

Module 14: Motor Vehicles,  
Mechanized Equipment and  
Marine Operations, Rollover  
Protective Structures and  
Overhead Protection; and Signs,  
Signals and Barricades Pages  
332 - 350

- OSHA requires that all employees participate in training programs related to handling and storage hazards. These programs must contain material that will be helpful to employees in reducing material handling and storage hazards.
- Due to the high incidence of back and spinal injuries that results from manual lifting, safe lifting techniques must be demonstrated to all employees.
- It is imperative that your company's management play an active role in the effective implementation of a safety and health program designed for handling and storage. When management is closely involved with such a program, line supervisors and (by extension) employees can be persuaded of its importance and motivated to take it seriously.

## **Module 14: Motor Vehicles, Mechanized Equipment and Marine Operations; Rollover Protective Structures and Overhead Protection; and Signs, Signals and Barricades**

### **Module Description**

This module is intended for workers who need to know about motor vehicles, mechanized equipment, rollover protective structures, overhead protection, signs, signals, and barricades.

We will be discussing motor vehicles, mechanized equipment, marine operations, rollover protective structures, overhead protection, signs, signals, and barricades in detail. This course will also cover the topics included in OSHA 29 CFR 1926 Subparts O-Motor Vehicles; W-Rollover Protection; and G-Signs, Signals, and Barricades.

### **Module Learning Objectives**

At the conclusion of this module, students will be able to:

- Identify OSHA standards for Motor Vehicle Safety
- Demonstrate machine and equipment handling according to OSHA standards
- Describe how industrial tractors are regulated by OSHA
- Discuss the purpose of signs and barricades

### **Lesson 1: Motor Vehicles (Subpart O)**

#### **Lesson Focus**

At the end of this lesson, students will be able to:

- Describe the general requirements for the use of motor vehicles in construction



- Describe safety measures for operating material handling equipment
- Identify proper access roadways and grades
- Explain when and why audible alarms are necessary
- Describe safety precautions that prevent struck-by and caught-in-between hazards

## General Requirements

### Introduction

Motor vehicles covered by Subpart O of the OSHA regulations are those vehicles that operate within an off-highway jobsite that is not open to public traffic. A majority of fatalities that occur in road construction work zones involve a worker being struck by a piece of construction equipment or another vehicle. If vehicle safety practices are not properly implemented, workers risk being pinned between construction vehicles and walls, struck by swinging backhoes, crushed beneath overturned vehicles, or struck by trucks or cars.

### Braking Systems

All vehicles must have a service brake system, an emergency brake system, and a parking brake system. These systems can utilize common components and they must always be maintained in operable condition. Whenever the equipment is parked, the parking brake should be set. Equipment parked on inclines should have the wheels chocked and the parking brake set. All equipment left unattended at night, adjacent to a highway in normal use, or adjacent to construction areas where work is in progress, should have appropriate lights or reflectors to identify its location, or barricades equipped with appropriate lights or reflectors should be set up.

### Seat Belts

Scrapers, loaders, crawler or wheel tractors, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment must be equipped with seat belts, except in the following cases:

- Seat belts need not be provided for equipment which is designed only for standup operation.
- Seat belts need not be provided for equipment which does not have rollover protective structure (ROPS) or adequate canopy protection.

### Headlights, Taillights, and Brake Lights

Whenever visibility conditions warrant additional light, all vehicles in use must be equipped with at least two operable headlights and taillights. All vehicles must also have brake lights in operable condition regardless of light conditions.



### **Audible Warning Devices**

All vehicles must be equipped with adequate audible warning devices at the operator's station. These devices must be kept operational.

### **Obstructed View to the Rear**

No employer should use any motor vehicle equipment having an obstructed view to the rear unless:

- The vehicle has a reverse signal alarm audible above the surrounding noise levels.
- The vehicle is backed up only when an observer signals that it is safe to do so.

### **Windshields**

All vehicles with cabs must be equipped with windshields and powered wipers. Cracked and broken glass must be replaced. Vehicles operating in areas or under conditions that cause windshields to fog or frost must be equipped with operable defogging and defrosting devices.

### **Cab Shield**

All haulage vehicles with payloads loaded by cranes, power shovels, loaders, or similar equipment, must have a cab shield and/or canopy adequate to protect the operator from shifting or falling materials.

### **Transporting Tools and Materials**

Tools and materials must be secured to prevent movement when transported in the same compartment with employees.

### **Transporting Employees**

Vehicles used to transport employees must have seats firmly secured and adequate for the number of employees to be carried.

### **Trucks with Dump Bodies**

Trucks with dump bodies must be equipped with positive means of support. The supports must be permanently attached and capable of being locked into position to prevent accidentally lowering a worker during maintenance or inspection work.



### **Operating Levers**

Operating levers controlling hoisting or dumping devices on haulage units must be equipped with latches or other devices that will prevent accidental startup or tripping of the mechanism.

### **Dump Truck Trip Handles**

Trip handles for dump truck tailgates must be installed so the operator can stay clear during dumping.

### **Mud Flaps**

Mud flaps may be used in lieu of fenders whenever motor vehicle equipment is not designed for fenders.

### **Vehicle Inspection**

All vehicles must be checked at the start of each shift to ensure that parts, equipment, and accessories are in safe operating condition and are free of apparent damage that could cause failure while in use. These components include:

- Service brakes, including trailer brake connections
- Parking system (hand brakes)
- Emergency stopping system (brakes)
- Tires
- Horn
- Steering mechanism
- Coupling devices
- Seat belts
- Operating controls
- Safety devices

All defects must be corrected before the vehicles are placed in service.

**Note:** These requirements also apply to equipment such as the following, where the equipment is necessary:

- Lights
- Reflectors
- Windshield wipers
- Defrosters
- Fire extinguishers





## Access Roadways and Grades

No employer may move or cause construction equipment or vehicles to be moved on any access roadway or grade unless it is constructed and maintained to safely accommodate such movement. Every emergency access ramp and beam used by an employer must be constructed to restrain and control runaway vehicles.

## Audible Alarms

All bidirectional machines, such as rollers, compacters, front-end loaders, bulldozers, and similar equipment, must be equipped with horns that can be heard over the surrounding noise levels. These horns must be operated as needed when machines are moved in either direction. They always must be kept operational.

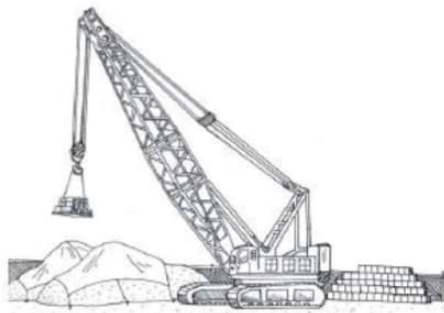
No employer should permit earthmoving or compacting equipment that is limited by an obstructed rear view to be used in reverse gear unless the equipment has a reverse signal alarm in operation that is distinguishable from the surrounding noise levels, or an employee signals that it is safe to do so.

## Struck-by and Caught-in-Between Hazards

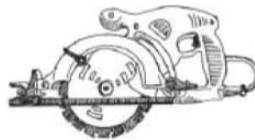
Being struck by an object is one of the leading causes of construction-related deaths. Workers are most often struck by:

- Heavy equipment and vehicles, like trucks and cranes
- Falling or flying objects, like tools and flying particles
- Concrete or masonry walls that are being constructed





**Crane Safety:** Can the crane operator see you? Stay out of the “swing radius” – of the cab and of the load – and never get under a suspended load.



**Tool Safety:** Picture shows the movable lower guard of this circular saw in its fully raised position and with the blade fully exposed below the base plate.

Prevent “kick-back” of the saw by adjusting the blade exposure to the minimum distance needed, with saw teeth extending just beyond the thickness of the material you are cutting.



**Unsafe Work:** You must cap the ends of exposed “rebars” (reinforcing bars) if anyone can walk into them or fall onto them.



**Tool Safety:** Always make sure the head of the hammer is firmly attached to the handle so the head doesn’t fly off.

To prevent injury or death from being struck by a vehicle:

- Wear a seat belt! Seat belts save lives, both on the roadways and on construction sites. (Note: Don’t wear one if the vehicle is only designed for standing up or if it has no rollover protective structure, like a roller used on paving jobs.)
- Make sure that all vehicles are inspected before each shift – everything should be in good working condition, including the brakes, before you begin work. Use your parking brake when the vehicle is not in use and chock the wheels if you are parked on an incline. And never lift or load more than the vehicle can hold.
- If you are driving a vehicle in reverse and you can’t see behind you, be sure to have a reverse alarm that people can hear AND have another worker signal to you that all is safe. Ensure that no one is in the way when you are using lifting and dumping devices. Get out and look for people and hazards.
- Don’t drive vehicles in areas that are not safely constructed or maintained. When using lifting or dumping devices, make sure to clear all personnel and lower or block all blades.
- All forklift operators must be trained and certified. Equipment must be inspected, and all safe operating procedures must be followed. Drive slowly, and don’t travel



with elevated loads. Make sure all signal alarms work and watch for hazardous conditions (involving both workers and objects).

- If you are working in traffic, use traffic signs and barricades. Use flaggers if needed. Be sure to stay out of blind spots. Workers must wear warning clothing, like orange vests. If they are working at night, these must be of a reflective material. Use proper lighting when working at night. Use traffic barricades whenever possible. If you can't barricade the traffic, use heavy equipment with impact attenuators (crash cushions) within the work zone, to protect you from moving traffic. Be alert for pedestrians in urban areas.

To prevent injury or death from falling or flying objects:

- Inspect tools, cranes, hoists to see that all are in good condition.
- Use toe boards, screens, debris nets, and guardrails on scaffolds to prevent tools/other items from falling from overhead work areas.
- If you are working underneath cranes, hoists, or scaffolds, never work under a suspended load. Barricade hazard areas and post warning signs. Don't exceed capacity, and don't assume the operator has seen you. Watch out for power lines, unstable soil, and high winds.
- Materials stored shall not be placed within 6 feet of hoist way/floor openings, nor within 10 feet of an exterior wall which doesn't extend above material.
- Don't use hand tools with loose, cracked, or splintered handles, or use impact tools with mushroomed heads; the head could fly off, striking you or others. Operators of powder-actuated tools (gunpowder) must be trained and licensed. Train all workers on safe operation of tools and inspect all tools before use.
- Train workers on safe operation of power tools, such as saws, drills, and grinders. Inspect all tools before use and wear protective gear. Guard rotating and moving parts – all guards must be in place when tools are in use.
- Secure tools and other items to prevent them from falling on the people below; stack and secure materials (even from wind gusts) to prevent sliding, falling or collapse. And always keep areas clear of clutter.
- Use personal protective equipment to prevent being hit by falling or flying objects. Wear a hard hat, safety glasses, goggles, and face shields. Wear hearing protection when needed.
- Reduce compressed air used for cleaning to 30 psi, and only use it with the proper guards and other protective equipment. And never clean your clothing with compressed air: you could be injured by a particle driven into your eyes or skin by the force.

Workers can be killed or seriously injured when they are building concrete or masonry walls. They can be struck by materials when the lifting equipment is putting the slabs in position, or when materials are not shored properly and are not yet stable. To prevent these kinds of accidents:

- Don't place loads on concrete structures until someone who is qualified says that it's safe to do.





- Shore structures until permanent supporting elements are secured; concrete should be
- tested to make sure it has enough support strength.
- Don't overload lifting devices and use automatic devices to support the forms in case the lifting mechanism fails.
- Use a personal fall arrest system, with full-body harness, to protect you from falls if other fall protection is not available.

In all of these situations, **be sure that you are properly trained** to do this work, and you are trained on all of the equipment you use.

Make sure that you and all other personnel are in the clear before using dumping or lifting devices. Wear high visibility clothing, such as red or orange vests, and reflective material if worn for night work.

### Case Study: NIOSH FACE Report 2002-03

A 54-year-old male construction laborer was fatally injured when he was run over and crushed by a motor grader. At the time of the incident, the grader operator was driving the grader in reverse on a road under construction in a housing development. The victim and a coworker were standing in the road at the rear of their parked pickup truck discussing the next stage of their work when the grader operator began backing in their direction. The coworker saw the grader backing toward them and yelled to the operator to stop. The operator did not hear the warning. The back tire of the grader struck the victim, knocking him down. The operator stopped the grader when it struck the rear of the parked pickup truck. The victim was under the rear tire of the grader.

### Lesson Summary

- A majority of fatalities that occur in road construction work zones involve a worker being struck by a piece of construction equipment or another vehicle.
- All vehicles must have a service brake system, an emergency brake system, and a parking brake system. These systems can utilize common components and they must always be maintained in operable condition.
- Scrapers, loaders, crawler or wheel tractors, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment must be equipped with seat belts, except in the following cases:
  - Seat belts need not be provided for equipment which is designed only for standup operation.
  - Seat belts need not be provided for equipment which does not have rollover protective structure (ROPS) or adequate canopy protection.
- Other standards that must be followed lay out requirements for the use of headlights, warning devices, windshields, and mudflaps, as well as the requirements for transporting employees.



- All bidirectional machines, such as rollers, compacters, front-end loaders, bulldozers, and similar equipment, must be equipped with horns that can be heard over the surrounding noise levels.
- Struck-by and caught-in-between injuries often result from vehicles.

## Lesson 2: Rollover Protective Structures for Material Handling (Subpart W)

### Lesson Focus

At the end of this lesson, students will be able to:

- Explain how rollover protective structures (ROPs) work
- Describe conditions when ROPs are required
- Recognize proper labeling of ROPs

### Introduction

Rollover protective structures (ROPs) are required for the following:

- Rubber-tired, self-propelled scrapers
- Rubber-tired front-end loaders
- Rubber-tired dozers
- Wheel-type agricultural and industrial tractors
- Crawler tractors
- Crawler type loaders
- Motor graders, with or without the attachments that are used in construction work

Note: This requirement does not apply to side-boom pipe laying tractors.

### Case Studies

Between 2000 and 2006, OSHA investigated over 50 rollover incidents that involved a variety of roller/compactor makes and models. Of the rollover accidents investigated:

- Five involved roller/compactors with rollover protective structures (ROPS) where operators used the seatbelts provided. None of these accidents resulted in a fatality.
- Nineteen involved roller/compactors with ROPS, but seatbelts were not used. In some cases, seatbelts were not provided. In other cases, the seatbelts provided were not used by the operators. Fourteen of these accidents resulted in fatalities. In a number of these cases, the operator was either ejected or jumped from the equipment and was pinned under or crushed by the ROPS.



- One case involved a pneumatic rubber-tired roller/compactor where the ROPS and seatbelt had been removed prior to the accident. The operator involved was fatally injured in the accident

### **Case Study 1**

In May 2005, an employee was fatally injured while operating a pneumatic rubber-tired roller/compactor on a roadway during asphalt compacting. The roller/compactor ran off the road and traveled down a 22-degree sloping embankment. It rolled over 1½ times, coming to a stop on its top. The operator was thrown from the machine and was fatally crushed between the machine and the ground. Although the roller/compactor was originally equipped and sold with a ROPS and a seatbelt, the ROPS and seatbelt had been removed prior to the accident.

### **Case Study 2**

In August 2005, an employee was operating a pneumatic rubber-tired roller/compactor on a gravel road, rolling magnesium chloride into the gravel. The roller/compactor ran off the road and traveled down a 28-degree sloping embankment. It rolled onto its side and came to a stop. As the machine traveled down the embankment, the operator was thrown from the machine and fatally crushed. The roller/compactor was not provided with a ROPS and the operator was not wearing a seatbelt.

## **Design of ROPS**

### **Strength**

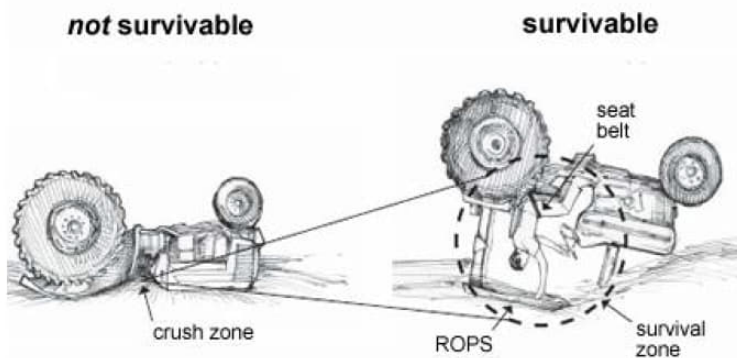
Rollover protective structures and supporting attachments must be designed, fabricated, and installed in a manner that supports at least two times the weight of the prime mover applied at the point of impact, based on the ultimate strength of the metal.

### **Overturn**

ROPs should be designed to minimize the likelihood of a complete overturn and thereby minimize the possibility of the operator being crushed as a result of a rollover or upset.

The design must provide a vertical clearance of at least 52 inches from the work deck to the ROPS, at the point of ingress or egress.





(<https://www.spartaengineering.com/frequently-asked-questions-on-roll-over-protective-structures-rops/>)

## Labeling

Each ROPS must have the following information permanently affixed to the structure:

- Manufacturer's or fabricator's name and address
- ROPS model number, if any
- Machine make, model, or series number that the structure is designed to fit

## Lesson Summary

The design objective of scrapers, loaders, dozers, tractors, crawlers, and graders discussed, must be to minimize the likelihood of a complete overturn and, thereby, minimize the possibility of the operator being crushed as a result of a rollover or upset. For this reason, rollover protective structures and supporting attachments must be designed, fabricated, and installed in a manner that supports, based on the ultimate strength of the metal, and at least two times the weight of the prime mover applied at the point of impact.

## Lesson 3: Signs, Signals, and Barricades (Subpart G)

### Lesson Focus

At the end of this lesson, students will be able to:

- Recognize accident prevention signs and tags, including:





- Danger signs
- Caution signs
- Exit signs
- Safety instruction signs
- Directional signs
- Accident prevention tags

## Accident Prevention Signs and Tags

Safety signs, labels, tags, and markings play a key role in effectively communicating important safety information. They use visual cues to:

- Remind people of potential hazards and how to avoid them
- Point people to the location of emergency equipment
- Direct people's path to safety in an emergency situation
- Reinforce safety training programs

Signs are commonly used to warn about potential injury hazards. Signs and symbols should be visible at all times when work is being performed and must be removed or covered promptly when the hazards no longer exist. General-policy safety signs inform and remind people of a company's expectations for safe behavior. Fire safety signs inform employees and firefighters about fire lanes and the location of firefighting equipment, emergency phones, risers, valve shutoffs, and disconnects.



<http://www.hsewebsite.com/osha-danger-signs/>





## Danger Signs

A danger sign must be used only where an immediate hazard exists. "DANGER" indicates a hazardous situation which, if not avoided, will result in serious injury or death. Its use should be limited to the most extreme situations. Each danger sign must have red as the dominant color for the upper panel, a black outline on the borders, and a white lower panel for additional sign wording.



**Corrosive Avoid  
Contact With  
Eyes and Skin**

## Caution Signs

Caution signs are used to warn against potential hazards or to caution against unsafe practices. "CAUTION" indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Every caution sign must have yellow as the dominant color, a black upper panel and borders, the word "caution" in yellow on the black panel, and a lower yellow panel for additional sign wording (black lettering should be used for any additional wording).



## Exit Signs

Exit signs guide people to a building's exits and to safety and assist rescue personnel in locating handicapped people in emergency situations. Exit signs must be lettered in legible red letters, not less than six inches high, on white fields with principal letter strokes of at least three-fourths of an inch in width.

## Safety Instruction Signs

Safety instruction signs define specific rules or procedures to follow to avoid causing a hazardous situation. Safety instruction signs, when used, must be white with green upper panels, using white letters for the primary message. Any additional wording on the signs must be in black letters on white backgrounds.



## Directional Signs

Directional signs, other than automotive traffic signs, should be white with a black panel and a white directional symbol. Any additional wording on the sign must be in black letters on the white background.

## Traffic Signs

Construction areas must be posted with legible traffic signs at points of hazard. Signs can convey both general and specific information by means of words or symbols, and have the same three categories as all road signs: regulatory, warning, and guide. All signs used at night must be either reflective or illuminated. Signs should be covered or removed when work is not in progress.

Signs should not be located on sidewalks, bicycle facilities, or areas designated for pedestrian or bicycle traffic. Ground-mounted signs installed at the side of the road in rural areas must be mounted at a height of at least 7 feet from the bottom of the sign to the ground.



**Figure 6F-1. Height and Lateral Location of Signs—Typical Installations**

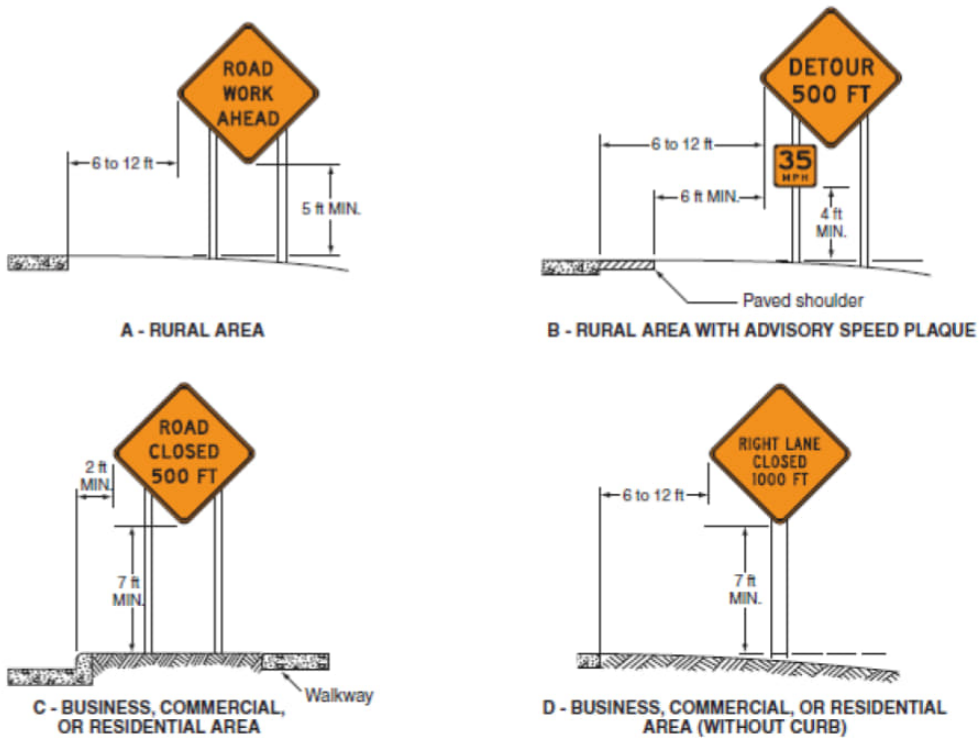


Figure 6F-2. Methods of Mounting Signs Other Than on Posts

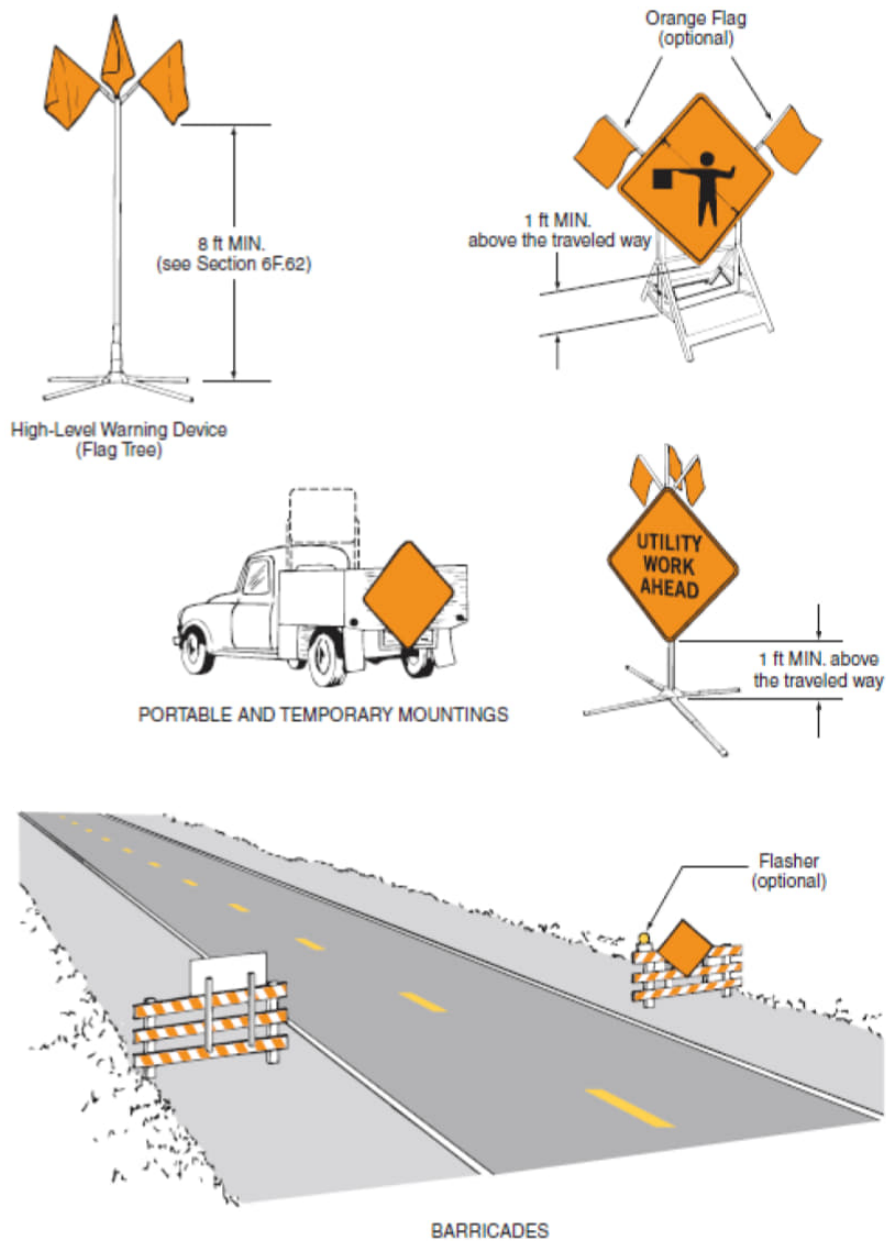
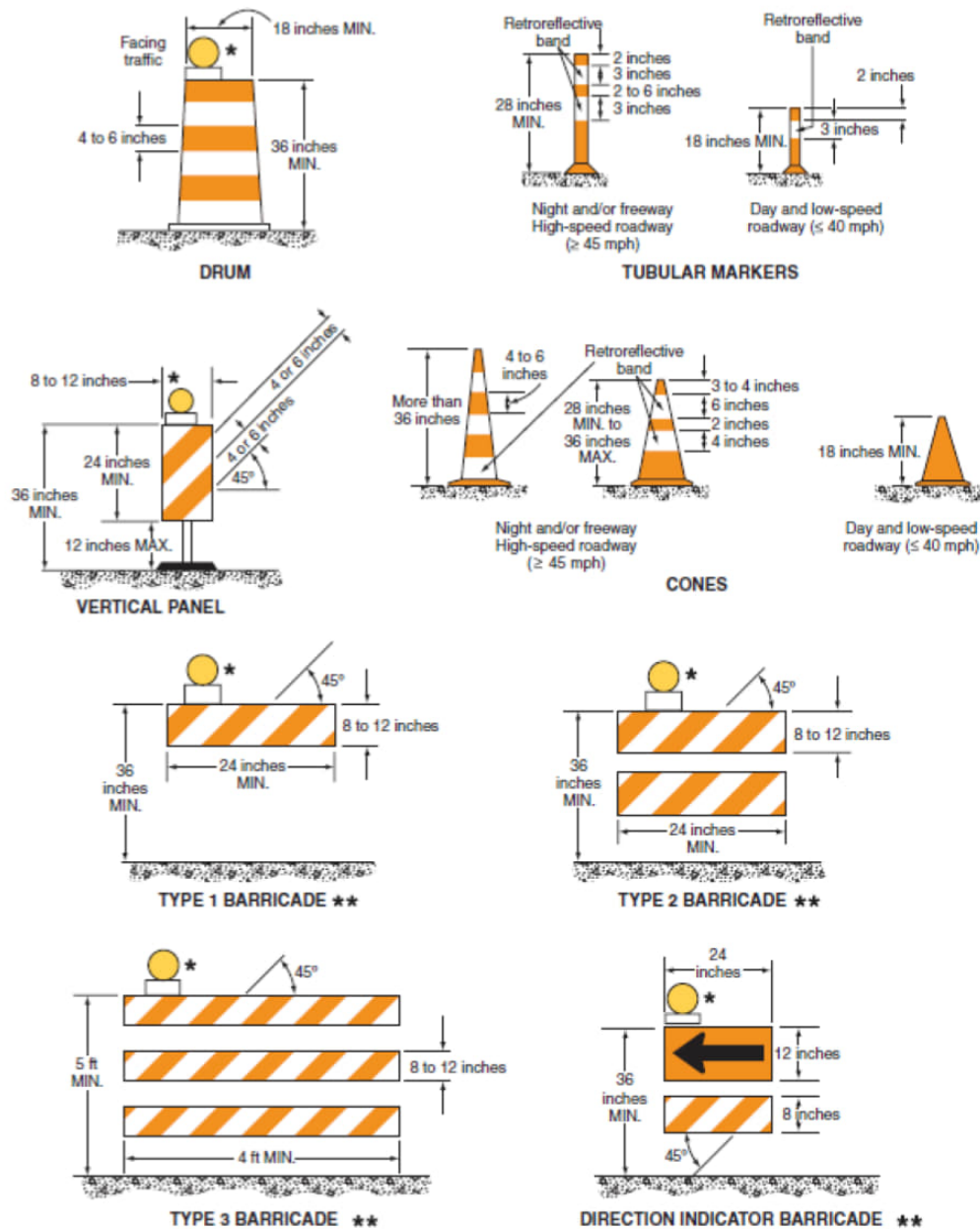


Figure 6F-7. Channelizing Devices



\* Warning lights (optional)

\*\* Rail stripe widths shall be 6 inches, except that 4-inch wide stripes may be used if rail lengths are less than 36 inches. The sides of barricades facing traffic shall have retroreflective rail faces.





**Table 6H-2. Meaning of Symbols on Typical Application Diagrams**

|  |  |  |                                      |
|--|--|--|--------------------------------------|
|  | Arrow board  |  | Shadow vehicle                       |
|  | Arrow board support or trailer (shown facing down)               |  | Sign (shown facing left)             |
|  | Changeable message sign or support trailer                       |  | Surveyor                             |
|  | Channelizing device  |  | Temporary barrier                    |
|  | Crash cushion  |  | Temporary barrier with warning light |
|  | Direction of temporary traffic detour                            |  | Traffic or pedestrian signal         |
|  | Direction of traffic   |  | Truck-mounted attenuator             |
|  | Flagger  |  | Type 3 barricade                     |
|  | High-level warning device (Flag tree)                            |  | Warning light                        |
|  | Longitudinal channelizing device                                 |  | Work space                           |
|  | Luminaire  |  | Work vehicle                         |
|  | Pavement markings that should be removed for a long-term project |  |                                      |

### Accident Prevention Tags

Accident prevention tags must be used as a temporary means of warning employees of an existing hazard, such as defective tools, equipment, etc. They must not be used in place of, or as a substitute for, accident prevention signs. These use some of the same colors and designs as danger and caution signs, and may warn against such hazards as radiation and high-voltage electricity.

### Lesson Summary

- A danger sign must be used only where an immediate hazard exists. "DANGER" indicates a hazardous situation which, if not avoided, will result in serious injury or death.
- Caution signs are used to warn against potential hazards or to caution against unsafe practices. "CAUTION" indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- Safety instruction signs define specific rules or procedures to follow to avoid causing a hazardous situation.
- Construction areas must be posted with legible traffic signs at points of hazard. Signs can convey both general and specific information by means of words or symbols, and have the same three categories as all road signs: regulatory, warning, and guide.



- Accident prevention tags must be used as a temporary means of warning employees of an existing hazard, such as defective tools, equipment, etc. They must not be used in place of, or as a substitute for, accident prevention signs.

## Module 15: Safety and Health Programs

### Module Description

Have you ever been injured on the job? Do you know what steps to take in the event of sickness, injury, or death due to your workplace environment? More importantly, do you know how to protect yourself, as well as others, and help promote healthy working conditions? Every year, more than 50,000 workers die from exposure to various hazards in the workplace. The Occupational Safety and Health Administration (OSHA) is committed to saving lives, preventing injuries, and protecting the health of workers all across America. This module will show you how to identify workplace hazards and become involved with ensuring healthy and safe working environments.

### Module Learning Objectives

At the conclusion of this module, students will be able to:

- Describe the importance of effective safety and health programs
- Summarize the common characteristics of exemplary workplaces
- Explain the General Guidelines of an effective safety and health program
- Discuss the major elements of an effective safety and health program
- Name the state programs
- List consultation services
- Describe the Voluntary Protection Program (VPP)
- Discuss the Safety Health Achievement Recognition Program (SHARP)
- Describe the Strategic Partnership Program
- Apply training and education
- Utilize electronic information

### Lesson 1: Effective Program Elements

#### Lesson Focus

At the end of this lesson, students will be able to:

- Explain the importance of having an effective safety and health programs
- Identify common characteristics of exemplary workplaces
- Describe OSHA's general guidelines for safety and health programs
- Identify the major elements of an effective safety and health program, which include:

