

MSHA HANDBOOK SERIES

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Roadways and Dumping
Locations Inspection
Handbook

PREFACE

This handbook provides mine inspectors information to evaluate the safety of a mine's roadways and dumping locations.

Not all procedures and requirements are applicable to all mine types. Deviations from the procedures outlined in this handbook should be based on the inspector's professional judgement and discussion with the inspector's supervisor given conditions, practices, and circumstances specific to the mine.

Approved:

/s/

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TABLE OF CONTENTS

CHAPTER 1 - INTRODUCTION	1
AUTHORITY	1
PURPOSE	1
RESPONSIBILITY	1
INSPECTION PROCEDURE CONSIDERATIONS	1
ADDITIONAL PUBLICATIONS	2
CHAPTER 2 - ROADWAYS.....	3
GRADES	3
ROADWAY WIDTH	3
ROADSIDE BERMS AND GUARDRAILS	4
RUNAWAY EQUIPMENT	5
SIGHT DISTANCE	5
OTHER SIGHT DISTANCE CONSIDERATIONS.....	6
STOPPING DISTANCE.....	6
SPEED LIMITS.....	6
TRAFFIC RULES AND SIGNS.....	7
ROADWAY MAINTENANCE.....	7
UNSTABLE MATERIAL AND OTHER HAZARDS	8
CHAPTER 3 - DUMPING LOCATIONS	9
BERMS AT DUMPING LOCATIONS	10
STABILITY NEAR THE DUMP EDGE	10

CHAPTER 1 - INTRODUCTION

Authority

The Federal Mine Safety and Health Act of 1977, as amended by the Mine Improvement and New Emergency Response Act of 2006, (Mine Act) requires that authorized representatives of the Secretary of Labor conduct mine inspections and investigations to determine whether miners and mine operators are in compliance with the Mine Act and mandatory safety and health standards, and to obtain, utilize, and disseminate information related to safety and health conditions.

Purpose

The design and maintenance of roadways and dumping locations play an important part in surface haulage safety.

This handbook provides mine inspectors with information to assist them in evaluating the safety of mine roadways and dumping locations. Inspectors can use this handbook to help identify hazardous roadway conditions, dumping location conditions, and associated work practices.

Responsibility

The Administrator for Mine Safety and Health Enforcement has the primary responsibility for enforcing the Mine Act, including the standards and regulations relating to mining. Shared responsibility rests with the regional administrators, district managers, assistant district managers, supervisors, specialists, and inspectors. Inspectors are responsible for conducting inspections and investigations. Inspectors should discuss safety and health practices with mine operators and miners during every inspection. Stakeholder participation is essential to an effective safety and health program at each mine.

Inspection Procedure Considerations

Inspectors should evaluate potential problem areas on roadways and dumping locations during the course of the inspection.

Pay special attention to roadway areas with steep grades, sharp curves, limited sight distances, narrow roadway widths, and/or slippery roadway surfaces. Note conditions at intersections, in congested areas, and at locations where it may be unclear who has the right-of-way. Spend time observing the traffic in all of these areas. Look for indications of equipment control issues, such as skid marks on the roadway. These may reveal:

ROADWAYS AND DUMPING LOCATIONS INSPECTION HANDBOOK

- roadway areas prone to near misses,
- over-reliance on service brakes on downgrades,
- operations exceeding performance limits of equipment, and
- equipment operator training deficiencies.

Inspectors may obtain the best perspective of roadways by accompanying an equipment operator. This provides an opportunity to discuss potential problems.

Pay special attention to dumping locations with:

- soft surfaces,
- evidence of settling,
- berms,
- drainage issues, and
- equipment dumping directly over or near the edge.

To investigate a situation further, an inspector may need specialized equipment like a measuring tape, a laser range finder, a stopwatch, and a device for measuring roadway grade.

If inspectors need a more detailed analysis of a roadway or dumping location, they should discuss the situation with their supervisor. The inspector's supervisor can obtain technical assistance from the District Office or the Directorate of Technical Support. The Technical Support, Pittsburgh Safety and Health Technology Center, Mine Waste and Geotechnical Engineering Division, provides technical assistance concerning roadways and dumping locations. The Technical Support, Approval and Certification Center, Mechanical and Engineering Safety Division, provides technical assistance concerning haulage equipment and braking systems.

Additional Publications

Inspectors, miners, and mine operators may obtain additional publications on roadways and dumping locations by contacting the National Mine Health and Safety Academy at the address below or electronically at mshadistributioncenter@dol.gov and MSHALibrary@dol.gov.

National Mine Health and Safety Academy
1301 Airport Road, Beckley, WV 25813
(304) 256-3100

CHAPTER 2 - ROADWAYS

Grades

Mine operators should consider grades when they design roadways. The grade of a roadway is a measure of the slope, which is the incline or steepness from horizontal. Mine operators will normally use “percent grade” to express the grade of a roadway. The percent grade is equal to the number of feet that the roadway vertically inclines or declines over a horizontal distance of 100 feet. For example, a 6 percent grade means the roadway vertically rises or drops 6 feet for every 100 feet traveled.

WHAT INSPECTORS CAN DO

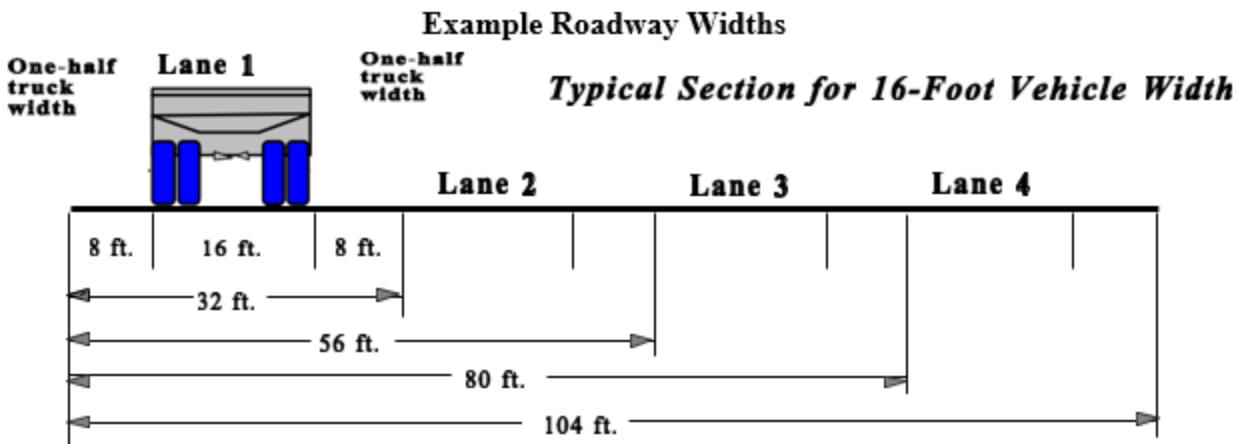
- Determine the percent grade of a roadway by measuring it with an Abney level, laser range finder, GPS, or by calculating it from an accurate topographic map.
- If the steepness of the roadway varies, divide the roadway into segments of constant grade and determine the grade for each roadway segment.
- Encourage mine operators to avoid placing a sharp curve near the top or bottom of a steep grade.
- Verify that the mine operator has considered the braking capabilities of the equipment in establishing speed limits for downgrades.
- If an opportunity presents, encourage mine operators to put a decal in the operator’s cab with the manufacturer’s recommendation of maximum operating speeds for various grades.

Roadway Width

Mine operators should consider the widest equipment to use a roadway when they establish roadway width. A basic rule of safe roadway design is each lane of travel should provide clearance on both sides equal to one-half the width of the widest vehicle using the roadway (see the example of widths in the image below), plus additional width around curves.

WHAT INSPECTORS CAN DO

- Measure roadway widths when they appear to be too narrow.
- Encourage mine operators to widen roadways or take additional safety measures, such as reducing speed limits and placing warning signs, when roadway widths are less than recommended.



NOTE: The example applies to straight roadways; additional width should be added around the curves

Roadside Berms and Guardrails

Mine operators use earthen berms, boulder berms, and/or guardrails along the outer bank of elevated roadways. Roadside berms and guardrails provide equipment operators a visual indication of the outer bank of the roadways. Roadside berms and guardrails also provide equipment operators a sensation of contact and deflect equipment back into the roadway.

Earthen berms should be firm with the inside slope of berms sufficiently steep. Loose berm material provides less restraint and equipment could plow through. A shallow slope on the inside of an earthen berm could allow equipment to ride up and over it.

Boulder berms are a continuous row of substantial boulders. The boulders should be large enough and have sufficient sliding distance to stop equipment when impacted. Additional roadway width should be available in case of contact with or pushing of the boulders.

WHAT INSPECTORS CAN DO

- Ensure that berms and guardrails are at least as high as mid-axle height of the largest equipment using the roadway.
- Encourage mine operators to use larger berms in areas with higher designated speed limits, curves, steep grades, and/or other areas where equipment operators are more likely to lose control.
- Check that the base elevation of an earthen roadside berm is no lower than the roadway elevation.
- Examine berm maintenance. Look for erosion, sloughing, slope undercutting, or other features that compromise berm integrity.
- Check that boulder berms have sufficient spacing and sliding distance to stop

ROADWAYS AND DUMPING LOCATIONS INSPECTION HANDBOOK

equipment.

- Ensure that guardrails are of sufficient construction.

Runaway Equipment

Mine operators may need to incorporate safety features into their roadway designs to safely stop runaway equipment, such as escape lanes/ramps, arrester beds, collision/drag berms, and median/center berms.

A collision or drag berm is a loose pile or row of material capable of stopping runaway equipment. Equipment operators can direct their runaway equipment to straddle the berm. The berm should be high enough to stop the runaway equipment by dragging against the equipment bottom. A median or center berm is a collision berm in the middle of the roadway, between the lanes.

An escape lane or ramp can stop runaway equipment by directing the equipment up grade and/or through an arrester bed of loose, high rolling-resistance material.

WHAT INSPECTORS CAN DO

- Consider runaway equipment potential when inspecting roadway segments, especially segments which are long and steep.
- Talk to mine operators about different types of runaway equipment safety features that they can use to safely stop runaway equipment.

Sight Distance

Mine operators should consider sight distance when they design roadways. "Sight distance" is a straight line distance that a driver can see ahead of his or her vehicle, and it may be shorter than the actual equipment travel path. A basic rule of safe roadway design is that, at all times, equipment operators must be able to stop their equipment within the available sight distance.

WHAT INSPECTORS CAN DO

- Determine sight distances by measurement or by pacing.
- Consider the equipment operator's position when determining sight distance. This should include consideration of visual obstructions and equipment blind spots.
- Look for ways to address limited sight distance, such as cutting back trees or brush, relocating a stockpile, realigning the roadway or intersection, cutting down the crest of the hill, or reducing the speed of the equipment.
- Be attentive to sight distance in areas such as curves, intersections, hill crests, and areas with pedestrian traffic or significant vehicular traffic.

ROADWAYS AND DUMPING LOCATIONS INSPECTION HANDBOOK

Other Sight Distance Considerations

There often is little contrast in the brightness between the background and other objects on mine property. This lack of contrast can make nighttime driving difficult. It is a good practice for mine operators to install roadside reflectors to help define the roadway and intersections for nighttime operations. Another good practice is to install and maintain marker lights on equipment that makes it easier to see the equipment from all sides at night.

Stopping Distance

Mine operators should consider stopping distance when they design roadways. Stopping distance factors include equipment operator response times, braking systems, gross vehicle weight (GVW), equipment speed, roadway grade, surface materials, and roadway conditions.

WHAT INSPECTORS CAN DO

- Determine available stopping distance for potentially problematic roadway sections.
- Address hazardous roadway sections where equipment stopping distance is greater than the sight distance. This may include increasing sight distance and/or reducing equipment speed.
- Consider equipment stopping distances and operator reaction times when determining safe following distances between equipment.
- Determine whether equipment operators are maintaining safe following distances.
- Determine whether mine operators are maintaining equipment braking systems according to manufacturer recommendations.
- Determine whether equipment operators have access to the operator's manuals for the mobile equipment they operate.
- Determine whether operators are following manufacturer use and maintenance specifications and recommendations.

Speed Limits

Mine operators must establish speed limits based on the capabilities of the equipment and roadway layout/condition that appropriately account for issues including limited sight distances, steep grades, congested areas, and pedestrian traffic areas.

WHAT INSPECTORS CAN DO

- Determine whether the equipment is traveling at or below the speed limit.
- Determine whether the mine operator has considered factors like equipment braking capabilities, sight distances, and roadway conditions to establish safe

ROADWAYS AND DUMPING LOCATIONS INSPECTION HANDBOOK

speed limits.

- Emphasize to equipment operators that speed limits apply only to normal driving conditions and that they should reduce their operating speed in other situations.

Traffic Rules and Signs

Traffic rules, signs, communications, and right-of-way rules should be clear and command attention. The mine operator should place signs at all points where vehicles enter the mine property, in locations where traffic patterns or communication procedures change, and in various areas around the property as reminders.

WHAT INSPECTORS CAN DO

- Be alert to areas where traffic rules may be unclear, especially with respect to right-of-way rules and control.
- View the roadways through the eyes of a new equipment operator or a visitor who is unfamiliar with the property.
- Ensure that left- or right-side traffic patterns are posted at appropriate locations.
- Encourage mine operators to place signs indicating the respective percent of grades for steep sections of the roadways.
- Recommend the use of reflective markers or other devices to mine operators in instances where sharp curves are unavoidable.
- Ensure that mine operators mark railroad crossings and have policies or procedures to prevent traffic from stopping on the tracks.
- Ensure that traffic signs are unobstructed, legible, and posted at appropriate locations.
- Review the training plan to ensure that it alerts equipment operators to traffic rules, patterns, communication procedures, and conditions on the property.

Roadway Maintenance

Mine operators have a responsibility to maintain roadways and to correct hazardous roadway conditions.

WHAT INSPECTORS CAN DO

- Determine whether haulage equipment loading practices minimize roadway spillage.
- Ensure that mine operators have implemented procedures to control roadway dust.
- Examine roadside ditches and culverts to determine if they are effective in minimizing water on roadways.
- Determine whether roadways are reasonably free of water and debris.
- Determine whether mine operators examine roadways where

ROADWAYS AND DUMPING LOCATIONS INSPECTION HANDBOOK

miners work or travel each shift.

Unstable Material and Other Hazards

Inspectors should make sure mine operators address unstable material above and below roadways which could present hazards to those using the roadways. Hazards may include rockfalls, slides, or roadway surface failures. Inspectors should also make sure mine operators address other roadway hazards, such as material falling from overhead structures and inadequate overhead clearances.

WHAT INSPECTORS CAN DO

- Check the highwalls or slopes above roadways for loose material.
- Be alert to fallen material on a roadway, this could indicate hazards above the roadway.
- Be alert for open rock joints, overhangs, and other geologic discontinuities above a roadway.
- Be alert to signs of movement in the roadway surface, such as tension cracks or settling.
- Pay attention to areas where water is seeping out of a slope. Water within a slope can make the slope less stable. Mine operators should collect seepage exiting onto the roadway and channel it away from the road if it could create a hazardous condition.
- Look for erosion which can compromise fill stability and create a hazard.
- Check slopes below roadways for over steepening, toe undercutting, and large erosion channels, which could affect the stability of the overlying roadway.

CHAPTER 3 - DUMPING LOCATIONS

Examining dumping locations for unsafe conditions is critical to assuring miners' safety. Inspectors should make sure mine operators monitor for and address unsafe conditions and practices at dumping locations. Dumping location conditions continually change due to the dumping of new material, operation of equipment near the dumping location, weather conditions, and the settling of material. The most common dumping location fatal accidents involve trucks going over the edge of piles. Dumping short of the edge or moving to another location when potentially unsafe conditions arise can prevent dumping location accidents.

WHAT INSPECTORS CAN DO

- Check for berms, dump restraints, or bumper blocks where equipment regularly dumps. These features should define the edge of the dumping location and restrain equipment from overtravel.
- Check if berm locations and edge material strength will support loaded equipment at the dumping location.
- Make certain the back-side of the berm is not constructed on perched rock cobbles or boulders.
- Check for excessive spillage at bumper blocks that could compromise the effectiveness of the blocks.
- Talk with supervisors and equipment operators about truck overturning hazards associated with wet or frozen material sticking in raised beds/trailers.
- Check dump location drainage and look for soft areas that could cause equipment to overturn.
- Look for indications of unsafe dumping practices such as backing up at an angle, hitting or traveling up the berm (berm bumping), excessive braking or stopping, and turning close to the edge before dumping.
- Check dumping locations for sufficient illumination.
- Check overhead clearance for dumping. Keep in mind that overhead clearance can decrease as dump heights increase.
- Make certain the top surfaces of dumping locations are relatively level from side to side for equipment stability.
- Make certain equipment operators dump sufficiently short if there is uncertainty about the stability of dumping locations.
- Talk with supervisors, equipment operators, and miners about how to recognize and correct unsafe working conditions at dumping locations. Share training material related to dumping locations available from MSHA and discuss good dumping practices (see list of "Good dumping practices" below).

Berms at Dumping Locations

To prevent equipment from overtravel, earthen berms should have a steep inside slope, sufficient height and width, and be firm enough. Berms constructed of only fine-grained material should be larger and more compacted. Berms constructed of broken rock may offer increased strength due to the interlocking and frictional resistance of the rock pieces.

Stability Near the Dump Edge

Material near dump edges or outslopes can be relatively loose, have steep-sided slopes, and may be unable to support heavy equipment. Moisture, thawing of frozen material, and/or removing material from the toe also 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 are warning signs of an unstable or marginally stable slope. Mine operators should identify/barricade tension cracks and settled areas or correct these conditions. Equipment operators should dump loads in a safe area away from these features. Covering a crack or a settled area does not make it stable.

Good dumping practices include:

- Dump in a safe location and push material over the edge.
- Dump further away from the edge if there are cracks, excessive settling, or the outslope is undercut, over-steepened, or sloughing.
- Block the access to the top of a pile whenever loading material from the toe.
- Slope the top of the dumping location so that equipment operators are backing upslope to dump.
- Use backup cameras, locating devices, or spotters to aid equipment operators.
- Be alert for material sticking in beds. Do not try to jar material loose by jamming on the brakes.
- When multiple trucks are dumping in close proximity to one another, leave space between trucks and/or equipment to prevent accidents associated with overturning and ground failure.
- Align roadway approaches to stockpiles so equipment operators can examine the outslope and toe areas as they approach the dump location.
- Avoid dumping in a single location due to the increased potential for instability and failure.
- Identify overhead power lines with highly visible objects.
- Control dust at the dumping location to maintain visibility and provide adequate illumination.