active dump point. This may lead to an over-steepened and unstable slope.
- Never drive haul trucks beyond cracks on the top of the dump site.
- Always construct substantial berms as a visual indicator to prevent over-travel or overturning of equipment.
- Clearly mark dump locations with reflectors or markers.
- Before moving to a new dump location, examine the slope below the dump point to ensure it is not cut out or over-steepened.
- Train miners to use safe dumping procedures and recognize dumping hazards.

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Resource Materials

Training Presentations

[Dump Point Safety - Equipment Considerations](#)

https://www.msha.gov/sites/default/files/events/Dump%20Point%20Safety%20Lessons%20-%20J%20Hall%20-%2010_3_2018.pdf

[Dump Point Safety – Geologic Considerations](#)

<https://www.msha.gov/sites/default/files/TRAM%202018%20Dump%20Point.pdf>

MSHA Handbook Series

[Roadways and Dumping Locations Inspection Handbook](#)

<https://arlweb.msha.gov/READROOM/HANDBOOK/PH20-I-1.pdf>

Recent MSHA Fatality Alert

[January 19, 2021](#)

MSHA Standards

Metal and Nonmetal Mine Safety Standards

Berms or guardrails: [56.9300/57.9300](#)

Dump site restraints: [56.9301/57.9301](#)

Construction of ramps and dumping facilities: [56.9303/57.9303](#)

Unstable ground: [56.9304/57.9304](#)

Truck spotters: [56.9305/57.9305](#)

Coal Mine Safety Standards

Dumping Facilities: [77.1608](#)

Construction of ramps and dumping facilities: [77.1605\(i\)](#)

Berms or guardrails: [77.1605\(k\)](#), [\(l\)](#)

Dump site restraints: [77.1605\(l\)](#)

Unstable ground: [77.1608\(b\)](#)

Truck spotters: [77.1608\(e\)](#)

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Powered Haulage Safety at Underground Mines

Powered haulage in underground mines often involves a combination of rubber-tired mobile equipment, rail-mounted mobile equipment, and conveyor systems. This equipment includes section equipment (e.g. shuttle cars, scoops, LHDs, and longwall conveyors), personnel conveyances, and track equipment. Working near or on this equipment is inherently dangerous. In addition, confined spaces, remote-controlled equipment, limited visibility due to dust, and poor lighting are added hazards.

Best Practices

Audible and Visual Warnings

- Turn headlights on when equipment is being operated.
- Maintain reflective material on each end of mobile equipment.
- Use strobe lights on the cabs of mobile equipment and on the hard hats of miners when near equipment travelways.
- Stop and sound an audible warning, distinguishable from surrounding noise, before tramming equipment through translucent curtains and clear fly pads or in other low visibility areas. Ensure sound levels of audible warnings are higher than ambient noise.
- Install reflective signs or warning lights to alert miners of low clearance areas.
- Place visible warnings and barrier devices at all entrances to areas prior to performing work in active travelways of mobile equipment.

Traffic Management

- Establish designated travel routes for main travel roads as well as on working sections.
- Provide separate roadways for each direction of travel, where possible.
- Use translucent curtains and clear fly pads as a ventilation control on working sections. Fly pads are designed to direct airflow while allowing equipment movement. Maintain translucent curtains and clear fly pads to ensure visibility.
- Only move equipment through designated haulage routes.
- Park equipment in designated locations away from roadways.
- Be aware of blind spots on mobile equipment when traveling in areas where other equipment operates.
- Operate mobile equipment at safe speeds.

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Cameras and Proximity Detection

- Cameras with monitors in mobile equipment operator compartments can improve operator awareness of their equipment surroundings.
- Consider equipping mobile equipment with proximity detection or collision warning and avoidance systems.

Communication and Training

- Establish procedures for equipment operators to communicate and verify all planned movement and equipment location upon entering or exiting a work area.
- Before performing work in an active haulage travelway, communicate your position, and intended movements to other miners and mobile equipment operators. Wait until miners acknowledge your message before moving your equipment.
- Ensure equipment operators verify with dispatchers that they have the right-of-way prior to proceeding, and advise the dispatcher when approved destination is reached.
- Train miners and equipment operators to communicate their location and wait for acknowledgment before moving.

Resource Materials

Recent MSHA Fatality Alerts

[June 3, 2021](#)

[January 22, 2021](#)

[February 22, 2021](#)

[November 23, 2020](#)

[October 13, 2020](#)

MSHA Standards

Training and Retraining of Miners

New miner training: [48.5](#)

New task training: [48.7](#)

Annual refresher training: [48.8](#)

Metal and Nonmetal Mine Safety Standards

Traffic control and communications: [57.9100](#)

Warnings prior to starting or moving equipment: [57.14200](#)

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Coal Mine Safety Standards

Audible warnings: [75.1403-6\(a\)](#)/[75.1403-10\(f\)](#)

Mantrips: [75.1403-7](#)

Haulage roads: [75.1403-8](#)

Reflectors and reflective paint: [75.1719-4](#)

Proximity detection systems: [75.1732](#)

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Conveyor Safety at Surface and Underground Mines

Conveyor systems are an important method of material haulage at many surface and underground mines. Conveyors typically operate continuously during working shifts presenting potential danger for miners working in close proximity to the moving components.

Fatal accidents and serious injuries related to working near or maintaining belt conveyors occur each year at underground and surface mines. The risk to workers can be reduced by following safe work practices during operation and maintenance, and by installing proper physical safeguards on the equipment.

1. Equipment Guards

Properly guarded belt conveyor systems allow miners to perform routine cleaning and maintenance tasks without contacting moving machine parts. Do not remove guards to perform tasks while a conveyor is energized or in motion.

Consider the following:

- Install guards of adequate size and in a location that protects miners from inadvertent contact with moving parts of a conveyor.
- Design guard protection with maintenance in mind. Oversized and heavy guards can lead to injury during removal or reinstallation related to maintenance work.

2. Working Around Belt Conveyors

Fatal accidents and serious injuries have occurred during maintenance work such as splicing conveyor belts when the conveyor suddenly and unexpectedly moved, entangling maintenance personnel.

Best Practices During Belt Conveyor Maintenance

Block From Motion

- Identify, isolate, and control stored mechanical, electrical, hydraulic, and gravitational energy.
- Effectively block the belt conveyor to prevent movement in either direction.

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- Relieve belt tension by releasing the energy at the take-up/belt storage system. Be aware that some tensile energy may remain.
- Anchor belt clamping systems to substantial belt structures. Use properly rated engineered belt clamps and come-along cables. Do not use belt grippers to restrain tensioned belts.
- Position belt splice where it can be safely accessed to avoid pinch points.
- Be aware of the consequences if blocking equipment fails. Stand in safe locations.

Lock and Tag

- De-energize electrical power, and lock and tag the main disconnect before beginning maintenance.
 - Lock and tag out the visual disconnect yourself and keep the key with you at all times until work is complete. Never rely on someone else.
 - Make sure that you are the only person who removes your lock after repairs or when maintenance is completed.
- Never lock out using the start and stop controls (belt switches). These do not disconnect the power at the source.
- Once power has been disconnected and properly locked and tagged out, test the system to assure that there is no power to the belt conveyor.
- Establish policies and procedures for performing specific tasks on or near belt conveyors and make sure that miners are trained.

Communication and Training

- Maintain communication with all persons working on or near the conveyor.
 - After maintenance has been completed and before removing the lock and tag, ensure everyone is clear of the belt conveyor and communicate to others that you will be restarting the belt.
- Ensure that persons assigned to work on or near, or to maintain, belt conveyors have received adequate training and verify that safe belt conveyor work practices are followed.

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Other Best Practices

- Provide a visible and/or audible warning system with a start-up delay to warn persons that the belt conveyor will begin moving.
- Avoid wearing loose-fitting clothing and keep tools and body parts away from moving components.
- Stay clear of moving equipment and do not reach into any part of a moving conveyor.

3. Crossover Safety

Miners have died while attempting to cross a moving conveyor. Consider the following best practices:

- Never attempt to cross a moving belt conveyor except at suitable crossings.
- Install practical and usable belt crossing facilities at strategic locations, including near controls, when height allows.

4. Conveyor Design, Installation, and Housekeeping

Well designed and properly installed conveyor systems feature safe access and minimal spillage. Additional best practices include:

- Maintain safe walkways, free of spillage, obstacles, and other tripping hazards.
- Install pull cords for emergency stops along the belt or at strategic locations.

Resource Materials

Video resources

[Conveyor Safety in Mining](#)

<https://www.youtube.com/watch?v=yEwFZHVLsso&feature=youtu.be>

Training presentations and other materials

[Belt Conveyor Guarding at Metal and Nonmetal Mines](#)

<https://www.msha.gov/guarding-slide-presentation-guarding-conveyor-belts-metal-and-nonmetal-mines>

[Coal-Guarding Requirements for Coal Mines](#)

https://www.msha.gov/sites/default/files/Training_Education/Coal-Guarding.pdf

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[Conveyor Entanglement Hazards Flyer](https://www.msha.gov/sites/default/files/events/Conveyor%20Entanglement%20Hazards%20Flyer.pdf)

<https://www.msha.gov/sites/default/files/events/Conveyor%20Entanglement%20Hazards%20Flyer.pdf>

[MSHA Alerts and Close Calls](https://www.msha.gov/news-media/alerts-hazards/filter?title=&topic%5B0%5D=180641)

<https://www.msha.gov/news-media/alerts-hazards/filter?title=&topic%5B0%5D=180641>

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Recent MSHA Fatality Alerts

[February 8, 2021](#)

[July 29, 2020](#)

MSHA Standards

[MSHA Standards on Conveyor Systems](#)

<https://www.msha.gov/msha-regulations-conveyor-systems>

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Pre-operational Examination of Equipment

Regularly scheduled maintenance of haulage equipment is important to assure that the equipment is in proper operating condition. A good pre-operational examination identifies hazards and ensures that those hazards are corrected before the equipment is placed into operation.

Best Practices

- Establish policies and procedures on how pre-operational examinations are conducted.
- Conduct pre-operational examinations using trained personnel to identify and repair defects that may affect the safe operation of equipment before it is placed into service.
- Promptly remove equipment from service if defects affecting safety are found.

Resource Materials

Video Resources

[Preventing Powered Haulage Accidents at Surface Mines](https://www.youtube.com/watch?v=q_4q8lm0tCs)

https://www.youtube.com/watch?v=q_4q8lm0tCs

[Pre-Operation Inspection of Off-Road Haulage Trucks](https://www.youtube.com/watch?v=ekCkC-G0DAc)

<https://www.youtube.com/watch?v=ekCkC-G0DAc>

MSHA Standards

Metal and Nonmetal Mine Safety Standards

Safety defects; examination, correction, and records: [56.14100/57.14100](#)

Coal Mine Safety Standards

Machinery and equipment; maintenance: [75.1725](#)

Loading and haulage equipment; inspection and maintenance: [77.1606](#)