

Stockpiling Safety



U.S. Department of Labor
Mine Safety and Health Administration
National Mine Health and Safety Academy

Safety Manual Series
SM 27

Revised 2001



Stockpiling Safety



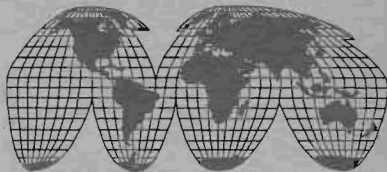
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PREFACE

This is one of a series of manuals prepared by the Mine Safety and Health Administration (MSHA) to acquaint the reader with a specific area of mining. This manual deals with the safe operation of mobile equipment on and around stockpiles. It discusses the hazards associated with stockpiles and reviews the procedures that can be used to minimize the occurrence of accidents.

Other manuals available in this series are listed on the inside back cover. Multiple copies may be ordered for \$2.00 each. Single copies of safety manuals may be obtained free of charge from:

National Mine Health and Safety Academy
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CONTENTS

	Page
Introduction	1
Mobile Equipment Accidents	2
Seat Belts	4
Stockpile Accidents	5
Stockpiling Techniques	5
Loading Out at the Toe	10
Slope Instability	13
Cracks Along the Crest	14
Slumping on the Slope	15
Bulging at the Toe	16
Haulage Trucks	18
Backing Over the Edge	18
Berms	19
Dumping in Designated Area	20
Backing Orientation	22
Backing Speed	24
Dumping on Unlevel Ground	25
Truckbed Position	28
Front-End Loaders	29
Tramming	29
Loading Trucks	31
Operating at the Base of the Pile	33
Operating at the Top of the Pile	36

CONTENTS

	Page
Introduction	1
Mobile Equipment Accidents	2
Seat Belts	4
Stockpile Accidents	5
Stockpiling Techniques	5
Loading Out at the Toe	10
Slope Instability	13
Cracks Along the Crest	14
Slumping on the Slope	15
Bulging at the Toe	16
Haulage Trucks	18
Backing Over the Edge	18
Berms	19
Dumping in Designated Area	20
Backing Orientation	22
Backing Speed	24
Dumping on Unlevel Ground	25
Truckbed Position	28
Front-End Loaders	29
Tramming	29
Loading Trucks	31
Operating at the Base of the Pile	33
Operating at the Top of the Pile	36

Dozers	37
Pushing Material	37
Draw Points	39
Scrapers	42
Highway Trucks	43
On Foot	45
Summary	51
Bibliography	52

INTRODUCTION

Stockpiles provide temporary storage for material awaiting shipping or processing. They are constantly changing in size and shape depending upon production levels or shipping schedules, and often involve a great deal of equipment activity. Mobile equipment involved in stockpiling activities include haulage trucks, front-end loaders, dozers, scrapers, an occasional maintenance vehicle, and a supervisor's pickup. Highway trucks and other non-mining vehicles can also be found near stockpiles contributing to the congestion. All of these vehicles, whether mining or private, are subject to hazards associated with stockpiling operations.

Stockpiles are designed for temporary storage and ease of material flowability, and often exhibit only marginal strength. When the heights of the piles, their continually changing shape, and the amount of vehicle activity are considered, it is easy to understand why stockpile accidents occur and why they are so prevalent within the mining industry.

The safe operation of mobile equipment on and around stockpiles can only be accomplished when equipment operators and their supervisors are aware of the potential hazards. This manual discusses the hazards associated with stockpiles and reviews the procedures that can be used to minimize accidents.

MOBILE EQUIPMENT ACCIDENTS

A mobile equipment operator has a greater chance of being injured in an accident than the average surface miner. This can be attributed to the size, speed, and complexity of mobile equipment and the ever-changing mine environment. The mine environment is continually changing due to the natural progression of the production areas and the effects of the weather.



Mobile equipment accidents are more severe than the average surface mining accident.

In addition, many of the older mining operations, which were originally designed for small equipment, have updated to larger equipment without corresponding changes in mine layout and facilities.

THE SAFE OPERATION OF MOBILE EQUIPMENT IS EXTREMELY DEPENDENT UPON THE CAPABILITIES OF THE EQUIPMENT OPERATOR. The equipment operator's ability to correctly identify and quickly react to a potential hazard is more critical than for most mining tasks. The dynamic nature of the job provides more opportunity for a hazardous situation to develop, and a serious injury to occur.

IT IS VERY IMPORTANT TO BE TRAINED ON EACH PIECE OF EQUIPMENT BEING OPERATED. Controls will vary on different pieces of equipment. The controls may be located in different positions or they may operate differently. This can lead to momentary confusion and incorrect reactions when operating an unfamiliar piece of equipment. Successfully avoiding an accident often depends on the operator making the correct split-second decision.

SEAT BELTS

The chance of surviving an accident is greater when a seat belt is worn. In fact, the safest place to be during an accident is in the cab with a seat belt fastened. Nearly one-half of all mobile mining equipment fatalities occur to operators who are not wearing seat belts, or who take them off in a futile attempt to jump clear of the equipment. Staying with the machine is almost always better than attempting to jump out. A number of needless fatalities can be prevented by the simple act of wearing a seat belt and remaining within the cab.

Federal regulations mandate (with a few exceptions) that seat belts be provided on dozers, scrapers, front-end loaders, haulage trucks, etc., and that they be maintained in working condition. More importantly, the regulations state that they must be worn.



Seat belts save lives.

STOCKPILE ACCIDENTS

Stockpiles by their nature have a high amount of vehicle activity. This activity occurs at the top of the pile where dumping takes place and at the toe of the pile where loading takes place. Stockpile accidents usually involve haulage trucks, front-end loaders, and dozers, but highway trucks, utility trucks, scrapers, and pedestrians can also be involved. (The construction of stockpiles with conveyors is also widely practiced, presenting a unique set of hazards. However, a discussion of these hazards is not within the scope of this manual.)

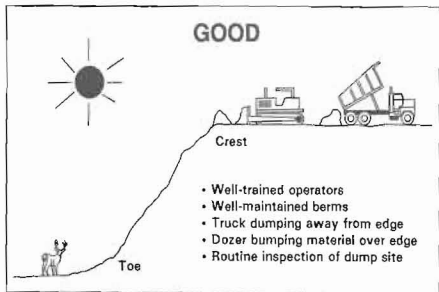
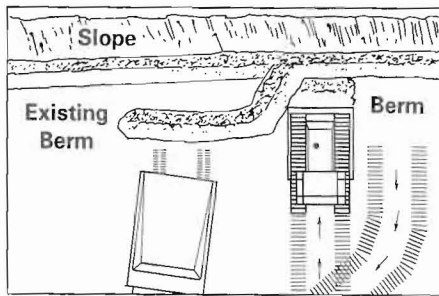
Stockpile accidents occur in all of the mineral industries including coal, metal, nonmetal, crushed stone, and sand and gravel. The accidents occur on stockpiles of mine run rock (blasted stone), screened stone, waste rock, fines, and sand and gravel. The same types of accidents also occur during the dumping of overburden, which is normally associated with permanent to semi-permanent structures such as waste dumps and spoil piles.

STOCKPILING TECHNIQUES

Stockpiling techniques vary depending upon the size of the mine, the type of material handled, and type of equipment available. Some techniques are safer than others and should be used when applicable.

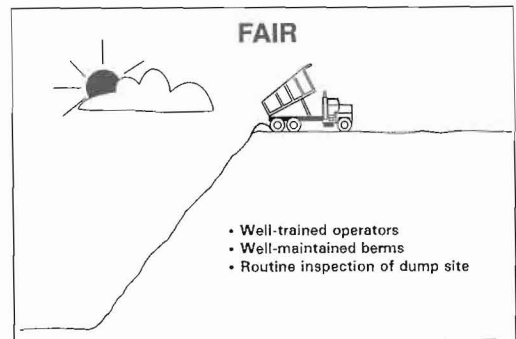
A "Good" Method of Stockpiling. A "good" method of stockpiling involves the haulage truck dumping its load

back from the crest of the pile. The material is then bumped over the edge by a dozer or front-end loader using other material. This method allows for the easy construction and maintenance of berms. This method also keeps mobile equipment away from the edge of the pile where the equipment has the highest chance of being involved in an accident. When combined with well-trained operators and routine inspections for signs of slope instability, this method drastically reduces the chance for an accident.



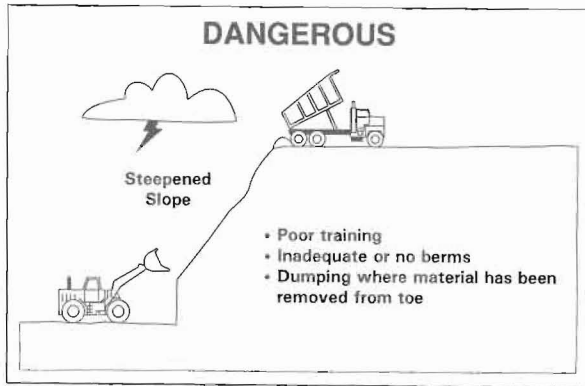
“Good” stockpiling method (top and side view).

A “Fair” Method of Stockpiling. A “fair” method of stockpiling involves the haulage truck dumping its load directly over the crest of the pile. For this method to be performed safely, adequate berms must be maintained and the equipment operators well trained regarding stockpile hazards. Other factors including the type of material, condition of the material, weather, and type and size of haulage truck need to be considered. It is also important to routinely inspect the dump area for signs of slope instability. When using this method it is important to ensure that material is not removed from the toe of the pile where dumping is taking place.



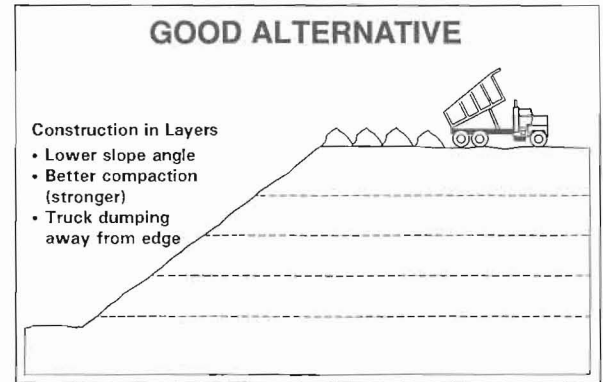
“Fair” stockpiling method (side view).

A “Dangerous” Method of Stockpiling. A “dangerous” method of stockpiling involves the haulage truck dumping its load directly over the crest of a pile where material has been removed from the toe. Removing material from the base of a pile generally results in a steepened slope. A steepened slope is less stable and cannot support as much weight. This creates a hazard for equipment operating near the crest of the pile, which is in danger of being involved in a slope failure. The mine supervisor, loader operator, and haulage truck driver must ensure that dumping does not occur where the slope has been steepened by reclaiming activities. The practice of dumping over the edge of a stockpile, in an area where the slope has been loaded out at the toe, should be prohibited.



“Dangerous” stockpiling method (side view).

Good “Alternative” Method of Stockpiling. A very good “alternative” method of stockpiling involves the construction of stockpiles in layers. In this method, haulage trucks dump their loads as piles on a single level. After a level is complete it is then smoothed over by a dozer and dumping continues on the next layer. The operation of the mobile equipment compacting the previous layer results in greater pile strength. The method also permits the slope angle to be maintained lower than the angle of repose, resulting in greater slope stability. Haulage trucks are also kept away from the edge of the pile. From a quality control standpoint, this method also avoids undesirable size separation of material.

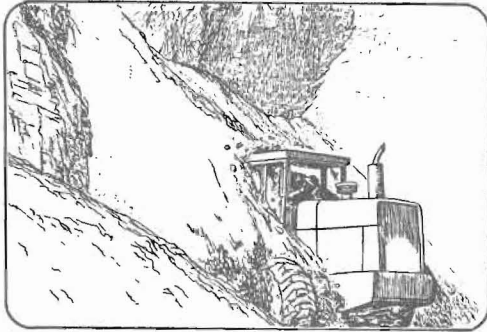


Good “alternative” method of stockpiling.

LOADING OUT AT THE TOE

“Loading out at the toe” refers to removal of material from the base or toe of the stockpile. This is usually done by front-end loaders. The material is loaded into trucks for shipping or is fed directly into crushers or feeders for further processing.

This method often results in a steepened slope with reduced stability. This presents a hazard to the loader operator at the base of the pile who needs to continuously watch for collapse of the steepened face.



Use extra caution when material is being removed from the base of a pile.

Equipment operators and others at the top edge of the pile are also in danger of being involved in slope failure. The weight of a haulage truck, in particular, can cause a weakened slope to fail. When this happens, the truck often falls down the slope with disastrous results. Loading out at the toe also presents a hazard to

pedestrians at the base of the pile, particularly highway truck drivers, who may be engulfed by falling material while walking between their truck and the pile.

THE PRESENCE OF A BERM DOES NOT NECESSARILY SIGNIFY THAT IT IS SAFE TO DUMP. Loading out at the toe can result in slopes so weakened that the slope, including the berm, will fail when a truck backs up to dump. Berms in these instances give a false sense of security to the haulage truck operator who assumes the berm signifies a stable slope. Removing material from the base of the pile can also result in the collapse of the berm. This can allow haulage truck drivers to simply back over the edge of a pile when, unexpectedly, a berm is no longer there.



Dumping on top of a pile that has been loaded out at the toe can result in disaster.

When loading out at the toe:

- The loader operator should be alert to material sloughing down the pile, and the fall of frozen or consolidated chunks.
- The loader operator should ensure that haulage trucks don't dump at the top of a pile where the toe has been removed.
- Highway truck drivers should not walk around the base of the pile or between equipment and the pile.
- Haulage truck drivers should routinely observe the base of the pile where they are dumping to ensure the pile has not been oversteepened by the removal of material.
- Haulage truck drivers should dump only in a designated area that has been prepared by the construction of berms, and after a supervisory inspection for signs of slope instability.
- When the slope is oversteepened, the haulage truck should dump a safe distance from the crest. The material can then be bumped over the edge by a dozer or front-end loader, using other material.
- When the slope is oversteepened, the haulage truck can also dump at the base of the pile, adjacent to where the loader is operating.
- If the pile is oversteepened, then dumping over the crest should not be allowed until: material bumped over the crest of the pile reaches its original shape; berms are constructed; and an inspection for slope stability is completed.

SLOPE INSTABILITY

Stockpiles by their nature are only marginally stable. As material is dumped over the edge of a pile it slides down the slope coming to rest at the angle of repose. At the angle of repose the pile is just strong enough to support its own weight. The strength of the stockpile will often increase a certain amount from the compaction and vibration of mobile equipment operating on it. (This may be apparent by the steeper slopes formed when material is removed from the base of the pile.) This additional strength can be misleading, however, as an oversteepened slope may not support the weight of mobile equipment.

Moisture within the stockpile will also allow the slope to stand at a steeper angle. This indication of increased slope strength is known as "apparent cohesion." This strength may disappear quickly with an increase or decrease in moisture levels. Apparent cohesion is also vulnerable to collapse induced by equipment vibration. Freezing can also result in a temporary increase in strength. This increase in strength is highly variable and can quickly disappear with a change in the weather. In general, moisture or freezing will give a temporary indication of strength that cannot be relied upon.

DUE TO THE MARGINAL STRENGTH OF STOCKPILES, IT IS IMPORTANT TO STAY ALERT TO ANY SIGNS OF SLOPE INSTABILITY. If one of the following warning signs appears, the slope edge may not be safe for equipment operation: 1) cracks along the crest, 2) slumping on the slope, or 3) bulging at the toe.

Cracks Along the Crest

Cracks along the edge of a slope signify that the slope is having trouble supporting its own weight. The additional weight of mobile equipment would likely be sufficient to cause a slope failure. **WHEN CRACKS ARE OBSERVED THE AREA SHOULD BE MARKED OFF BY A BERM OR CONES UNTIL THE CONDITION IS CORRECTED.** A crack is an important warning sign and shouldn't be covered up. Dumping can continue at a safe distance from the cracks with the material being bumped over the edge, preferably by a tracked dozer. The dozer should not operate past the cracks.



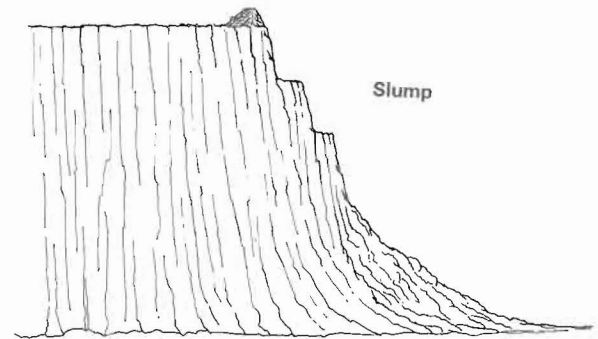
Cracks along crest of pile.

If the weakened slope resulted from loading out at the toe, then material should be bumped over the edge until the slope is at the original angle of repose. Pushing material over the edge until the original angle of repose is achieved should strengthen the pile sufficiently to permit further end dumping over the edge. Dumping

material at the base of the pile will add additional strength. If slope stability is still uncertain, dumping should continue at the base of the pile rather than at the top edge.

Slumping on the Slope

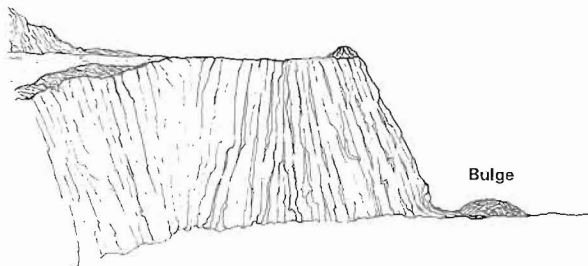
Slumping on the face of a pile is evidence that the slope cannot support its own weight and is failing. It normally occurs on waste dumps consisting of overburden and results when the slope angle near the top of the pile is too steep (often caused by the tendency of the waste, particularly the fines, to temporarily hang up near the top). When slumping is observed, end dumping over the edge should be stopped. Haulage trucks should dump their load a safe distance back from the slope edge, and dozers should be used to push the material over the crest.



Slumping along face of pile.

Bulging at the Toe

Bulging at the base of a pile is evidence that the foundation cannot support the weight of the pile. This is rare and usually occurs on large, relatively high, waste dumps. Movement of the material is usually very slow. Bulging can indicate the potential for a slope failure that might involve material movement up to and including the crest of the pile. When a bulge is observed near the base of a pile, dumping operations should be closely monitored, frequent inspections performed for signs of an impending failure (cracks at the top of pile, etc.), and a slope stability evaluation completed.



Bulging at the toe.

Signs of slope instability may be difficult to see when operating mobile equipment. For this reason a supervisory inspection on foot should supplement the equipment operator's constant vigilance. In general, MSHA regulations state that:

30 CFR 56/57.9304 Unstable ground.

- (a) Dumping locations shall be visually inspected prior to work commencing and as ground conditions warrant.
- (b) Where there is evidence that the ground at a dumping location may fail to support the mobile equipment, loads shall be dumped a safe distance back from the edge of the unstable area of the bank.

30 CFR 77.1713 Daily inspection of surface coal mine; certified person; reports of inspection.

- (a) At least once during each working shift, or more often if necessary for safety, each active working area and each active surface installation shall be examined by a certified person designated by the operator to conduct such examinations for hazardous conditions and any hazardous conditions noted during such examinations shall be reported to the operator and shall be corrected by the operator.

HAULAGE TRUCKS

Backing Over the Edge

Operators must **STAY ALERT** when operating their haulage trucks near the crest of a stockpile. They must know where their rear tires are in relation to the slope edge. A surprising number of stockpile accidents occur when a haulage truck is simply backed over the edge of a pile. When operators are end dumping over the crest of a stockpile, they must make sure that they are in a designated area with adequate berms or other impeding devices.



Know where your rear tires are.

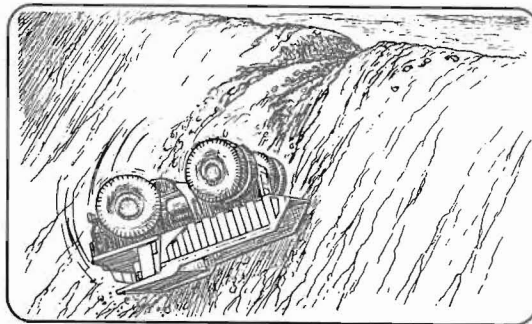
Mirrors must be clean and properly adjusted. If dumping at night there should be adequate lighting to see the edge. Brakes must be tested to ensure they are working properly.

Operators should back slowly to ensure there is adequate time to react and stop before contacting the berm. **BERMS CANNOT BE RELIED ON TO STOP A TRUCK.** When a spotter is used, the spotter

should stand where his/her signal can be clearly recognized. Spotters should use signal lights at night and when visibility is limited.

Berms

Backing through or over a berm is a common cause of stockpile accidents. A normal rule of thumb is that berm height should be equal to mid-axle height of the largest truck using the dump site. For roadways, this is mandatory under 30 CFR 56/57.9300. The MSHA Program Policy Manual, Volume V, PART 77, Subpart Q, page 202, also requires that berms be equal to axle height of the largest truck at the work site. The berms should be constructed strong enough to survive a moderate impact. However, they should not be used to stop a truck. Berms should be used as a visual indicator of where the truck should be stopped, or to provide a "feeling" of the berm as the rear tires contact it. **A BERM SHOULD BE USED FOR SPOTTING ONLY!**



Don't rely on a berm to stop a truck.

If a berm is present it should not be assumed that it is safe to dump. The haulage truck driver should verify that material has not been removed from the toe of the pile. Routine supervisory inspections should also be performed to ensure that the slope is stable. Federal regulations state that:

30 CFR 56/57.9301 Dump site restraints.

Berms, bumper blocks, safety hooks, or similar impeding devices shall be provided at dumping locations where there is a hazard of overtravel or overturning.

30 CFR 77.1605 Loading and haulage equipment; installations.

(1) Berms, bumper blocks, safety hooks, or similar means shall be provided to prevent overtravel and overturning at dumping locations.

Therefore, depending upon the specific mine, an impeding device other than a berm may be used. **TRUCK DRIVERS MUST MAKE SURE THAT THEY ONLY DUMP WHERE A BERM OR IMPEDING DEVICE IS PROVIDED.**

Dumping in Designated Area

Drivers must dump only at a location designated by the supervisor. **IF A DRIVER IS UNSURE WHERE TO DUMP, THEN HE/SHE SHOULDN'T DUMP.** Drivers should contact their supervisor and determine

the correct dumping location rather than to take a chance and dump at a potentially unsafe area. A supervisor may designate dump locations based not only on production requirements, but also on safety considerations that drivers are unaware of. When drivers are assigned to a dump location, they should stay alert for potential hazards and notify the supervisor immediately if a problem is spotted.



Dump at the designated location.

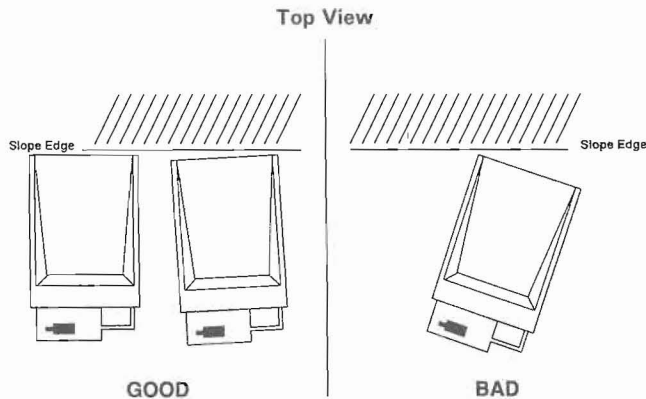
If dumping is done in an area where dozers are being used to push material over the edge of the pile, they should be permitted to do their job. Drivers should dump their loads back from the slope edge as directed. Accidents routinely occur when a truck dumps over the edge where a dozer has been assigned to push material over. In many of these cases, the crest of the pile is not strong enough to support the weight of the truck or the berms are inadequate.

Backing Orientation

When backing at an angle to the slope edge one set of rear duals will reach the edge before the other. If the rear tires on the side of the truck opposite the operator's compartment reach the slope edge first, the chance for an accident increases. This happens when the operator is watching his/her side of the truck and unexpectedly contacts the berm with the other side. The far-side tires contact the berm too hard and the truck either goes through or over the berm. If the berms are inadequate or other impeding devices are not provided, then the operator may simply back the far-side duals over the edge.

It is important for drivers to back their trucks square to the edge of the slope or at a slight angle that places the operator's side closer to the slope edge. Drivers should primarily use the mirrors on the operator's side of the truck when backing. It is much easier to judge backing distance when using these mirrors. They are closer and provide a larger image than the mirrors located on the far side of the truck.

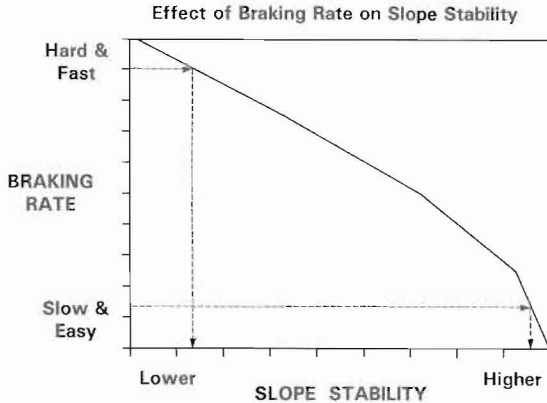
In summary, **DRIVERS SHOULD BACK SQUARE TO THE EDGE USING THE CLOSEST MIRROR, OCCASIONALLY GLANCING AT THE FAR MIRRORS TO CHECK FOR CORRECT ORIENTATION AND POTENTIAL OBSTACLES.**



Back square to the slope edge.

Backing Speed

Drivers should approach the slope edge at a moderate to slow speed when backing to dump, and apply the brakes gradually while stopping. Braking hard at the last moment imposes a large horizontal force in addition to the normal vertical force imposed by the weight of the truck. This additional horizontal force substantially increases the chance of a slope failure. Even when backing to the slope edge slowly, it is important to brake gradually.



Back slowly and brake easy.

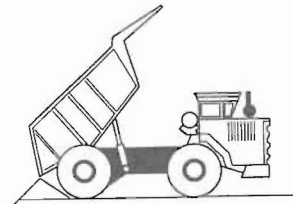
In addition to slope failures, there are other hazards associated with backing too fast. Backing too fast decreases the driver's reaction time to hazards that may develop at the dump point or problems that may develop with the truck. It also increases the risk that the driver will contact the berm too fast, going over or through it.

Dumping on Uneven Ground

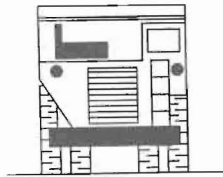
The vehicle center of gravity rises as the truckbed is raised into the dump position. If the truck is parked on a slight downhill grade toward the berm or if it is leaning sideways, it may be in danger of tipping. The potential for tipping increases when the load is hanging up in the truckbed or the material is not flowing out freely.

The dump point should **NEVER** be constructed so the truck is parked on a downward slope toward the berm. If the decline is too steep and material hangs up in the truckbed, then the truck is in danger of tipping over backwards. Sloping the dump point toward the berm also provides poor drainage, allowing water to accumulate at the berm. An accumulation of water at the berm (dump point) can result in decreased slope strength and a soft footing which may allow the rear tires to sink. In addition, stopping on a decline requires additional braking force. This places additional reliance upon the braking system and imposes greater forces on the slope, increasing the potential for a slope failure. **THE DUMP POINT SHOULD BE CONSTRUCTED LEVEL OR AT A SLIGHT UPWARD INCLINE.** Maintaining the dump point at a slight upward angle (1° to 3°) allows for drainage and decreases the amount of force required to stop the truck. It also decreases the chance of tipping over backwards should material hang up in the truckbed.

THE DUMP POINT SHOULD BE CONSTRUCTED SO THE HAULAGE TRUCK SITS FLAT, NOT LEANING TO THE SIDE. If the sideways angle is too steep or material hangs up in the truckbed, the truck is in danger of tipping on its side. This is also a problem when the dump point is soft. The rear tires may sink as the truckbed is raised into the dump position. If the tires do not sink evenly, the truck will lean to one side increasing the chance of tipping over. Soft material will also force the operator to apply more power to the drive wheels when approaching the berm, complicating control of the truck in this potentially hazardous area.



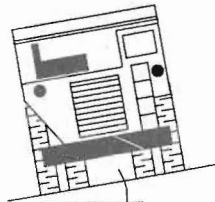
GOOD



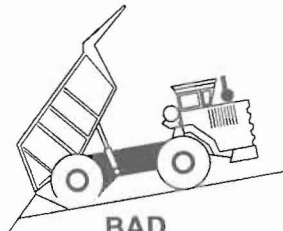
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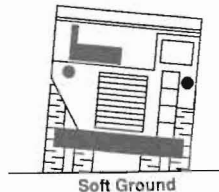
BETTER



BAD



BAD



BAD

Use caution when dumping on unlevel or soft ground.

Truckbed Position

When you approach the dump site look for any overhead obstructions, such as power lines, which may be in the area. After backing to the dump point bring the truck to a complete stop and apply the parking or holding brake. Follow the procedures provided in the operators manual for the particular truck you are operating.



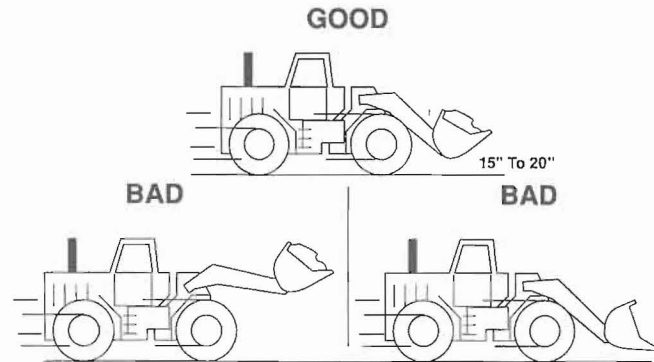
Make sure the truckbed is lowered before leaving dump site.

After dumping the load, pull out slowly. Engage the transmission before releasing the parking brake to prevent the truck from rolling backwards. Lower the truckbed as quickly as possible. If material is hanging up in the bed, moving the truck can increase the chance for tipping over. The truckbed should be fully lowered before leaving the dump site and entering the haul road.

FRONT-END LOADERS

Tramming

It is very important that the bucket be kept low while tramming. This maintains a low center of gravity and provides better stability. It also allows for an unobstructed view of the roadway. The bucket should be tilted back and kept 15 to 20 inches off the ground. When tramming with a full bucket, the bucket should be shaken slightly before starting to remove any loose material that may fall off. When tramming with an empty bucket, the bucket should not be tilted forward or carried too low. The bucket might unexpectedly catch on or hit an obstruction or rough spot in the roadway.



Keep the bucket low and maintain control.

If tramping on a steep grade, the operator should go slow and keep the transmission in a low gear. This will allow higher engine RPM and adequate hydraulic pressure for braking and steering. A lower gear will also help maintain a lower speed with less danger of stalling.

Having the bucket elevated (especially when full) significantly increases the chance of tipping sideways. This can occur when tramping along a slight grade or if the operator inadvertently drives up along the bottom edge of a stockpile or berm. If a loader is tramped on a roadway where a drop-off or danger of rollover exists, the operator should make sure adequate berms are maintained.

When a loader is tramped up an elevated ramp to a feeder, berms become especially important. The ramp slope should be maintained at 10 degrees or less with a level pad provided in front of the feeder. The pad should be at least 1½ times the length of the loader. (The operator should be able to see the top edge of the ramp when starting to back away from the hopper.) Berms should be provided and the sides of the ramp should be constructed lower than the angle of repose to ensure adequate stability.

Loading Trucks

When loading a truck, the impact of material into the truckbed should be minimized. This can be accomplished by loading fines prior to any large chunks, by tilting the bucket slowly to reduce the sudden drop of material, and, when possible, by breaking large consolidated chunks before loading. It is equally important not to strike the truck with the loader bucket or bucket arms. Any sudden impact can cause damage to the truck and injury to the truck driver.

Loader operators should watch for the truck drivers and make sure that they stay in the cab of the truck. If they must get out, have them stand a safe distance from the slope and out of the way of equipment operation. The loader operator should not swing the loader bucket over the cab of the truck or load while individuals are standing next to the truck. The loader operator should keep the load area clean, and when time permits clean up, level, and maintain berms at the top of the pile.



Use caution around other equipment.

Loader operators and truck drivers should stay alert to other equipment that may be operating in the area and the occasional unexpected pedestrian. Windows and mirrors should be clean and properly adjusted. If it is windy and dusty, the loader operator should keep the wind to his/her back while dumping so dust won't obscure vision. Finally, it is important that backup alarms be regularly checked to ensure that they are working properly.

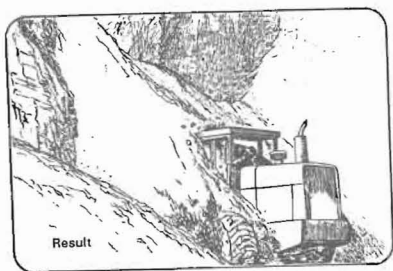
Operating at the Base of the Pile

In most cases when material is removed from the toe of a stockpile, material will collapse and flow down the face of the pile. This is good as the slope remains at the angle of repose maintaining stockpile stability. If the material does not flow easily due to moisture, freezing, or compaction, there is danger of oversteepening or undercutting the pile. This can result in the unexpected fall or collapse of the slope. The loader operating at the base of the pile is in danger of being engulfed by loose material or struck by large consolidated chunks.

The hazard becomes greater as stockpile height increases, especially when the pile becomes higher than the reach of the loader. Slopes not only become weaker with height (for material that does not easily flow), there is more material involved when the slope does fail. If a stockpile, significantly higher than the reach of the loader, begins to become oversteepened or undercut, immediate action is required. Material should be bumped over the crest and the pile worked down from above until the slope approaches the original angle of repose. When possible this should be accomplished with a dozer. (When available, specially equipped machinery such as a long arm backhoe may offer a safer alternative, without the inherent dangers associated with equipment operation on top of the pile.) **IT IS VERY IMPORTANT THAT THE CONDITION NOT BE ALLOWED TO GET SO BAD THAT IT CAN'T BE CORRECTED WITHOUT ENDANGERING WORKERS.** If oversteepening or undercutting routinely occurs, the height of the pile

should be reduced to a height only slightly greater than the reach of the loader.

When pile height decreases so does the danger. If a stockpile only slightly higher than the reach of the loader bucket becomes undercut or oversteepened, use the loader bucket to work the face of the pile from the top down. It is very important that conditions are not allowed to become unsafe before corrective action is taken.



Don't allow the stockpile to become oversteepened or undercut.

If portions of the pile are frozen, then large chunks can slide or fall. They can strike the loader, severely injuring the operator within the cab. They can also bounce into the cab striking the operator. Accidents have occurred where entire cabs have been crushed.

THE LOADER SHOULD ALWAYS BE OPERATED PERPENDICULAR RATHER THAN PARALLEL TO THE BASE OF THE PILE.

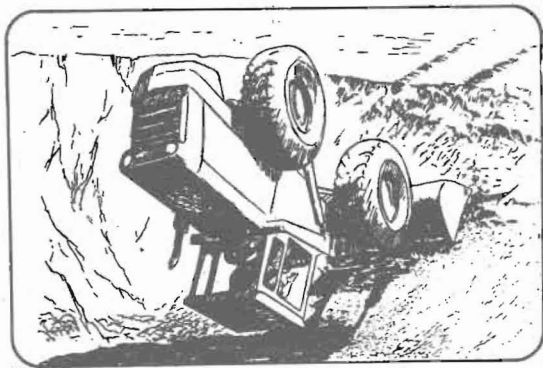
This places the operator compartment further from the slope. It allows for quicker response in moving the loader should a slope failure occur. In addition, when operating both close to and parallel to the slope, less material is required to bury the cab, and the operator becomes more susceptible to falling or bouncing rocks.

THE LOADER OPERATOR IS IN THE BEST POSITION TO OBSERVE A STOCKPILE HAZARD. If a hazardous situation develops, the loader operator should take immediate action. Other equipment should be prevented from operating at the top or base of the pile until the situation is corrected.

Operating at the Top of the Pile

While operating at the top of the pile, front-end loaders are subject to many of the same hazards as haulage trucks. These hazards include driving over the edge, going through or over an inadequate berm, or being involved in a slope failure. As with haulage trucks, most of the slope failures occur as a result of material being removed from the base of the pile. In addition, when operating close to and parallel to the slope edge, material settlement or soft ground may be sufficient to tip the loader over or cause the operator to lose control.

THE BEST METHOD TO PREVENT LOADER ACCIDENTS AT THE TOP OF A PILE IS TO KEEP THE LOADER PERPENDICULAR TO AND FACING THE SLOPE EDGE. This keeps the weight of the loader further from the slope edge and lowers the chance of tipping or leaning sideways if the edge settles. It also allows you to quickly back the loader out of danger should a hazard develop.



Keep loader perpendicular to the slope edge.

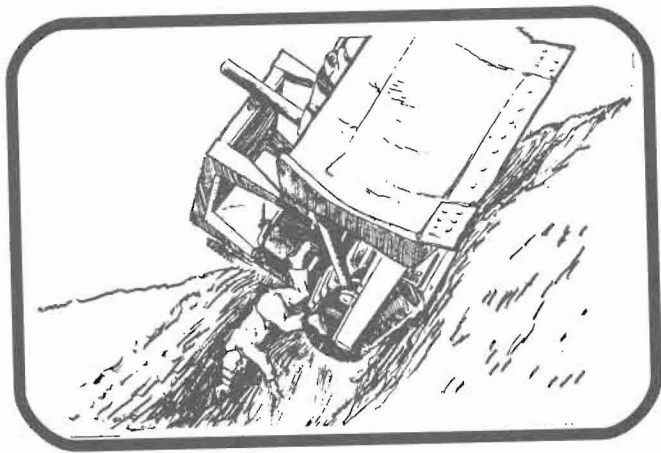
DOZERS

Pushing Material

The power, stability, and traction of dozers can result in a false sense of security. Operators should never become overconfident in the capabilities of the dozer or in their capabilities of operating it. When pushing material over the crest of a stockpile or waste dump, the operator should stop a safe distance from the edge and use other material to bump it over.

THERE SHOULD ALWAYS BE A BERM MAINTAINED AT THE CREST OF THE PILE to prevent equipment operators from inadvertently going over the edge. When working or leveling the top of the pile, operators must keep track of where the edge is. Many accidents occur when the dozer unexpectedly backs over the edge of a pile.

The dozer should always be perpendicular to and facing the slope edge. This will allow a quicker response in backing from the edge should a slope failure or settlement occur. An operator should **NEVER** run the dozer along the slope edge. The weight and vibration of the machine increase the chance that a slope failure and rollover will occur. When operating parallel to the slope edge, there is also less room and time to respond in case of operator error.



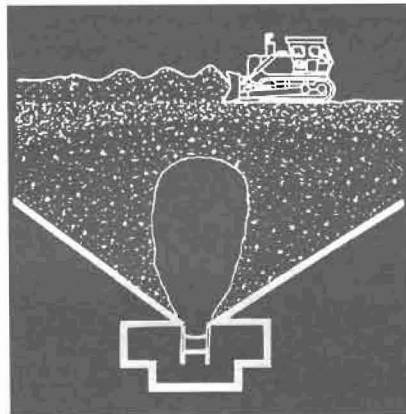
Never push a load completely over the edge. Use the next load to bump it over.

Dozer operators should always watch for signs of slope instability such as cracks along the crest or slumping on the slope. If there are visible signs of slope instability, operators should maintain a safe distance from the edge. They should be alert to the changes in ground conditions resulting from the weather (rain, sleet, snow, freezing and thawing). If material is removed from the base of the pile, they should inspect the slope for oversteepening, undercutting, and overhangs. Dozer operators should always keep the blade low and operate at a speed consistent with the type of work being performed and the current ground conditions.

If it is necessary to work on the face of a pile, dozer operators should work the slope vertically. They should keep the blade facing downhill and should back up the slope before beginning the next pass. This will reduce the chance of sliding sideways or rolling over.

Draw Points

Stockpiles and surge piles that have material being removed by underground feeders can be particularly dangerous. Two major hazards exist: the weak material around the draw hole and the possibility of hidden cavities (bridged material).



Never operate mobile equipment over a draw point.

As the underground feeder removes material, a draw hole is formed. The top edge of the draw hole is very unstable and always near collapse. When a dozer is operated close to the edge, it can induce a slope failure and slide down into the draw hole. Injuries and fatalities occur when material sloughs down on top of the dozer, either crushing or suffocating the operator. **OPERATORS SHOULD NEVER PUSH MATERIAL DIRECTLY INTO THE DRAW HOLE.** They should bump it in with other material, keeping the dozer a safe distance away from the edge.

When working near the draw hole, the dozer should always be operated perpendicular to the edge of the draw hole. Operators must stay alert to the location of the draw point and use caution not to back or slip into it. The location of each draw point should be clearly indicated by a marker, such as a brightly colored object suspended directly above it.

OPERATORS MUST NEVER GET OFF THEIR DOZER AND WALK TO THE EDGE OF THE DRAW HOLE. They could easily be drawn into the material flowing into the feeder.



Use extreme caution on surge piles located over draw points.

Occasionally the draw point may bridge over. This can be especially dangerous as it may be impossible to determine the exact size and location of the cavity under the bridged material. Material may continue to flow into the plant as the cavity forms. There may not be any indication of a problem to the plant personnel. The dozer operator should have a direct means of

communication, such as a two-way radio, with plant personnel to determine which feeders are being used and the amount of material being removed. Feeder locations should be clearly marked, by using large markers or lights suspended directly above the feeders. The dozer operator should also be provided with a means to shut down the feeder and stacker belt from the cab. With this information and an inspection of the surge pile, it may be possible to determine if a bridge has formed.

Injuries and fatalities occur when the bridged material fails under the weight of the dozer allowing it to fall into the cavity and become buried. **IF AN ACCIDENT DOES OCCUR IT IS EXTREMELY IMPORTANT THAT THE DOZER OPERATOR STAYS IN THE CAB.** If a cavity is known to exist, operators must use extreme caution keeping the dozer a safe distance from the draw point. It may become necessary to remove material from the pile in order to safely collapse the cavity. The material should be removed from the side of the pile carefully working toward the cavity.

It is recommended that equipment operating on surge piles be provided with **CABS STRONG ENOUGH TO RESIST BURIAL PRESSURE, OR USE REMOTE CONTROL EQUIPMENT.** The windows of dozers can be made to withstand burial pressure by a combination of installing supports and improving the edge support for the glass, and using high-strength (such as chemically-strengthened) glass. Self-rescuers, radio communication, and lighting should also be provided so that the operator can be rescued in the event of an accident.

SCRAPERS

Soft material along the crest of a pile can allow the tires to sink, pulling the scraper over the edge. On side slopes, scrapers become very unstable and can easily roll over. If a scraper goes over the edge, the operator should stay with the machine and ride it out. In some circumstances, the operator may be able to apply power to keep the scraper steered straight down the slope.

Operators should always slow down before turning and should never turn sharply when going uphill or downhill, especially downhill. If running along a hillside they should go slowly and turn very carefully. They should never get on a steep side grade.

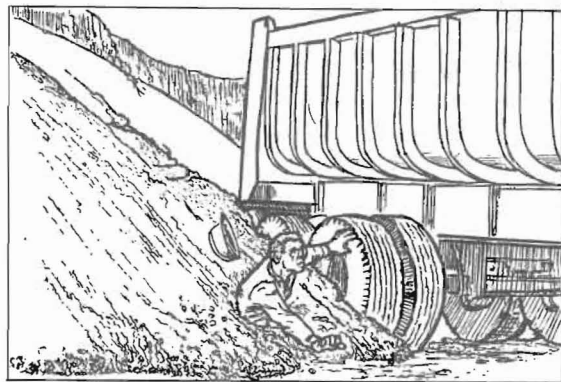


Maintain a safe speed and never turn sharply when operating on a hill.

Operators must know the traffic patterns and always give right-of-way to loaded machines. When tramming, the bowl should be kept as low as conditions permit to increase stability.

HIGHWAY TRUCKS

Highway truck drivers should be encouraged to stay in their trucks with their seat belts fastened. They may not be aware of the hazards around stockpiles and mining equipment. If truck drivers must get out of the truck, they must stand a safe distance from the stockpile and out of the way of equipment operation.



Truck drivers should stay in their truck.

Many accidents occur when truck drivers are engulfed by falling material while standing between their truck and the stockpile. In most cases they are unaware of the hazards associated with oversteepened slopes and the potential of material movement. **HIGHWAY TRUCK DRIVERS SHOULD NEVER BE ALLOWED TO STAND BETWEEN THEIR TRUCK AND THE STOCKPILE** (30 CFR 56/57.3430).

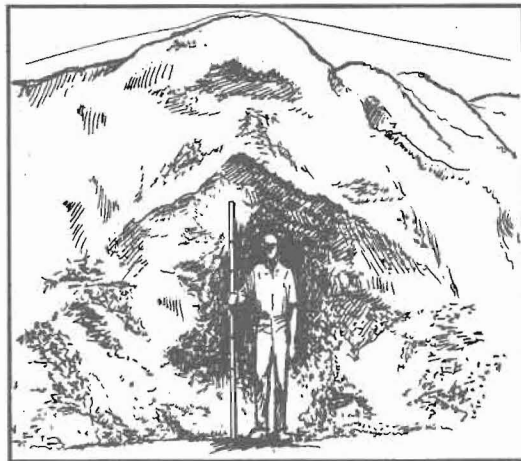
The truck driver is also in danger of being struck by material falling out of the loader bucket or spilling over the truck as it's being loaded. This can occur while the driver is walking behind or alongside the truck. In addition, the truck driver may not be aware of the large blind spots behind mining equipment, and may inadvertently place himself/herself in an unsafe position.

MATERIAL SHOULD NEVER BE LOADED OR SWUNG OVER THE CAB OF THE TRUCK. If this must be done then the driver must exit the truck and stand in a safe location. The driver could remain in the truck if it is equipped with falling object protection; however, this is very rare on highway trucks.

ON FOOT

Persons should only be on or around a stockpile if their work requires it. **IF WORKERS MUST BE ON FOOT AND WORK AROUND A STOCKPILE, THEY MUST NOTIFY THEIR SUPERVISOR AND ALL EQUIPMENT OPERATORS.** In most cases, and for good reasons, pedestrians are not allowed on or near stockpiles. The amount of equipment activity and unstable nature of the material presents too many hazards to persons on foot.

When working around a stockpile, workers should stay away from the toe. They could easily be engulfed or struck by falling material which has been dumped at the top of the pile or has fallen from a sudden collapse of an oversteepened or undercut slope.



Stay away from the toe of a stockpile.

Workers must make sure loader operators and truck drivers are aware of their presence. Equipment operators do not expect people on foot when working around the pile and they cannot be counted on to see someone on foot. In addition, most mobile mining equipment will have large blind areas where the operator is unable to see.



Workers on foot must stay alert to backup alarms and be ready to move in a hurry if necessary.

When working at the top of the pile, workers should stay away from the edge. The edge can unexpectedly fall away at any time, especially when material is being removed from the toe. In addition, when walking along the top edge of the pile, the footing is usually bad and the worker could simply trip and fall. When the material

they are standing on begins to move or collapse, it is very easy to get sucked in and trapped.

A person can become entrapped in material that is only knee deep and suffocate in material that is only chest deep. When buried to the chest, the material closes in as the person breathes in and out, packs tightly, and eventually makes breathing impossible.



Do not stand on the top edge of a stockpile.



Workers should never walk on a surge pile where material is being, or has been, removed by an underground feeder.

Workers can be caught and drawn into material that is gradually being worked down by the feeder, or they can suddenly fall into a cavity that is covered by bridged material. The weight of an individual is sufficient to cause bridged material to collapse. If workers must work on a surge pile, they should make sure that all feeders that supply or remove material from the pile are locked out. They should also make sure that enough material is removed from around the draw point to prevent an unexpected collapse. When working on a surge pile where hazardous conditions exist, workers should make sure that someone can see them and that they can maintain two-way communications. Because of the danger of encountering a bridged-over cavity, ladders, platforms, or some other form of support should be provided. The person involved should wear a safety belt or harness, with a lifeline, and a second person should keep the line taut.

In general, MSHA regulations state that:

30 CFR 77.209 Surge and storage piles.

No person shall be permitted to walk or stand immediately above a reclaiming area or in any other area at or near a surge or storage pile where the reclaiming operation may expose him to a hazard.

30 CFR 56/57.9312 Working around drawholes.

Unless platforms or safety lines are used, persons shall not position themselves over drawholes if there is danger that broken rock or material may be withdrawn or bridged.

30 CFR 56/57.16002 Bins, hoppers, silos, tanks, and surge piles.

(a) Bins, hoppers, silos, tanks, and surge piles, where loose unconsolidated materials are stored, handled or transferred shall be:

- (1) Equipped with mechanical devices or other effective means of handling materials so that during normal operations persons are not required to enter or work where they are exposed to entrapment by the caving or sliding of materials; and
- (2) Equipped with supply and discharge operating controls. The controls shall be located so that spills or overruns will not endanger persons.

(b) Where persons are required to move around or over any facility listed in this standard, suitable walkways or passageways shall be provided.

(c) Where persons are required to enter any facility listed in this standard for maintenance or inspection purposes, ladders, platforms, or staging shall be provided. No person shall enter the facility until the supply and discharge of materials have ceased and the supply and discharge equipment is locked out. Persons entering the facility shall wear a safety belt or harness equipped with a lifeline suitably fastened. A second person, similarly equipped, shall be stationed near where the lifeline is fastened and shall constantly adjust it or keep it tight as needed, with minimum slack.

SUMMARY

Safety is the responsibility of everyone, from the equipment operator to the mine manager. Only through the active involvement of all employees can a safe work environment be ensured. A good safety attitude reflects well upon the professionalism of American miners, and can be used as a tool to enhance competitiveness. An active safety program can instill teamwork, improve communication, and reinforce to the employees their value to the mining operation.

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SAFETY MANUALS

Accident Investigation
 Accident Prevention
 Back Injuries in the Mining Industry
 Coal Mine Maps
 Coal Mine Roof and Rib Control (Historical)
 Coal Mining
 Coping with Substance Abuse in Mining
 Electrical Hazards
 Fire Safety
 First Aid
 Heat Stress in Mining
 Industrial Hygiene for Healthier Miners
 Job Safety Analysis
 Laboratory Safety (Historical)
 Mine Escapeways
 Mine Gases
 Mine Ventilation
 Permissibility – Electric Face Equipment
 Personal Protective Equipment
 Radiation Hazards in Mining
 Stockpiling Safety
 Surface Haulage Safety
 Winter Alert