

# Work Zone Technician



For Participants  
Rev. 1/2/2007





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## Section 1: Fundamental Principles and Work Zone Areas

The purpose of temporary traffic control is twofold. First, to provide for the safe and efficient movement of both motorized and non-motorized traffic through or around a temporary traffic control zone. Second, to provide protection for workers and equipment in the work space.

Temporary traffic control violates driver expectation and, because highway-related work is performed in vulnerable conditions, it is imperative that temporary traffic control be properly planned and executed to achieve these objectives successfully.

### Fundamental Principles

Motorized and non-motorized traffic and worker safety is an integral and high-priority element of every incident management, maintenance, permit and utility operation. Consideration of the following principles will ensure a safe temporary traffic control zone.

- ◆ Prepare a temporary traffic control plan and communicate it to all responsible parties prior to occupying the site.
- ◆ Provide those whose actions affect the temporary traffic control zone with training appropriate to their level of responsibility.
- ◆ Employ the same basic safety principles used to design permanent roadways.
- ◆ Avoid frequent or abrupt geometric changes.
- ◆ Minimize delay and disruption.
- ◆ Schedule and coordinate operations according to *Work Zone Guidelines*.
- ◆ Provide adequate warning, delineation, and channelization in advance of and through the area affected.
- ◆ Provide positive guidance.
- ◆ Provide for safe operation of work.
- ◆ Encourage use of alternative routes.
- ◆ Assume drivers will only reduce their speeds if they clearly perceive a need to do so.
- ◆ Provide for reasonably safe passage of bicyclists and pedestrians.
- ◆ Provide recovery areas where practical.
- ◆ Coordinate operations with those having jurisdiction over any affected cross streets, railroads, or transit facilities.
- ◆ Ensure continuation of emergency services.
- ◆ Communicate with and provide reasonable accommodations for adjoining property owners.
- ◆ Ensure temporary traffic control devices used are in good working order, reasonably consistent with the temporary traffic control plan, and effective.
- ◆ Monitor performance of the temporary traffic control and modify as needed.
- ◆ Inspect and maintain temporary traffic control devices.

- ◆ Remove, cover, or turn; and turn off all unnecessary temporary traffic control devices.
- ◆ Maintain a record of any crashes or incidents.
- ◆ Store unused equipment and material in such a manner to reduce the probability of being hit.
- ◆ Involve the media to assist in information dissemination.

### Training

Each person whose actions affect temporary traffic control work zone safety, from the upper-level management through field workers, should receive training appropriate to the job decisions each individual is required to make. Only those individuals who are trained in proper temporary traffic control practices and have a basic understanding of the principles should supervise the selection, placement, and maintenance of temporary traffic control devices used for temporary traffic control work zones and for incident management.



### Key Terms

May – permitted

Should – strongly recommended

Shall – mandatory

### Worker Considerations

Of equal importance to the safety of the motorized and non-motorized traffic navigating the temporary traffic control zone is the safety of the worker involved in activities within the zone. Therefore, it is important to comply with the following minimum requirements.

- ◆ Train field employees involved in the planning, set-up, operation, maintenance or removal of temporary traffic control to the level of their responsibility. For MoDOT employees, this typically requires the completion of both the *Flagger Training* and *Work Zone Technician* courses.
- ◆ Require workers to wear the appropriate safety apparel while in the temporary traffic control zone. For MoDOT employees, refer to the department's *Safety Policies, Rules & Regulations Employee Handbook*.
- ◆ Inspect and operate vehicles and equipment within the temporary traffic control zone appropriately. For MoDOT employees, refer to the department's *Safety Policies, Rules & Regulations Employee Handbook*.





In addition to the previous items and those previously noted in Fundamental Principles, consideration of the following should enhance the safety and effectiveness of the workforce.

- ◆ Use physical barriers instead of channelizers to separate traffic from the activity area.
- ◆ Reduce speeds through the temporary traffic control zone.
- ◆ Use protective vehicles and truck mounted attenuators within the temporary traffic control zone to provide protection from errant vehicles.
- ◆ Close the road to traffic temporarily where traffic volumes are low and an adequate alternate route exists.
- ◆ Request assistance of law enforcement officials in patrolling the temporary traffic control zone.
- ◆ Provide adequate lighting to perform work activities within and guide traffic through the temporary traffic control zone.
- ◆ Heighten awareness of the temporary traffic control zone through the use of supplemental warning methods.
- ◆ Ensure workers are visible to equipment operators.
- ◆ Ensure signal person and equipment operator understand hand signals.

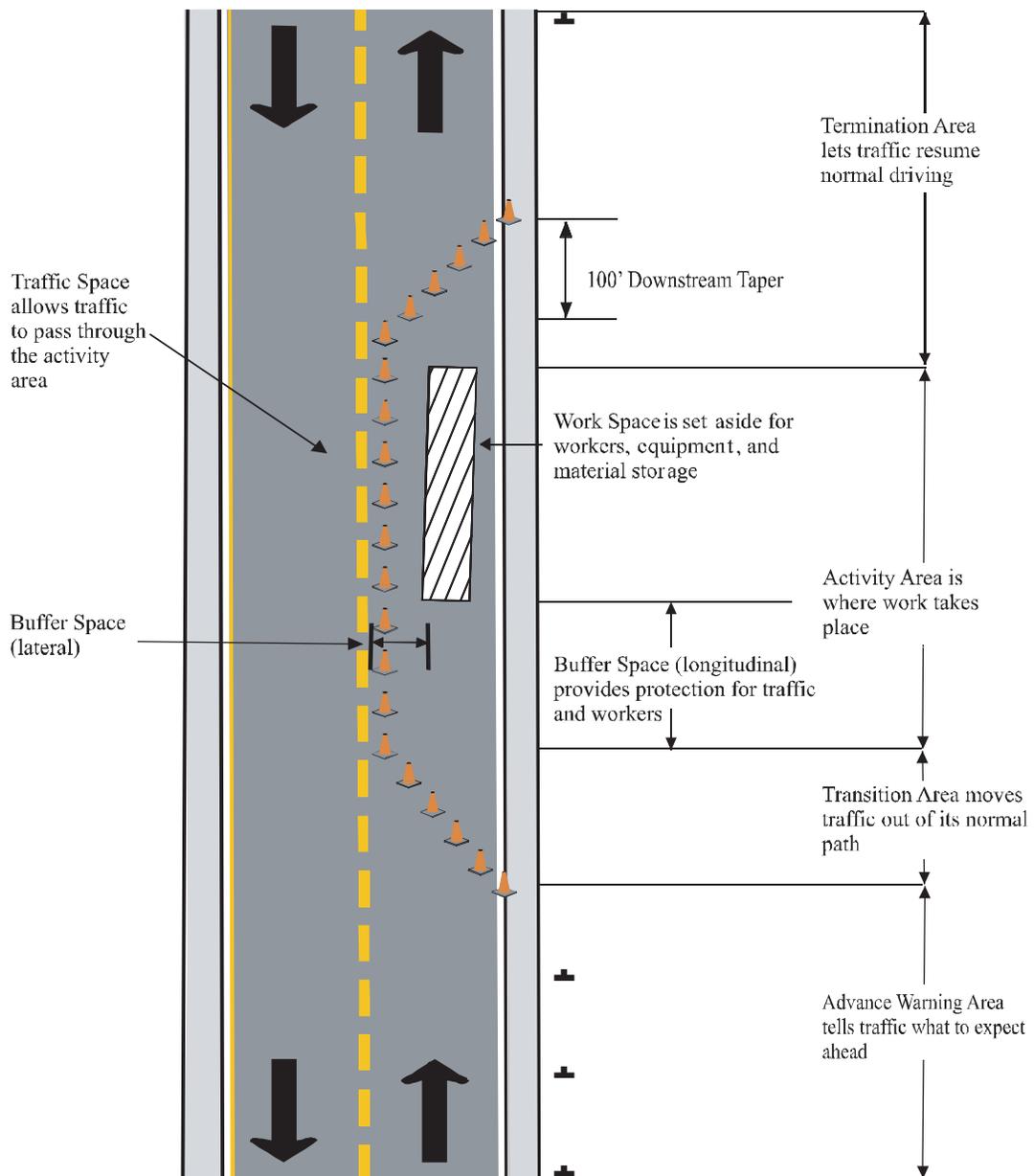


### Temporary Traffic Control Zone

A temporary traffic control zone is a section of highway where traffic conditions are changed due to a work zone or an incident area through the use of temporary traffic control devices, law enforcement or other authorized officials. It extends from the first warning sign or rotating/strobe lights on a vehicle to the last temporary traffic control device. The zone may either be stationary or move as work progresses.

A temporary traffic control zone consists of four areas - advance warning, transition, activity, and termination.

These areas are illustrated in the following figure.





### Advance Warning Area

The advance warning area is where traffic is informed of an upcoming temporary traffic control zone. It may vary from a single sign or rotating/strobe lights on a vehicle to a series of signs depending on the duration, location, and type of work.

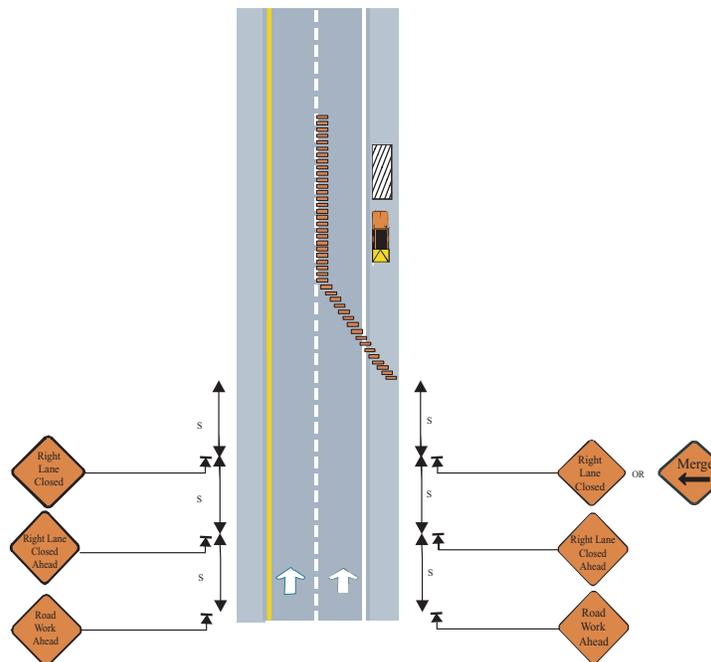
Recommended sign spacing in this area is shown in the following table.

Sign Spacing Chart

Speed Limit (mph)	Spacing <sup>1</sup> (ft.)	
	Undivided Highway	Divided Highway
0-35	200	200
40-45	350	500
50-55	500	1000
60-70	1000	1000

<sup>1</sup>Sign spacing may be adjusted, normally by increasing it, to accommodate field conditions and visibility.

Note: Sign spacing may be adjusted for field conditions, such as sight distance, sign location, curves, etc.



### Tips to Calculate Distances

Pavement markings are a great way to measure distances between channelizers.

- ◆ A pavement dash is 10 foot long with a 30 foot space between markings.

Another way is if a roadway is equipped with delineators, which are

- ◆ Spaced 1/10 of a mile apart (1/10 of a mile is approximately 500 feet).
- ◆ The odometer on your work vehicle will also show you 1/10 of a mile.



## Transition Area

The transition area is where traffic is redirected out of its normal path and into the traffic space. This is usually accomplished through the use of a series of channelizers placed in a taper across the portion of roadway to be closed. There are three types of tapers: shoulder; lane; and one-lane, two-way.

The *shoulder taper* is used to close the shoulder where it is part of the activity area or when improved shoulders might be mistaken for a driving lane.

The *lane taper* is used to close a driving lane by forcing traffic to merge.

Recommended taper length and channelizer spacing for shoulder and lane tapers in the transition area are shown in the following table.

Taper Spacing Chart

Speed Limit (mph)	Taper Length <sup>1</sup> (ft.)		Channelizer Spacing <sup>4</sup> (ft.)
	Shoulder <sup>2</sup> (T1)	Lane <sup>3</sup> (T2)	
0-35	70	245	35 <sup>5</sup>
40-45	150	540	40 <sup>5</sup>
50-55	185	660	50 <sup>6</sup>
60-70	235	840	60 <sup>6</sup>

<sup>1</sup> Taper lengths may be adjusted to accommodate crossroads, curves, intersections, ramps, or other geometric features.

<sup>2</sup> Based on 10 ft. shoulder width.

<sup>3</sup> Based on 12 ft. lane width

<sup>4</sup> Channelizer spacing may be reduced to discourage traffic encroachment.

<sup>5</sup> Spacing reduced to  $\frac{1}{2}$  at intersections.

<sup>6</sup> Spacing may be reduced to  $\frac{1}{2}$  at intersections.

The **one-lane, two-way taper** is used to close one lane of a two-lane, undivided highway where the remaining lane is used alternately by traffic in each direction. The taper should have a length of 100 feet (5 channelizers @ 20 foot spacing). In addition to the channelizers, a flagger, STOP or YIELD sign, pilot car or temporary traffic signal controls traffic through this section.

Note: Taper lengths may be adjusted whenever they are located in close proximity to a crossroad, curve, intersection, ramp, or other geometric feature.

Whenever tapers are to be used near interchange ramps, crossroads, curves, or other influencing factors, it may be desirable to adjust the length of tapers. Longer tapers are not necessarily better than shorter tapers (particularly in urban areas characterized by short block lengths, driveways, etc.), because extended tapers tend to encourage sluggish operation and to encourage motorists to delay lane changes unnecessarily. The real test of taper length involves observation of motorist's user performance after traffic control plans are put into effect.



## Activity Area

The activity area is where work activity takes place. It is comprised of three spaces - work, traffic, and buffer.

The *work space* is the area closed to traffic and set aside for workers, equipment, materials, and a protective vehicle, if one is used upstream. They are usually delineated by channelizer or temporary barriers to exclude vehicles and pedestrians.

The *traffic space* is the area in which traffic is routed through the activity area.

The *buffer space* is the area separating traffic from the work space or an unsafe area. Since this area provides some recovery space for an errant vehicle, it should be kept free of any work activity, equipment, vehicles, and material storage. There are two types of buffer spaces - longitudinal and lateral.

A longitudinal buffer space may be used in advance of the work space or to separate opposing traffic flows using portions of the same traffic lane. When an item such as a protective vehicle is located in this space, only the area upstream of the item functions as the buffer space.

A lateral buffer space may be used adjacent to the work space, an unsafe condition, or between two lanes, especially those carrying traffic in opposite directions. The minimum width of this space is not set but should be determined based on the type of facility, work activity, condition for which the space is being provided, and space available.

Recommended longitudinal buffer length and channelizer spacing in the activity area are shown in the following table.

Buffer Chart

Speed Limit (mph)	Buffer Length (ft.)	Channelizer Spacing <sup>1</sup> (ft.)
0-35	120	50 <sup>2</sup>
40-45	220	100 <sup>2</sup>
50-55	335	100 <sup>3</sup>
60-70	550	100 <sup>3</sup>

<sup>1</sup> Channelizer spacing may be reduced to discourage traffic encroachment.  
<sup>2</sup> Spacing reduced to 1/2 at intersections.  
<sup>3</sup> Spacing may be reduced to 1/2 at intersections.

## Termination Area

The termination area is where traffic is returned to its normal path. This area extends from the downstream end of the activity area to the last temporary traffic control device. This area may include a downstream taper or a sign informing traffic they may return to normal operations (e.g. END ROAD WORK or Speed Limit). When a downstream taper is used, the recommended length is 100 feet (5 channelizers @ 20 foot spacing) per lane.



## Section 1: Review Questions

1. Define:  
  
May: \_\_\_\_\_  
  
Should: \_\_\_\_\_  
  
Shall: \_\_\_\_\_
2. Who should be trained properly in safe work-zone practices?
  - a. College Students
  - b. All MoDOT employees
  - c. Contractors
  - d. Anyone whose actions affect temporary traffic control zones
3. In the advance warning area, drivers are informed of:
  - a. How much time it will take to reach their destination
  - b. What is expected ahead
  - c. Which lane they should stop in
  - d. None of the above
4. In the transition area, drivers are:
  - a. Transferred to another road
  - b. Redirected out of their normal path and into the traffic space
  - c. Informed of what type of work to expect
  - d. Informed of what type of traffic to expect
5. The area of roadway where work takes place is called:
  - a. Advance warning area
  - b. Termination area
  - c. Activity area
  - d. Buffer space
6. A great tip to calculate distance is:
  - a. Measure it with a tape measure
  - b. Use the pavement markings (dashed lines) on the roadway
  - c. Use the white delineators in the right-of-way
  - d. B and C

## Section 2: Temporary Traffic Control Zone Operations

### Duration of Work

Work duration is a major factor in determining the number and types of devices used in temporary traffic control zones. The duration of a temporary traffic control zone is defined relative to the length of time an operation occupies a location. The six categories of work duration are as follows:

- ◆ *Long-Term Stationary* - planned work occupying a location more than three days.
- ◆ *Intermediate-Term Stationary* - planned work occupying a location more than one daylight period up to three days, or nighttime work lasting more than 30 minutes.
- ◆ *Short-Term Stationary* - planned daytime work occupying a location for more than 30 minutes, but less than twelve hours.
- ◆ *Short Duration* - planned daytime or nighttime work occupying a location up to 30 minutes.
- ◆ *Mobile* - planned work moving intermittently or continuously.
- ◆ *Emergency* - work involving the initial response to and repair/removal of Response Priority 1 items according to the *MoDOT's Incident Response Plan Manual*.

**Long-term stationary operations** include planned work occupying a location more than three days. Post-mounted signs, larger channelizers and barricades, temporary traffic barriers, temporary pavement markings, work lighting, area lighting, warning lighting, and temporary traffic signals are devices generally incorporated into the temporary traffic control plan for these operations. In addition to providing a greater margin of safety, these types of devices provide superior operational characteristics - an important consideration during nighttime hours and periods when workers are not present.



**Intermediate-term stationary operations** include planned daytime work occupying a location from more than one daylight period up to three days or planned nighttime work occupying a location more than 30 minutes.

In these operations the same procedures and devices used in long-term stationary operations may be desirable. However, their use should be carefully considered, as they may not be feasible or practical to deploy. The increased time to place and remove these devices in some cases could significantly lengthen the project, thus increasing exposure time.





**Short-term stationary operations** include planned daytime work occupying a location for more than 30 minutes, but less than twelve hours. This category describes the majority of work zone activities undertaken on the state highway system.

In these operations, procedures and devices are usually simplified when compared to intermediate- and long-term stationary operations because workers are present to maintain and monitor the temporary traffic control zone, the zone is only set up during daylight hours, and it is only in place for a relatively short period of time. Portable signs, flashing arrow panels, channelizers, fleet lighting, protective vehicles, and truck-mounted attenuators are devices generally incorporated into the temporary traffic control plan for these operations.

**Short duration operations** include planned daytime or nighttime work occupying a location up to 30 minutes.

These operations might involve different types of temporary traffic control devices since it often takes longer to set up and remove the temporary traffic control than it does to perform the actual work. Vehicle-mounted signs, truck-mounted flashing arrow panels, fleet lighting, protective vehicles, channelizer cones, and truck-mounted attenuators are typical devices considered for use in these types of operations.

**Mobile operations** include planned work that moves intermittently or continuously.

These operations often involve frequent, short stops for activities where workers are on foot. These **stops can last up to 15 minutes in duration**. Typical work activities include litter cleanup and pothole patching.

Due to the similarity of these activities to short duration operations, the same procedures and devices considered for use in short duration operations are also desirable for use in these types of mobile operations. When non-mobile devices like portable signs are used, they should be moved periodically to keep them near the operation.

Mobile operations also include work activities in which workers and equipment move along the roadway without stopping. Typical work activities include mowing, snow removal, spraying, sweeping, and long-line striping.

In these types of activities the advance warning area moves with the operation. Therefore, total mobility of the temporary traffic control zone is important and devices should be chosen accordingly. In some continuously moving operations, a work vehicle equipped with fleet lighting may be sufficient. In others, a protective vehicle equipped with fleet lighting, a truck-mounted attenuator, a flashing arrow panel, and a sign may be needed. Where work proceeds at unusually slow speeds, less than five miles per hour, it may be desirable to place warning signs along the roadway and move them periodically as work progresses.





**Emergency operations** include unplanned work occupying a location up to 15 minutes. Within MoDOT, these operations consist of the initial response to and repair/removal of safety concerns as defined by Response Priority 1 items (refer to the *MoDOT's Incident Response Plan Manual*).

In these operations, it is usually more advantageous, from a safety standpoint, to remove or provide warning of the risk in a timely manner with limited temporary traffic control than it is to set up a temporary traffic control zone for short duration operations. The decision to reduce the temporary traffic control shall be at the discretion of the supervisor. However, work activities shall still be performed with the safety of the motorist and worker in mind. A vehicle-mounted sign, truck-mounted flashing arrow panel, and fleet lighting are devices generally incorporated into the temporary traffic control plan for these operations. A protective vehicle and truck-mounted attenuator should be considered as additional safety measures.

### Location of Work

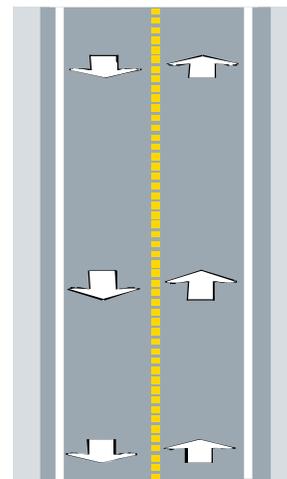
In addition to work duration, work location is also a major factor in determining the temporary traffic control needed for a temporary traffic control zone. As a general rule, the closer the work activity is to traffic, the greater the need for, and number of, temporary traffic control devices. Typically, the degree of temporary traffic control is based on three locations - work beyond shoulder, work on shoulder, and work within the traveled way.

**Work beyond shoulder** includes any work performed between the edge of the shoulder, the edge of the traveled way where no shoulder exists, to the right-of-way line or within any unimproved median.

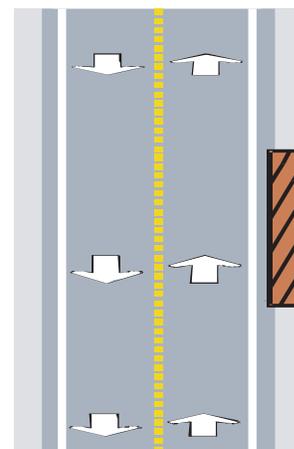
Work performed in this area typically requires a minimal amount of temporary traffic control, such as signs and fleet lighting, or even none at all. The amount and type of temporary traffic control depends on the lateral displacement of the work activity and the location and movement of any work vehicle or equipment relative to the edge of the shoulder, or traveled way where no shoulder exists.

**Work on shoulder** includes any work performed on the shoulder that does not significantly encroach upon the adjacent driving lane. Where no shoulder exists, this also includes any work performed adjacent to the roadway that encroaches, but not significantly, upon the adjacent driving lane. A significant encroachment means ten feet of driving surface cannot be maintained for traffic.

Outside the shoulder

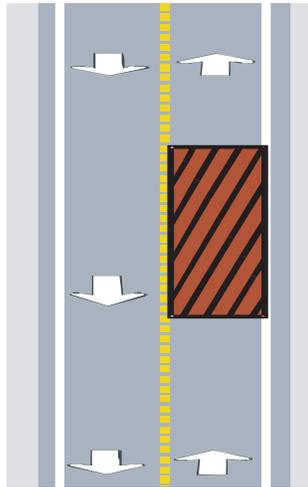


On the shoulder with no encroachment



**Work within the traveled way** includes any operation requiring a lane closure. Due to the location of the operation, more temporary traffic control devices are required to ensure the safety of both the motorist and the worker. Mobile operations typically require a vehicle-mounted sign, flashing arrow panel, fleet lighting, protective vehicle, and truck-mounted attenuator. Stationary operations usually require the substitution of multiple stationary signs for the single vehicle-mounted sign and the addition of channelizers and flaggers.

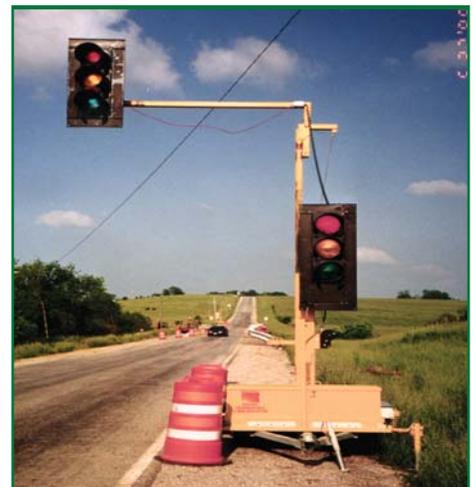
Within the travel way



### Flagger Control

The role of the flagger in temporary traffic control is an important one. It is the flagger's responsibility to assess the safety and efficiency of traffic operations within the temporary traffic control zone and manage the movement of traffic through the proper assignment of right of way and/or by controlling speed. Guidelines for performing this vital function are set forth in the *Flagger Training* course materials. It is good practice for flaggers to review these guidelines on a regular basis in order for them to perform their duties effectively.

Except when performed under emergency conditions, workers engaged in flagging operations on the state highway system shall have successfully completed a recognized flagger training course. For MoDOT employees, this requires the successful completion of the *Flagger Training* course or an approved substitute.





## Section 2: Review Questions

1. What is considered a long-term stationary operation?
  - a. When workers are exposed to traffic
  - b. When work is performed up to 3 days
  - c. When work exceeds 3 days
  - d. All the above
  
2. Which group below classifies road types according to the *Traffic Control for Field Operations Manual*?
  - a. Urban, rural, or interstate
  - b. Urban, rural divided, or rural undivided
  - c. Two lane or four lane highways
  - d. Supplementary route, primary routes
  
3. Why are standards and uniformity important to MoDOT and the public?
  - a. They cut down on costs
  - b. Standards and uniformity help motorists know what to expect
  - c. Keeps everything from becoming metric
  - d. Standards and uniformity help keep track of inventory
  
4. Which manual was the *MoDOT Traffic Control for Field Operations Manual* developed?
  - a. The Governor's guide to highway safety
  - b. The fundamentals of highway safety and management book (edition 4)
  - c. Manual for Uniform Traffic Control Devices
  - d. None of the above
  
5. Which of the following defines an intermediate-term stationary operation?
  - a. Lasts more than 3 days
  - b. The placement of signs without channelizer
  - c. 3 hours of evening work
  - d. Safety needs have to be addressed before working
  
6. What is considered to be "on the shoulder with minor encroachment?"
  - a. On the highway, but in the same direction as traffic
  - b. On the highway, but in the opposite direction of traffic
  - c. Taking up only 10 feet of the lane
  - d. Work on shoulder with at least 10 feet of driving lane available
  
7. Which of the following is a short-term stationary operation?
  - a. Work performed at night, but lasting only one day
  - b. Painting pavement markings at a railroad crossing
  - c. New highway construction
  - d. None of the above



## Section 3: Special Considerations

### Driving Ability

People overrate their driving ability. As people age they need more light and time to be able to see things with the same clarity as younger people.

People read from left to right and from top to bottom.

The location and spacing of devices outlined in typical applications are minimum values based on ideal or normal conditions. Obviously, to be effective, traffic control devices must be seen. Motorist must have enough perception and reaction time to perform the required action. There are several factors which might indicate adjustments are needed to typical plans.

### Factors Affecting Visibility/Location

- ◆ Hills
- ◆ Curves
- ◆ Intersections
- ◆ Shade
- ◆ Color contrast
- ◆ Driveways
- ◆ Trees
- ◆ Other signs
- ◆ Buildings
- ◆ Bad weather
- ◆ Darkness
- ◆ Bridges/Overpasses
- ◆ Time of day



### Factors Affecting Stopping Distance

- ◆ Traffic speed
- ◆ Vehicle weight
- ◆ Type of road
- ◆ Road & weather conditions
- ◆ Visibility



### Factors that Influence Traffic Control

- ◆ Traffic Factors
- ◆ Duration of Work
- ◆ Location of Work
- ◆ Work Activity
- ◆ Weather
- ◆ Roadway Characteristics
- ◆ Speed
- ◆ Typical Application
- ◆ Traffic Generators

Other considerations are Traffic Generators. Some examples of Traffic Generators are:

- ◆ Shopping Malls
- ◆ Business Districts
- ◆ Special Events
- ◆ Schools

### Requirements of Traffic Control Devices

To be effective, a traffic control device should meet five basic requirements:

1. Fulfill a need
2. Command attention
3. Convey a clear, simple meaning
4. Command respect of traveling public
5. Give adequate time for proper response





### Section 3: Review Questions

1. People overrate their \_\_\_\_\_ .
  - a. Braking time
  - b. Visual perception
  - c. Driving ability
  - d. None of the above
  
2. As people age, they need more \_\_\_\_\_ to see things with the same clarity as younger people.
  - a. Light
  - b. Time
  - c. Both a and b
  - d. None of the above
  
3. What generates an increase in traffic volume?
  - a. Schools
  - b. Special events
  - c. Business districts, shopping malls
  - d. All of the above
  
4. People read signs from:
  - a. Right to left and top to bottom
  - b. Left to right and top to bottom
  - c. Left to right and bottom to top
  - d. All at the same time
  
5. \_\_\_\_\_ are for communicating simple messages.
  - a. Pictures
  - b. Letters
  - c. Graphics
  - d. Sign/Symbols



## Section 4: Temporary Traffic Control Devices

### General

Temporary traffic control devices are the medium through which traffic is informed of and guided through a temporary traffic control zone or otherwise protected from an unsafe condition. The most common devices include signs, portable changeable message signs, flashing arrows panels, channelizers, barricades, temporary traffic barriers, pavement markings, lighting devices, temporary traffic signals, crash cushions, protective vehicles, and truck-mounted attenuators.

Due to the placement of these devices in relation to traffic, these devices should be crashworthy. This requires that all temporary traffic control devices conform to the crash test requirements of the National Cooperative Highway Research Program (NCHRP) Report 350.

It may become necessary to ballast some of these devices to inhibit their movement due to natural and vehicle-induced wind in the field. This is particularly the case for portable sign supports and channelizers. Ballast shall be selected and installed such that the ballast itself does not become a hazard if impacted by a vehicle. When in doubt on ballasting, consult the device's manufacturer for their recommendation.

In order for these devices to perform the functions noted previously, they must command the public's respect. This means the correct devices are installed according to the temporary traffic control plan and they function as intended. Furthermore, the devices are maintained throughout the life of the operation and removed when no longer needed. Devices that are damaged or have lost their functionality should be replaced or, when acceptable, repaired. Refer to *MoDOT's Quality Standards for Temporary Control devices* for guidelines regarding acceptability of devices.

### Signs

Temporary traffic control signs convey, in words and symbols, both general and specific messages used by motorized and non-motorized traffic to navigate the temporary traffic control zone safely and efficiently. Therefore, it is important all permanent and temporary signs not applicable to conditions present in the temporary traffic control zone be removed, covered, or turned away from the roadway so they are not visible to traffic.





## Sign Classification

Temporary signs are classified into one of three types:

- ◆ Regulatory
- ◆ Warning
- ◆ Guide

**Regulatory signs** give notice of traffic laws or regulations and indicate applicability of legal requirements that would not be readily apparent. These signs are generally rectangular in shape and black legend on white background in color. A noteworthy exception to this rule is STOP, YIELD, DO NOT ENTER, and WRONG WAY signs. For additional information on regulatory signs, refer to Chapter 11 of the *Signing* section of the *Traffic Manual*.



**Warning signs** give notice regarding situations or conditions that might not be readily apparent. These signs are generally diamond shaped and, when used in a temporary traffic control zone, show a black legend on orange background. For additional information on standard and temporary warning signs, refer to Chapters 12 and 13 of the *Signing* section of the *Traffic Manual*, respectively.



**Guide signs** indicate route designations, destinations, directions, distances, services, points of interest, or other geographical, recreational, or cultural information. These signs come in different shapes and colors depending on the type and purpose of the signing. However, special guide signs relating to the conditions of the temporary traffic control zone (e.g. RAMP OPEN, DETOUR, ROAD WORK NEXT XX MILES, etc.) are typically rectangular in shape and black legend on orange background. For additional information on temporary and standard guide signs, refer to Chapters 13 and 15 of the *Signing* section of the *Traffic Manual*, respectively.





### Sign Design

Details, descriptions, and ordering information for signs used for temporary traffic control are specified in the Signing Section of the *Traffic Manual*, as noted in the preceding section.

These signs may have a rigid or flexible substrate. However, the two sign materials are not necessarily interchangeable. Each should be used on a sign support for which the sign system (i.e. the sign and support) has been designed. This is especially true when trying to meet crashworthiness requirements.

Flashing warning lights and/or flags may be used to supplement these signs provided they do not block the sign face.

### Sign Installation

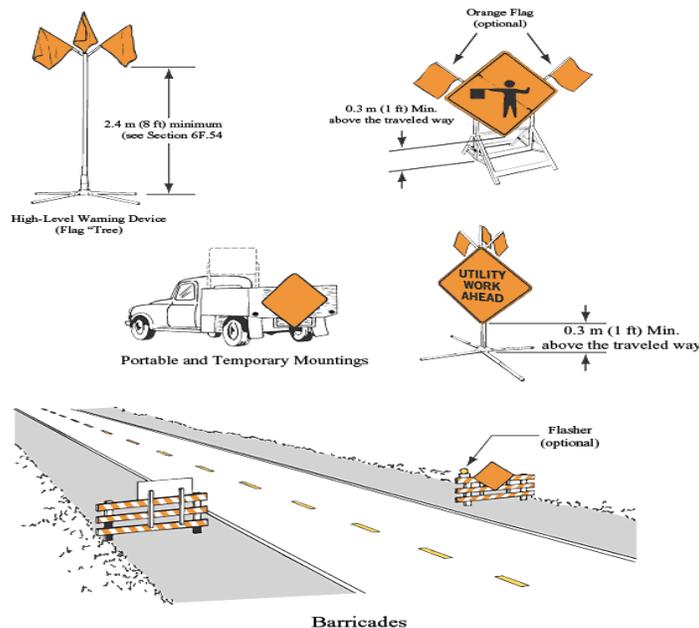
Signs used for temporary traffic control are placed on the right side of an undivided highway and on both sides of divided highways unless otherwise specified in this manual. Where space exists, signs may also be placed on the left side of multi-lane, undivided highways. Signs should not be located where they will conflict with the movement of non-motorized traffic or where visibility of them will be limited by field conditions.

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.

Speed Limit (mph)	Spacing <sup>1</sup> (ft)	
	Undivided Highway	Divided Highway
0-35	200	200
40-45	350	500
50-55	500	1000
60-70	1000	1000

<sup>1</sup> Sign spacing may be adjusted, normally by increasing it, to accommodate field conditions and visibility.

Methods of Mounting Signs Other than on Posts





Signs may be supported in one of four methods on a:

- ◆ portable support (self-driving posts, easels, fold up sign stands, barricades, etc.)
- ◆ post mounted (perforated square steel tube, u-channel, wood, etc.)
- ◆ vehicle
- ◆ traffic barrier

**Portable signs** are temporary traffic control signs affixed to a portable support such as a self-driving post, easel, fold-up sign stand, barricade, etc..

These signs are be constructed of either a rigid or flexible substrate, as required, to meet crashworthiness requirements.

A minimum mounting height of one foot, measured vertically from the bottom of the sign to the near edge of the pavement, is recommended. However, higher mounting heights should be considered on higher volume highways, on multi-lane highways, in urban settings, and where the sign is located in line with other traffic control devices to increase visibility of the sign. Mounting heights for critical regulatory and guide signs (e.g. STOP, YIELD, DO NOT ENTER, WRONG WAY, ONE WAY and Gore Exit) are as specified for post-mounted signs.

Portable signs may be located adjacent to or within the roadway itself. However, a minimum lateral clearance of three feet, measured horizontally from the edge of the sign to edge of the designated traveled way, is recommended.

Signs mounted in this manner may be left in place for up to three days. An exception to this duration is any crosswalk/sidewalk closure, any road closure, Horizontal Arrow, Double-Headed Horizontal Arrow, Chevron, DETOUR (within arrow), or Gore Exit sign. These sign may be left in place for over three days.

When not in use, consideration should be given to removing portable signs from the temporary traffic control zone to discourage theft and limit potential hazards within the right-of-way.

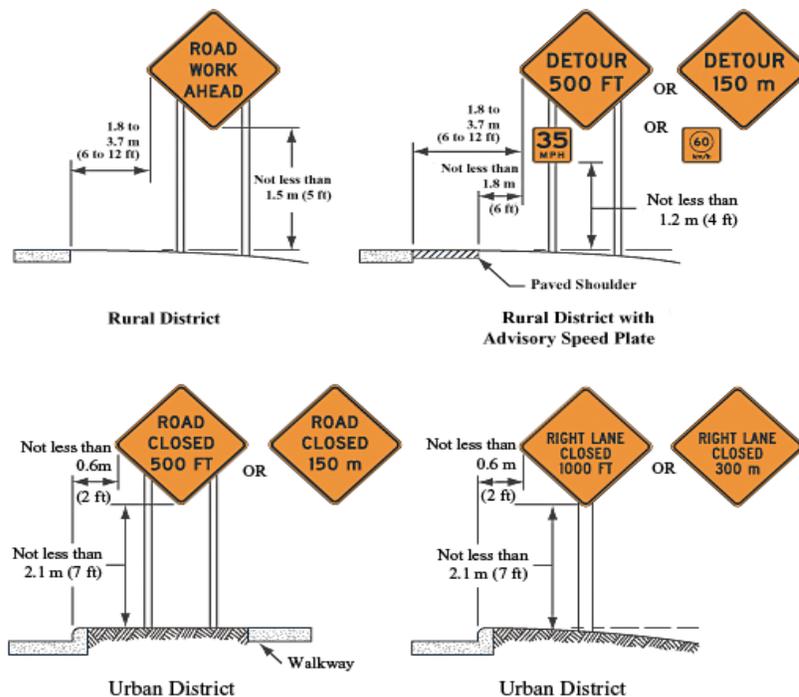
**Post-mounted signs** are temporary traffic control signs affixed to a breakaway support such as perforated square steel tube, u-channel, wood, etc.

These signs are constructed of a rigid substrate.

A minimum mounting height of seven feet, measured vertically from the bottom of the sign to the near edge of the pavement, is recommended for urban highways and rural divided highways. A minimum mounting height of five feet, measured vertically from the bottom of the sign to the near edge of the pavement, is recommended for rural undivided highways. If a supplemental sign is mounted below another sign, the mounting height of the supplemental sign may be one foot less than the heights specified.

A minimum lateral clearance of two feet, measured horizontally from the edge of the sign to the edge of the roadway, is recommended for installations on roadways with curbed sections. A minimum lateral clearance of six feet, measured horizontally from the edge of the sign to the edge of the traveled way, is recommended for installations on roadways without curbed sections.

#### Height and Lateral Location of Signs - Typical Installations



**Vehicle-mounted signs**, when allowed in this manual, are temporary traffic control signs affixed to a protective vehicle or pilot car at a recommended minimum height of four feet (48 inches), measured vertically from the bottom of the sign to the pavement surface.

**Barrier-mounted signs** are temporary traffic control signs affixed to the top portion of a temporary or permanent traffic barrier. The method of attachment to the barrier must assure a positive connection and minimize potential for vehicle snagging. Mounting heights for critical regulatory and guide signs (e.g. STOP, YIELD, DO NOT ENTER, WRONG WAY, ONE WAY and Gore Exit) are as specified for post-mounted signs.

In order to accommodate narrow medians, it may be necessary to reduce the sign size; clip the sign corners or edges; or possibly both.



## Portable Changeable Message Signs

Portable changeable message signs are temporary traffic control devices with the flexibility to display a variety of messages. These messages provide pertinent traffic operation and guidance information to the motorist. They serve as a supplement to, and not as a replacement for or repeat of, static temporary traffic control signing. In temporary traffic control applications, these units are generally mounted on a trailer.

Some typical situations where a portable changeable message sign use may be beneficial to temporary traffic control are as follows:

- ◆ Where the speed of traffic is expected to drop substantially
- ◆ Where significant queuing and delay are expected
- ◆ Where adverse environmental conditions exist
- ◆ Where there are changes in alignment or surface conditions
- ◆ Where there is a ramp, lane, or roadway closure.
- ◆ Where a crash or incident has occurred.
- ◆ Where traffic patterns change.



Messages should consist of a maximum of two phases. Typically, these phases consist of three lines of eight characters. Techniques such as fading, exploding, dissolving, moving, or scrolling text shall not be used. The entire message cycle should be readable to traffic at least twice while traveling at the posted speed. Messages should be programmed prior to deployment of the unit to the field. Consideration of the following will assist in designing a message:

- ◆ Each phase should convey a single thought
- ◆ If the message can be displayed in one phase, the top line should present the problem, the center line should present the location or distance ahead, and the bottom line should present the recommended driver action
- ◆ The message should be as brief as possible
- ◆ When a message is longer than two phases, additional portable changeable message signs should be used
- ◆ When abbreviations are used, they should be easily understood



Signs should be located to provide traffic with ample warning of any conditions ahead or actions they may need to perform.

It is preferable to locate signs off to the right of any usable portion of the roadway. Where field conditions do not allow for this placement, the signs may be located on the outside shoulder of the roadway or within the median where field conditions do not allow for deployment on the outside shoulder. A minimum lateral clearance of three feet, measured horizontally from the edge of the sign to edge of the traveled way, is recommended.

If multiple signs are used, the signs should be located on the same side of the road and separated according to the sign spacing chart.

A minimum mounting height of seven feet, measured vertically from the bottom of the sign to the roadway, is recommended.

When deployed, the sign shall be sighted and aligned with approaching traffic to ensure visibility of the message.

Five channelizers should be used to delineate each sign. These channelizers should be positioned on the upstream end of the unit to form a taper leading up to traffic side of the unit. The recommended length of this taper is 100 feet. For a sign located in the median, the sign should be delineated from both directions.



### Flashing Arrow Panels

Flashing arrow panels are temporary traffic control devices with a matrix of elements capable of flashing displays. The devices are intended to provide additional warning and directional information to assist in traffic movement through or around a temporary traffic control zone. These units may be either trailer- or truck-mounted. However, truck-mounted units are preferred in mobile operations.



The overall minimum dimensions of the panels are 60 inches wide by 30 inches high for truck-mounted units and 96 inches wide by 48 inches high for trailer-mounted units. Panels for both units shall include 15 yellow elements.

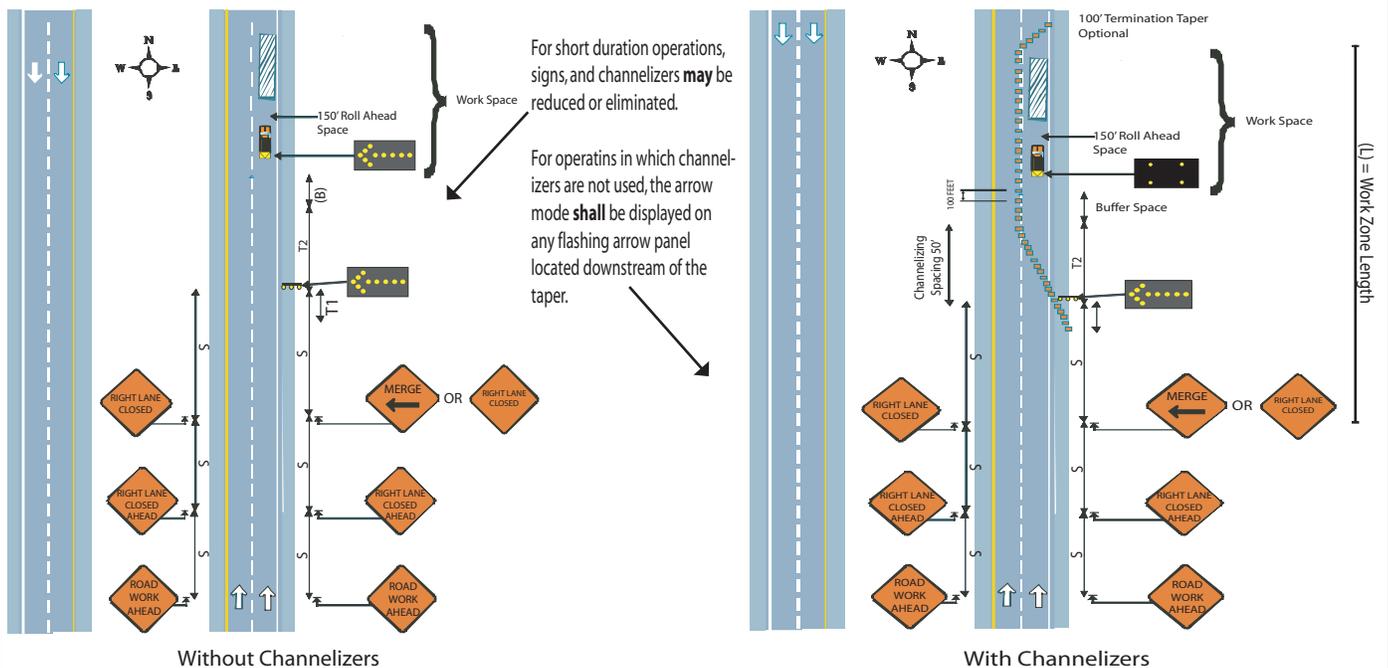
Flashing arrow panels are intended to provide additional warning and directional information to assist in traffic movement through or around a work zone. These truck or trailer-mounted units are operated in one of three modes - arrow, double arrow, or four-corner caution.

The arrow and double arrow modes are used for stationary or moving lane closures on multilane roads where traffic may pass to one side or both sides, respectively. In stationary operations, the flashing arrow panel should be placed on the shoulder at the start of the lane closure taper or, where space does not allow, within the closed lane behind the taper. In moving operations the unit is placed within the closed lane.

Note: In channelized operations, additional units located downstream of the taper area shall display the caution mode.

The caution mode is used for shoulder work, blocking the shoulder, work within the lane where the lane is not closed, and lane closures on two-lane undivided highways.

Flashing arrow panels should maintain a 7-foot mounting height and a 3-foot offset from the traveled way. Care should be taken to ensure the units are sighted and aligned with approaching traffic and dimmed at night to provide maximum visibility.



A minimum lateral clearance of three feet, measured horizontally from the edge of the panel to the edge of the traveled way, is recommended for trailer-mounted units deployed as specified in the previous paragraphs.

A minimum mounting height of seven feet, measured vertically from the bottom of the panel to the roadway, is recommended for trailer-mounted units. For truck-mounted units, the panel mounting height should be as high as practical.

When deployed, the panel shall be sighted and aligned with approaching traffic to ensure visibility of the display.

Except when panels are located behind a taper or are truck-mounted, five channelizers should be used to delineate each panel. These channelizers should be positioned on the upstream end of the unit to form a taper leading up to traffic side of the unit. The recommended length of this taper is 100 feet.

### Channelizers

The function of channelizer is to warn motorized and non-motorized traffic of conditions created by temporary activities or conditions in or near the roadway, and to guide them through or around these conditions. Uses for these devices include the following:

- ◆ Provide smooth and gradual traffic flow from one lane to another, onto a bypass or detour, or into a narrower traveled way
- ◆ Separate traffic from the activity area, pavement drop-offs, opposing traffic, or non-motorized traffic
- ◆ Separate non-motorized traffic from the activity area or unsafe conditions
- ◆ Delineate spot obstructions
- ◆ Supplement other traffic control devices

There are four types of channelizers used to perform these functions:

- ◆ Cones
- ◆ Drums
- ◆ Trim-line channelizers
- ◆ Directional indicator barriers

**Cones** are conical-shaped devices that are orange in color and 28 inches in height. For nighttime operations, they are augmented with bands of retroreflective white sheeting to improve their visibility.

For nighttime use, cones shall be retroreflective or equipped with lighting devices for maximum visibility. Retroreflection of cones, 28 inches or larger, shall be provided by a white band 6-inches wide, no more than 3 to 4 inches from the top of the cone, and an additional 4-inch wide white band a minimum of 2 inches below the 6-inch band.



Steps should be taken to ensure that cones will not be blown over or displaced by wind or moving traffic. Cones can be doubled up to increase their weight. Some cones are constructed with bases that can be filled with ballast. Others have special weighted bases, or weights such as sandbag rings, that can be dropped over the cones and onto the base to provide added stability. Ballast, however, should not present a hazard if the cones are inadvertently struck.

**Drums** are cylindrical-shaped devices that are orange in color, 36 inches in height, a minimum of 18 inches in diameter, and augmented with alternating bands of orange and white retroreflective sheeting.

**Trim-line channelizers** are conical-shaped devices that are orange in color, 42 inches in height, eight inches in diameter at the base, and augmented with alternating bands of orange and white retroreflective sheeting. They are particularly effective in areas like ramps and intersections or where there is limited lateral clearance. In these situations, they provide greater warning and delineation functions than cones while maintaining a smaller footprint than drums.

**Directional Indicator Barricades** are 36 inch tall devices consisting of a 24 inch wide by 12 inch tall retroreflective orange panel with a horizontal arrow on top and a 24 inch wide by eight inch tall panel of alternating orange and white retroreflective stripes at a 45-degree angle on bottom. They may be used in lieu of other channelizers for tapers in the transition area. When used, the arrow on the top panel and the stripes on the bottom panel shall point toward and slope downward, respectively, to the side of the unit in which traffic is to pass.



Recommended channelizer spacing is shown in the following table.

**Channelizer Spacing Chart**

Speed Limit (mph)	Channelizer Spacing <sup>1</sup> (ft.)	
	Taper	Buffer/Work Areas
0-35	35 <sup>2</sup>	50 <sup>2</sup>
40-45	40 <sup>2</sup>	100 <sup>2</sup>
50-55	50 <sup>3</sup>	100 <sup>3</sup>
60-70	60 <sup>3</sup>	100 <sup>3</sup>

<sup>1</sup> Channelizer spacing may be reduced to discourage traffic encroachment.

<sup>2</sup> Spacing reduced to 1/2 at intersections.

<sup>3</sup> Spacing may be reduced to 1/2 at intersections.



## Quality Requirements

Temporary traffic control devices shall be installed and maintained in an acceptable condition. Unless specified otherwise, this requirement does not necessitate the use of functional devices. Unacceptable devices shall be replaced or corrected in accordance with the contract documents or, in the absence of a contract, as directed by the department's representative.

## Quality Standards

The quality standards set forth in the Quality Standards for Temporary Traffic Control Devices should be used by those responsible for the installation, operation, maintenance, and inspection of temporary traffic control devices as a guide to determine if those devices are acceptable for use on the state highway system.

These standards should be applied at several stages: prior to delivery to the work zone, during initial setup, and routinely during the course of work. Such scrutiny will ensure the effectiveness of the temporary traffic control devices throughout life of the work zone.

### General

All temporary traffic control devices shall be:

- ◆ In conformance with the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) and MoDOT Standards
- ◆ Installed and maintained at locations and in orientations that maximize safety and minimize disruption to traffic flow
- ◆ Aligned with the road user's line of vision
- ◆ Positioned as to not obstruct other applicable traffic control devices
- ◆ Free of any appreciable dents, holes, deformations, abrasions, tears, marks, stains, residues, fading, or other deficiencies that affect the operational performance of a device; cause the failure of a device to conform with the requirements of the MUTCD or MoDOT standards to be considered crashworthy
- ◆ Properly covered, turned, stowed, or removed when not in use

### Barricades, Channelizing Devices, and Signs

These devices shall be:

- ◆ Reasonably plumb to the pavement
- ◆ Safely and neatly ballasted, as needed
- ◆ Clearly visible and legible/distinguishable to approaching traffic during the day and, if applicable, at night

**Warning Lights**

These devices shall be:

- ◆ Visible from a distance of 3,000 feet on a clear night for Type A (low-intensity, flashing) and Type C (low-intensity, steady-burn) and from distance of 1,000 feet on a sunny day without the sun directly on or behind the devices for Type B (high-intensity, flashing) warning lights
- ◆ Illuminated at appropriate times
- ◆ Securely affixed to the host

**Flashing Arrow Panels**

These devices shall be/have:

- ◆ Functioning in the appropriate mode
- ◆ No more than one lamp, of those to be energized, out in stem and no lamps out in the arrow head(s) when in the arrow (single- or double-headed) and no lamps out when in the caution (four corners) modes
- ◆ Appropriately dimmed at night

Note: Any lamp drawing less than 60% of its original power draw or producing less than 60% of its original output is considered out.

**Changeable Message Signs:**

- ◆ Displaying the prescribed message at an appropriate cycle
- ◆ Clearly legible to approaching traffic with minimal display abnormalities
- ◆ Appropriately dimmed at night



## Sign Coverings

These items shall be:

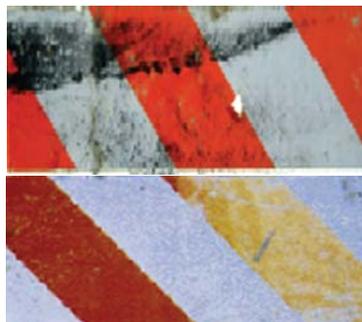
- ◆ Sized to match the sign to be covered
- ◆ Positioned to cover most of the sign face
- ◆ Designed to prevent “bleed through” of the covered sign and damage to the permanent sign installation
- ◆ Constructed with non-metallic handles
- ◆ Adequately secured to the host sign assembly

The following are examples of acceptable sign covering practices.



## Unacceptable Standards

Shown below are examples of unacceptable temporary traffic control devices. These examples apply to all such devices.





## Barricades

A barricade is a portable device used to close, restrict, or delineate all or a portion of the right-of-way to motorized and non-motorized traffic. Each unit contains a number of rails augmented with stripes of alternating orange and white retroreflective sheeting on the side facing traffic.

Where a barricade extends entirely or partially across a roadway, the stripes should slope downward at a 45-degree angle across the entire barricade array in the direction in which traffic is to pass. Where both right and left movements are provided, the stripes should slope downward in both directions from the center of the barricade array. Where no movements are provided, the stripes should slope downward toward the center of the barricade array.

The Type I (one rail) and Type III (three rail) barricade configurations are used on the state highway system. The Type III barricade is the preferred option to perform the previously noted operations. The Type I barricade is acceptable for use in non-motorized traffic operations on all highways and in emergency road closures on two-lane, undivided highways.

When a roadway is closed, but access is still allowed for local traffic or work vehicles, barricades may be offset to facilitate movement into and out of the closed area.



## Temporary Traffic Barrier

Temporary traffic barriers may be used in lieu of, or in addition to, channelizers separating motorized traffic from the work space, an unsafe condition, or non-motorized traffic. Barriers should not be used to form tapers.

Due to the amount of resources needed to put a barrier in place, this option is generally reserved for long-term stationary operations where the need for the noted functions is critical.

If barrier is desired, consult with appropriate engineering staff for design requirements prior to installation.

When used, the barrier shall be supplemented with delineation for increased visibility. This delineation shall match the applicable pavement marking color.

Any end of the barrier installation susceptible to being hit by vehicular traffic shall be protected with a crashworthy end treatment. This requires installation of a barrier height transition for speeds less than or equal to 35 mph, or an approved crash cushion for speeds greater than or equal to 40 mph. As an option, the barrier may be flared at a rate of 8:1 back to the limits of the clear zone, backslope, or curb provided the side slope is 6:1 or flatter.





## Pavement/Temporary Pavement Markings

Pavement markings are the primary means of channelizing and providing guidance to traffic. However, when temporary traffic control activities impact the use of a roadway, or when operations eliminate permanent pavement markings, existing pavement markings, or lack thereof, can confuse the motorist.

**Changes in roadway use** caused by long-term operations should be accompanied by pavement marking revisions (i.e., the removal or obliteration of any pavement markings that are not applicable to current roadway use and the installation of temporary pavement markings). For operations of shorter duration, the other temporary traffic control devices (e.g. channelizers, signs, etc.) deployed will be relied on to provide traffic with the needed channelization and guidance cues. Pavement marking revisions for shorter duration operations could be a possibility; but, should be considered on a case-by-case basis.



**Elimination of permanent pavement markings** for a distance of 200 linear feet or more caused by operations such as leveling course, patching, seal coat, spot sealing, crack pouring, milling, and scrub sealing shall be accompanied by the installation of temporary centerline and lane line pavement markings and NO CENTER STRIPE signs, as specified.

There are four means typically used to provide temporary pavement marking – preformed short-term pavement marking tape, Type 1 temporary raised pavement markers, Type 2 temporary raised pavement markers, and pavement marking paint.

**Preformed short-term pavement marking tape** consists of a four-inch wide retroreflectorized tape with a pressure-sensitive adhesive on the back. The tape, available in white and yellow, may be used to provide a surrogate permanent pavement marking or it may be cut into four-foot long sections and applied to the road surface at 40-foot intervals as a temporary pavement marking. The length and spacing of the latter pavement marking may be reduced to one-half when marking intersections, ramp gores, and other transition areas. This material is typically used to temporarily mark changes in normal roadway use and to provide temporary marking of centerlines and lane lines when permanent pavement markings are eliminated. It is not recommended for locations where the material will be subjected to heavy traffic, in areas of heavy turning movements, on short radius curves, or on roadways having loose aggregate on the surface, as the material will not adhere well under these conditions. These markings do not have to be removed when placed on intermediate lifts.

**Type 1 - Temporary Raised Pavement Markers** consist of an L- or T-shaped flexible tab with a retroreflective sheeting on both faces of the vertical section and a pressure-sensitive adhesive on the base. These markers, available in white and yellow, are typically used to temporarily mark centerlines and lane lines by applying them to the road surface at 40-foot intervals and shoulder areas at 200 ft. intervals. Except for hot/cold mix asphalt applications and diamond grinding operations, the markers are installed prior to an operation, with the removal of the protective film covering the retroreflective sheeting occurring upon completion of the operation. This spacing may be reduced to one-half when marking intersections, ramp gores, and other transition areas. Type 1 markers are the preferred means of providing temporary marking on rough surfaces. These markings must be removed prior to placement of subsequent lifts.

**Type 2 - Temporary Raised Pavement Markers** consist of a plastic dome with reflectors on the sides and a pressure-sensitive adhesive on the base. These markers, available in white and yellow, are typically used to temporarily mark changes in normal roadway use or temporarily mark centerlines and lane lines by applying them to the road surface at 40-foot intervals. This spacing may be reduced to one-half when marking intersections, ramp gores, and other transition areas. Type 2 markers work well on concrete and smooth asphaltic surfaces. These markings must be removed prior to placement of subsequent lifts.



Note: A combination of Type 1 and Type 2 temporary raised pavement markers may be used to temporarily mark centerline and lane lines for enhanced daytime visibility and nighttime reflectivity.

**Pavement Marking Paint** consists of applying a four-inch wide strip of acrylic waterborne paint with drop-on glass beads for retroreflectivity. The paint, available in white and yellow, may be used to provide a surrogate permanent pavement marking or it may be applied in four-foot long sections at 40-foot intervals as a temporary pavement marking. The length and spacing of the latter pavement marking may be reduced to one-half when marking intersections, ramp gores, and other transition areas. This material is typically used to temporarily mark changes in normal roadway use and to provide temporary marking of centerlines and lane lines when permanent pavement markings are eliminated. These markings do not have to be removed when placed on intermediate lifts.

In addition to providing temporary pavement markings, **NO CENTER STRIPE signs** may also be warranted. NO CENTER STRIPE signs are black-on-orange warning signs used on two-lane and two-lane with auxiliary lane facilities where no-passing zone centerline marking is eliminated for 200 linear feet or more. These signs are placed in advance of the missing no-passing zone centerline marking area at the recommended sign spacing. For extended areas continuously or intermittently missing no-passing centerline marking, NO CENTER STRIPE signs should also be installed within 150 feet after the intersection of a state highway and at one-mile spacing throughout the affected area. Upon the discretion of the supervisor, additional NO CENTER STRIPE signs may be installed within 150 feet after other intersections. When a sign placed at the one-mile interval and one placed after an intersection fall within one-eighth mile of each other, the sign placed at the one-mile interval may be eliminated.

When temporary pavement markings and/or NO CENTER STRIPE signs are necessitated by either a change in roadway use or the elimination of permanent pavement markings, the following provisions shall be incorporated into the operation by:

- ◆ Those performing the operation shall be responsible for coordinating the procurement, installation, maintenance, and removal, as applicable, of pavement markings, temporary or permanent, and any NO CENTER STRIPE signs.
- ◆ Temporary pavement markings and any NO CENTER STRIPE signs shall be in place prior to opening a roadway to traffic. On two-lane highways with AADTs less than 1000, however, installation of pavement markings may be delayed up to 5 working days, initiated by the elimination of the permanent pavement markings, provided the required NO CENTER STRIPE signs are in place prior to opening the facility to traffic.

- ◆ Temporary centerline and lane line pavement markings and any NO CENTER STRIPE *signs* shall be in accordance with Standard Plan 620.10. Note: Temporary marking of edgelines is not required for work performed by maintenance forces.
- ◆ For maintenance forces, permanent pavement markings shall be installed no later than 15 calendar days after an operation has been completed. For construction projects, permanent pavement markings shall be installed no later than 5 calendar days after an operation has been completed. Every effort shall be expended to minimize installation time.
- ◆ Removal or obliteration of all pavement markings are to be complete and leave minimal pavement scarring. Concealing any pavement marking with black paint or liquid asphalt is not acceptable. Installation of temporary pavement marking are to be aligned to the same standards as permanent pavement marking.
- ◆ Temporary pavement markings will provide adequate retroreflectivity for positive guidance to motorists. Temporary pavement markings are to be periodically checked to ensure effectiveness until permanent pavement markings can be applied.

### Lighting Devices

There are two purposes for providing lighting devices in temporary traffic control zones. The first purpose is to illuminate a portion of the roadway in order to safely and effectively perform work activities or to highlight areas requiring increased driver attention. This is accomplished through work and area lighting, respectively. The second purpose is to supplement other temporary traffic control devices or to identify work vehicles and equipment. This is accomplished through warning and fleet lighting, respectively.

**Work lighting** enhances worker safety and quality of the work performed during nighttime operations by illuminating the work area to a level at which workers can adequately see what they are doing.

A minimum intensity of five foot candles is recommended to satisfy this objective. Typically, this lighting is provided by an array of vehicle- or equipment-mounted floodlights, an array of floodlights on a portable lighting unit, or an internally illuminated balloon. Lighting shall be positioned such that it does not cause glare for motorists, spill onto adjacent properties, create shadows within the work space, or become a safety concern.



**Area lighting** illuminates specific areas significant to traffic guidance within the temporary traffic control zone during nighttime hours. Lighting of this nature is required at flagger stations and may be considered at gore areas, transitions, ingress and egress areas, equipment crossings, intersections, and temporary signals. A minimum intensity of 0.6 foot candles in the specific area is recommended for this type of lighting. Typically, this lighting is provided by a single light on a portable lighting unit or mounted on a temporary pole. As with work lighting, lighting shall be positioned such that it does not cause glare for motorists, spill onto adjacent properties, create shadows, or become a safety concern.

**Warning lights** are an option available to increase the target value of other temporary traffic control devices. Typically, a single self-contained unit that emits a yellow light is used for this type of lighting. There are three types of warning lights - A, B, and C.

**Type A warning lights** - are low-intensity, flashing light units capable of being visible from a distance of 3000 feet on a clear night. These units may be used during nighttime hours to warn motorists they are approaching or proceeding through a potentially hazardous area. Their use is limited to supplementing other traffic control devices throughout the temporary traffic control zone. They are not be used for delineation.

**Type B warning lights** - are high-intensity, flashing light units capable of being visible from distance of 1000 feet on a sunny day with the sun directly on or behind the device. These units may be used during both daytime and nighttime hours to warn motorists they are approaching a potentially hazardous area. Their use is limited to supplementing signs in the advance warning area and other temporary traffic control devices at point locations throughout the temporary traffic control zone. They are not be used for delineation.

**Type C warning lights** - are steady-burn light units capable of being visible from a distance of 3000 feet on a clear night. These units may be used during nighttime hours to delineate the intended path. Their use is limited to supplementing a traffic control device in a lane taper; one-lane, two-way taper; diversion, curve, and other similar condition. Note: When used to help delineate curves, light units shall only be placed on the outside of the curve.

Warning lights shall be mounted at a minimum of 30 inches, measured from the base of the host device to the bottom of the unit, exclusive of any housing. In addition, lights should be installed so they do not hinder the functionality of the device they supplement or become a hazard themselves.

**Fleet lighting** increases the visibility of work or incident response vehicles and equipment while in the temporary traffic control zone. All work vehicles and equipment shall be equipped with an acceptable warning light system. These lights shall be activated whenever a vehicle or piece of equipment is engaged in a work zone or incident response operation within the temporary traffic control zone. An exception to this requirement is those vehicles and pieces of equipment located within a work space delineated by channelizers or protected by temporary traffic barrier. For this situation, activation of the lights is not required. Standard hazard warning lights may be used as a supplement to, but not as a replacement for, fleet lighting.





## Temporary Traffic Control Signals

Temporary traffic control signals are used at haul road or equipment crossings, on one-lane, two-way operations, and at temporary intersections located within the temporary traffic control zone to assign vehicular right of way. Typically, this is done with temporary span-wire installations or trailer-mounted units.

Consideration of the following factors will assist in the design and application of a signal installation.

- ◆ Site characteristics (e.g. safety and traffic needs; traffic volumes and speeds; sight distance and turning restrictions; side streets and driveways; parking; pedestrians; existing traffic control devices; human factors; etc.)
- ◆ Temporary traffic control design details (e.g. work staging; operation location and duration; feasibility of using other temporary traffic control measures; placement of this and other temporary traffic control devices; etc.)
- ◆ Functional aspects (e.g. signal phasing and timing requirements; full-time or part-time operation; actuated, fixed-time, or manual operation; interconnection with other temporary or permanent signals; etc.)
- ◆ Operational issues (e.g. power source; operation, inspection, and maintenance needs; record keeping; etc.)

When used, signals shall be installed and operated in accordance with the Signals section of the *Traffic Manual*. In addition, the signals shall meet the physical display and operational requirements of conventional signals.

A traffic engineer or their designee shall approve all timing of the signal. In one-lane, two-way situations, this timing shall include an all-red interval of sufficient duration for traffic to clear the portion of roadway controlled by the signal.

A minimum lateral clearance of three feet, measured horizontally from the edge of the trailer to the edge of the traveled way, is recommended for trailer-mounted units.

When deployed, signal heads shall be properly aligned with approaching traffic to ensure visibility of the indications.

Five channelizers should be used to delineate each trailer-mounted signal. These channelizers should be positioned on the upstream end of the unit to form a taper leading up to traffic side of the unit. The recommended length of this taper is 100 feet.



Temporary Traffic Control Signal



## Crash Cushions

Crash cushions are systems that mitigate the effects of errant vehicles impacting roadside obstacles such as fixed objects or exposed barrier and guardrail ends. The system is designed to accomplish this by either smoothly decelerating the vehicle to a stop or redirecting the vehicle.

Due to variability of site conditions, systems shall be selected on a case-by-case basis. Consult appropriate engineering staff for this assistance.



## Protective Vehicles

Protective vehicles are used to safeguard the work space from errant vehicles. In some operations, these devices also serve as platforms for signs and other devices used to warn traffic of upcoming conditions or inform them of needed actions. For increased motorist, driver, and worker safety, the protective vehicle may be equipped with a truck-mounted attenuator as noted in the following section.

Protective vehicles should provide sufficient warning to approaching traffic and maximum protection to workers and equipment. This implies the protective vehicle be positioned so that it is clearly visible to approaching traffic, minimizes any vehicular encroachment into the area between the protective vehicle and the work space, and maintains a recommended minimum of 150-foot clear roll ahead distance between the vehicle and the work space.

The wheels of the protective vehicle should be aligned with traffic at all times. In addition, the emergency brake shall be set and the transmission put into neutral in stationary operations.





### Truck-Mounted Attenuators

Truck-mounted attenuators are energy-absorbing devices attached to the rear of trucks used as protective vehicles. These devices are designed to protect the motorist and protective vehicle driver upon impact. Note: Refer to typical applications for specific usage.

In general, the guidelines for the use of these devices are shown in the following table.

Highway Type	Operation Location and Duration		
	In Lane		On Shoulders and Ramps and at Intersections
	Mobile	Stationary	
Two-Lane Undivided	Recommended	Recommended	Recommended
Multi-Lane Undivided	Required	Recommended	Recommended
Multi-Lane Divided	Required	Required	Recommended

Truck-mounted attenuators shall be periodically inspected to ensure their functionality. Damaged parts shall be promptly repaired or replaced. Vehicles equipped with TMA's should be checked to make sure they are properly ballasted.

Examples of when a truck-mounted attenuator may be used:

- ◆ High volume/high speed situations
- ◆ Low volume/high speed situations
- ◆ Emergency situations
- ◆ Mobile and moving operations
- ◆ Stationary Operations



## Supplemental Warning Methods

It may, on occasion, be desirable to enhance the target value of certain temporary traffic control devices or the entire zone. The purpose of this is to increase awareness of the temporary traffic control zone or specific conditions within it.

Typical methods for accomplishing this objective include supplementing the prescribed devices with other devices, adding devices to the zone, or changing the characteristics of a device itself. Examples of possible enhancements are as follows.

- ◆ Cones by signs or at flagger stations
- ◆ Flags atop signs
- ◆ Increased sign height
- ◆ Additional signs
- ◆ More or increased levels of retroreflectivity
- ◆ Warning lights on devices
- ◆ Area lighting
- ◆ Portable changeable message signs
- ◆ Pavement markings
- ◆ Speed trailers
- ◆ Light bars on vehicles
- ◆ Law enforcement
- ◆ Press releases



## Miscellaneous Items

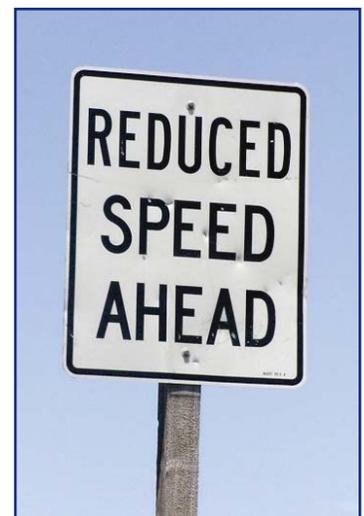
### Speed Limits

The Missouri Department of Transportation has the authority to set speed limits on the state highway system. This power extends to establishing speed limits in temporary traffic control zones, where the speed limit may be reduced from the normal speed limit for safety purposes.



A reduced speed limit should be carefully considered before it is imposed, as motorists will only reduce their speed if they perceive a need to do so. Any decision to reduce the speed limit based on an arbitrary, 'across the board,' or other inappropriate rationale may result in non-compliance with the reduced speed limit by the motorists and a false sense of security for the workers.

Should a reduced speed limit be deemed appropriate, the following table shows the recommended maximum speed reductions or the minimum speed that may be imposed in temporary traffic control zones.





Location of Activity (i.e. Workers, Equipment, Material)	Posted Speed Greater Than 55 MPH		Posted Speed Less Than 55 MPH	
	Protected	Unprotected	Protected	Unprotected
Beyond 30' of Equipment	Posted	Posted	Posted	Posted
10' to 30' of Equipment	Posted	Posted-10	Posted	Posted
Within 10' of Equipment	Posted	Posted-10	Posted	Posted-10
In Traffic Lane of Multilane Facility	Posted-10	Posted-20 (Min. 45 MPH)	Posted-10	Posted-10
<b>2 Lane / 2 Way Operation</b>				
Beyond 10' of Equip.	Posted	Posted-10 (Min. 55 MPH)	Posted	Posted
Within 10' of Equip.	Posted	Posted-20 (Min. 45 MPH)	Posted	Posted-10
1 Lane / 2 Way Opr.	35 MPH *			
Temporary Closure with Flagger	35 MPH *			
<b>Legend:</b>			* Conditions may allow for speeds greater than 35 MPH.	
<p>"EDTP" - Edge of Through Pavement  <b>"Protected"</b> Indicates that activity is physically shielded by a crash-worth device: Traffic barrier, Guard Rail, Impact Attenuators, etc.  <b>"Unprotected"</b> Indicates that activity is not shielded by a crash-worth device. It may only be delineated by channelizing devices or pavement markings.  <b>"Posted"</b> Indicates posted (existing) speed prior to work activity  <b>"Posted-xx"</b> Indicates a reduction in the speed limit by the amount shown in MPH</p>				
Work Zone Speed Limit				

After selecting a reduced speed limit based upon the table above, the following guidelines will assist in the proper installation and application of that reduced speed limit in the temporary traffic control zone.

- ◆ When the reduced speed applies to the entire temporary traffic control zone, speed limit and REDUCED SPEED AHEAD, if applicable, signs shall be inserted in between the first and second advance warning signs at the prescribed sign spacing. If the reduced speed only applies to a specific section within the zone, the signing shall be placed in advance of the condition for which the reduced speed is deemed necessary at the prescribed sign spacing. Note: Speed Limit and REDUCED SPEED AHEAD signs are not shown on the typical applications
- ◆ On divided highways, the reduced speed is applicable to the affected direction of travel only
- ◆ Existing speed limit signs within the temporary traffic control zone shall be covered or removed



- ◆ Speed limit signs indicating the normal speed limit should be installed at the end of the reduced area provided no other reduction is imposed within the next one-half mile or no existing speed limit sign is located within the next one-half mile
- ◆ Reduced speed limit signing shall be removed, covered, or turned from traffic when conditions requiring the reduced speed no longer exist
- ◆ A special activity within a temporary traffic control zone may require a lower speed limit than the one imposed for the zone itself. The further reduced speed limit shall only be effective for the duration of that special activity and should comply with these guidelines

General Notes:

Reduced speeds shall not be below 36 mph except when local ordinance provides for a lower speed. The lower speed will be used when applicable.

On divided highways, the reduced speed is applicable to the affected direction of travel only. When traffic on divided highways is detoured to a head-to-head operation, the speed limit shall be "posted-10" mph.

If a speed reduction is used, existing speed limit signs within the work zone shall be covered or removed. Speed limit signs indicating the normal speed limit shall be installed at the end of the work zone. Provided no further work zones will be encountered within the next  $\frac{1}{2}$  mile.

If there are geometrics in the work zone that require a lower speed than the speed indicated in the chart (i.e. temporary bypasses, narrow lanes, etc.). Appropriate warning signs with advisory speed plates shall be used to advise of this specialized situation.

Temporary speed limit signs and reduced speed ahead signs shall be covered or removed when the condition requiring reduced speeds do not exist.

Special activity within a work zone may require a lower speed limit than the general work zone speed limit. The further reduced speed limit shall be effective only for the duration of that special activity.

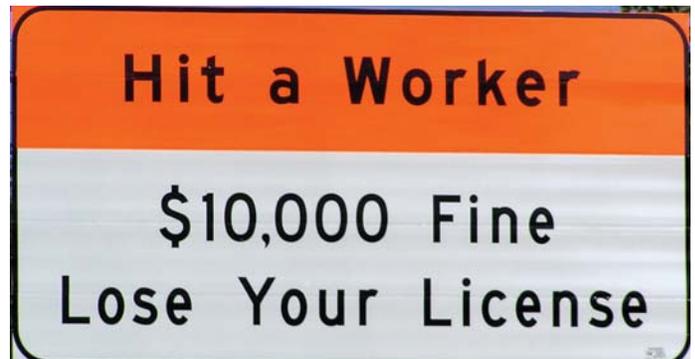
For speed reductions greater than 20 mph, the speed limit should be reduced in two stages.

Deviations from this chart shall be documented.

## Fine Signs

A new law to increase highway workers' safety went into effect on August 28, 2006. The new law increases the fines for killing or injuring a highway worker, including motorist assist employees, up to \$10,000 with the possibility of the motorist losing his or her license. Other changes with the new law includes:

- ◆ Changing the definition of a work zone to include work related to incident removal;
- ◆ Repeals a previous sign covering/uncovering provision, which states that informational signs in work zones must remain unveiled;
- ◆ Increases the fine to \$300 for the second offense for passing in a work zone on a two-lane highway when workers or equipment are present and/or when an appropriate sign is visible;
- ◆ Creates the crimes of endangerment of a highway worker and aggravated endangerment of a highway worker;
  - (1) Exceeds the posted speed limit by 15 mph or more;
  - (2) Passes another vehicle in a work zone and such offense results in the death or injury of a highway worker;
  - (3) Fails to stop for a work zone flagman or fails to obey traffic control signals erected in the work zone;
  - (4) Physically assaults or attempts to assault a highway worker with a motor vehicle or other instrument;
  - (5) Intentionally strikes or moves barrels, barriers, signs, or other devices erected to control the flow of traffic for a reason other than avoidance of an obstacle, an emergency or to protect the health and safety of another person; or
  - (6) Commits various offenses in which points may be assessed
- ◆ If a motorist endangers a highway worker without causing the worker injury or death, the motorist shall be subject to a fine of not more than \$1,000 and shall have four points assessed against his or her driver's license;
- ◆ If a person commits the offense of aggravated endangerment of a highway worker, the offender shall be subject to a fine up to \$5,000 where a highway worker is injured; and up to \$10,000 if a highway worker is killed. The offender will also have 12 points assessed against his or her license, which is an automatic one-year suspension of the driver's license.
  - (1) A person commits the offense of aggravated endangerment of a highway worker if, as a result of one of the traffic violations under endangerment of a highway worker, a highway worker is injured or killed.



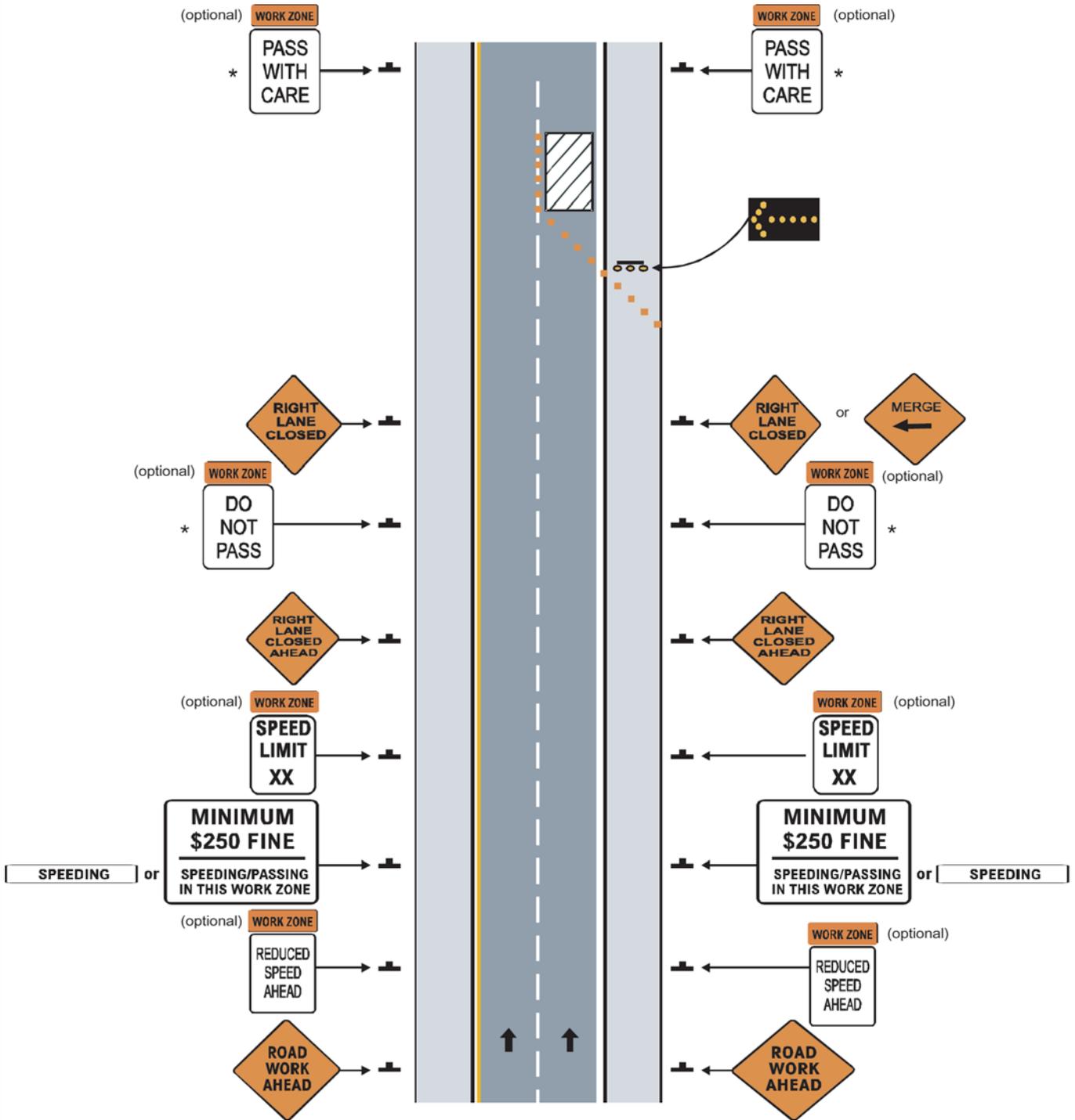
### **Aggravated endangerment of a high-way worker:**

A person commits the offense of aggravated endangerment of a highway worker if, as a result of one of the traffic violations under endangerment of a highway worker, a highway worker is injured or killed.



The implementation of the passing portion of this provision may be considered when, in addition to meeting the previous criteria or judgment, there is a lane drop on a multi-lane highway consisting of a maximum of two lanes in the affected direction.

When fine signs are used, their location, as well as other signing requirements, shall conform to the following illustration.



\* Signs not used when only speeding portion of provision is invoked.



### Section 4: Review Questions

1. What factors determine sign spacing?
  - A. Speed Limit
  - B. Road Classification, such as “Divided” or “Undivided”
  - C. Both A and B
  - D. None of the Above
  
2. Which one of the following is NOT a sign classification?
  - A. Regulatory
  - B. Mandatory
  - C. Warning
  - D. Guide
  
3. Each portable changeable message sign should consist of a:
  - A. Maximum of two phases with four lines each
  - B. Maximum of two phases with three lines each
  - C. Maximum of three phases with two lines
  - D. Maximum of three phases with three lines
  
4. The protective vehicle should position the front wheels \_\_\_\_\_
  - A. Aligned with traffic
  - B. Turned away from traffic towards the ditch
  - C. Turned toward traffic away from the work space
  - D. None of the above
  
5. If a protective vehicle is used, a vehicle-mounted sign is recommended to be mounted height of \_\_\_\_\_ inches above the road surface.
  - A. 24
  - B. 36
  - C. 48
  - D. 54
  
6. What sign is NOT a “Regulatory Sign?”
  - A. Stop
  - B. Yield
  - C. Do Not Enter
  - D. Railroad Crossing



7. MoDOT recognizes the following operating modes on flashing arrow panels.
  - A. Arrow
  - B. Double Arrow
  - C. Caution
  - D. All of the above
  
8. The sign height (bottom of the sign) on a post-mounted sign for a rural undivided highway is:
  - A. 1 foot
  - B. 3 feet
  - C. 5 feet
  - D. 7 feet
  
9. Sign spacing for an undivided highway at a posted speed limit of 55 mph is during daytime operations:
  - A. 200 feet
  - B. 350 feet
  - C. 500 feet
  - D. 1000 feet
  
10. When deployed, the bottom of the portable changeable message sign is recommended to be a minimum of \_\_\_\_\_ feet vertically from the bottom of the sign to the roadway.
  - A. 1
  - B. 3
  - C. 5
  - D. 7

## Section 5: Application

### Work Zone Length

While it is important to grab the motorists' attention as they approach the temporary traffic control zone, it is just as important to maintain their attention as they travel through the zone. To accomplish this, the work zone length, including any areas of inactivity within this length, must be kept to a minimum. The work zone length is defined as the distance from the last sign in the advance warning area to the last temporary traffic control device in the same direction or to the last sign in the advance warning area in the opposing direction, whichever is longer. Where operations require work to be spread out along a section of the roadway, the maximum work zone length is recommended in accordance with the following table.

Highway Type	Work Zone Length
Urban	1 mile
Rural Divided	2 miles
Rural Undivided	3 miles

### Railroads

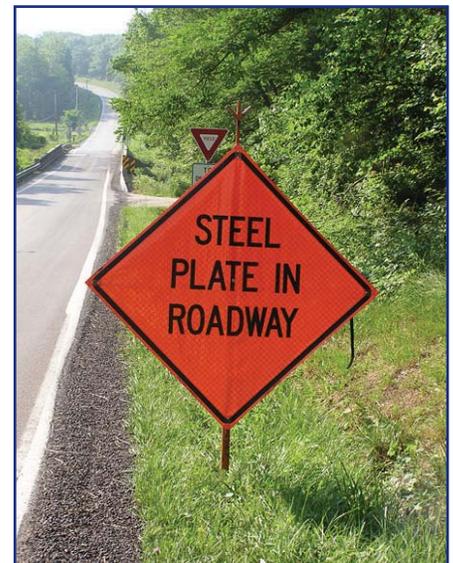
When a highway-rail grade crossing exists within or upstream of the transition area and backups resulting from the lane closure might extend through the highway-rail grade crossing, the temporary traffic control zone should be extended so the transition area precedes the highway-rail grade crossing. It is the responsibility of the supervisor or work zone technician to notify the railroad when you are working within 25 feet of a railroad



### Excavations

When work activities involve movement of soil or subsurface operations, utilities shall be located by calling DIG-RITE, the local provider, and MoDOT.

Unprotected excavations or repairs located within the roadway shall be backfilled or plated while workers are not present. In locations where fills or plates affect the profile of the roadway (e.g., fills appreciably higher or lower than the road surface, thick plates, etc.), the responsible party should install a BUMP or DIP sign, as appropriate, along the edge of the roadway, immediately adjacent to the location. If plated between October 1 and March 31, the responsible party should install a STEEL PLATE IN ROADWAY or BUMP sign along the edge of the roadway, immediately adjacent to the location, and convey the location of the site to appropriate MoDOT personnel.





## Pavement Maintenance Operations

When needed, FRESH OIL, LOOSE GRAVEL, or FRESH OIL/ LOOSE GRAVEL signs, as applicable, shall be incorporated into the advance warning signs at the prescribed spacing. Signs should also be installed within 150 feet after the intersection of a state highway and at one-mile spacing throughout the affected area. Upon the discretion of the supervisor, additional signs may be installed within 150 feet after other intersections. When a sign placed at the one-mile interval and one placed after an intersection fall within one-eighth mile of each other, the sign placed at the one-mile interval may be eliminated.



## Installation of Stationary Lane Closures

Stationary lane closures should be installed with the flow of traffic in the following sequence:

1. Layout the traffic control.
  - a. Determine the location of the work space.
  - b. From the work space, measure the appropriate distance for any buffer space.
  - c. From the “upstream” end of the buffer space, measure the appropriate distance for the transition area taper.
  - d. From the “upstream” end of the transition, measure appropriate distance for the shoulder taper.
  - e. From the beginning of the shoulder taper, measure the appropriate distance to each sign, until the first sign is reached.
2. Install the first sign(s) motorist will see. Proceed downstream with the rest of any advance warning signs at the appropriate spacing. Cover inapplicable signs. (If signs are needed on a barrier wall on the left side, it may be easier to place signs coming from the opposite direction.)
3. Install the shoulder taper.
4. If required, place an arrow panel on the shoulder at the beginning of the merging taper.
5. Place channelizer at the required spacing for the appropriate distance to form the transition area taper (See sign spacing\speed limit chart in appendix section).
6. Install devices at the appropriate spacing for appropriate distance to form the buffer space (See sign spacing chart in the appendix section).
7. Continue placing devices at the appropriate spacing for work space moving downstream. (See channelizing device spacing chart in the appendix section).
8. If required, place the traffic devices 20 feet apart to create a 100-foot long downstream termination taper.
9. End of road work sign is optional.
10. Ride through the entire temporary traffic control zone to ensure it is installed and functioning properly. A night inspection is needed for nighttime work.



## Inspections

To provide acceptable levels of operations, routine daytime and nighttime inspections of temporary traffic control elements should be performed as follows:

- A. Individuals who are knowledgeable (trained in traffic control) in the principles of proper temporary traffic control should be assigned responsibility for safety in temporary traffic control zones.
- B. As the work progresses, temporary traffic controls and/or working conditions should be modified in order to provide safe and efficient motorist movement and to promote worker safety.
- C. Temporary traffic control zones should be carefully monitored under varying conditions of traffic volume, light, and weather to check that applicable temporary traffic control devices are effective, clearly visible, clean, and in compliance with the temporary traffic control plan.



## Removal

All temporary traffic control devices should be removed as soon as practical when they are no longer needed. When work is suspended for short periods of time, temporary traffic control devices that are no longer appropriate should be removed or covered.

### Removal of Stationary Lane Closures

Stationary lane closures should be removed against the flow of traffic in the following sequence:

1. Make sure the work is completed and the activity area is clear of equipment, tools, and people.
2. Remove channelizer from the end of the temporary traffic control zone back to the widest part of the merging taper, then continue removing taper.
3. Remove the arrow panel after ensuring the roadway is clear. Remove the advance warning signs as soon as possible.



## Work Zone Checklist

### Advance Warning Area

#### Message Sign

- Placement/height - 7' above pavement
- Is sign visible by motorist from 1/2 mile and message legible at 650 feet?
- Message appropriate
- Limit of two messages per sequence - no duplications of standard signs
- Is message brief? Is message simple and easy to understand?
- If motorized, tank full of fuel?
- Is panel locked?
- Is board locked in an upright position?
- Is message board in a location that will be least likely to get hit by motorist?

#### Signs

- Proper signs/number of signs present
- Is spacing correct according to the *Traffic Control for Field Operations Manual*?
- Proper height for duration and location
- Accessories (cones/flags) if required by district
- Visibility by motorist
- Condition/reflective/retroreflective

#### Flagger

- On site (if required)
- Location of flagger station - can be seen by motorist
- Communication between flaggers (two-way hand held radio and/or clear sight distance)
- Equipment (paddle, vest, and hat)
- Proper techniques (hand signals and paddle)

### Transition Area

#### Taper(s)

- Distance from advance warning area
- Quality of devices
- Proper type, spacing, alignment, and number of devices
- Retroreflectivity if nighttime work
- Room for motorist to merge?
- Are channelizers present?

### Arrow Panel

- Placement and visible by motorist
- Type appropriate for job (moving operation or stationary)
- Operating (bulbs work, oil, and fuel)
- Proper setting (day/night, left/right, caution/double arrow)

### Activity Area

#### Channelizer

- Proper type and spacing
- Quality/quantity appropriate for job

#### TMA

- Protective Vehicle (front wheels aligned with the traffic and brake set)
- Warning lights, safety alarms, arrow panel is operational, and arrow flashing the correct way
- Proper location

#### Buffer Space

- Proper spacing if used (see buffer chart)
- Free of equipment, vehicles, and people

#### Work Space

- Adequate room to accomplish work
- Stays within range of advance warning area
- Workers adequately protected from motorist
- Are additional traffic control devices needed?
- Does work space encroach on motorist space?
- Are motorist traveling through work zone in a reasonable manner?
- Do motorist seem to comprehend messages conveyed by signs, flaggers, and other traffic control devices?

### Termination Area

- Proper spacing
- Proper number of devices
- Speed limit change (if needed)
- Is "End Road Work" sign needed?
- Are routine inspections of traffic control elements being performed?



**MoDOT  
Temporary Traffic Control  
Visibility and Mobility Inspection Worksheet**

District: \_\_\_\_\_ County: \_\_\_\_\_ Route: \_\_\_\_\_

Project No.: \_\_\_\_\_ Location: \_\_\_\_\_

Date/Time: \_\_\_\_\_ Weather: \_\_\_\_\_ Reviewer: \_\_\_\_\_

**I. VISIBILITY**

**A. General**

1.	Devices installed and maintained at locations and in orientations that maximize safety and minimize disruption to traffic flow.	Pass	Fail	N/A
2.	Devices aligned with the road user's line of vision.	Pass	Fail	N/A
3.	Devices positioned as to not obstruct other applicable traffic control devices	Pass	Fail	N/A
4.	Devices free of any appreciable dents, holes, deformations, abrasions, tears, marks, stains, residues, fading or other deficiencies that affect the operational performance of a device.	Pass	Fail	N/A
5.	Devices properly covered, turned, stowed, or removed when not in use.	Pass	Fail	N/A

**B. Barricades, Channelizing Devices, and Signs**

1.	Signs convey proper messages	Pass	Fail	N/A
2.	Reasonably plumb to the pavement.	Pass	Fail	N/A
3.	Safely and neatly ballasted, as needed.	Pass	Fail	N/A
4.	Clearly visible and legible/distinguishable to approaching traffic during the day and, if applicable, at night.	Pass	Fail	N/A

**C. flashing Arrow Panels**

1.	Functioning in the appropriate mode.	Pass	Fail	N/A
2.	No more than one lamp, of those to be energized, out in stem and no lamps out in the arrow head(s) when in the arrow (single or double headed) mode and no lamps out when in the caution (four corners) modes.	Pass	Fail	N/A
3.	Appropriate light intensity level during day or nighttime.	Pass	Fail	N/A

**D. Changeable Message Signs**

1.	Displaying a pertinent message at an appropriate cycle.	Pass	Fail	N/A
2.	Clearly legible to approaching traffic with minimal display abnormalities.	Pass	Fail	N/A
3.	Clearly legible to approaching traffic with minimal display abnormalities.	Pass	Fail	N/A

**E. Temporary Pavement Markings**

1.	In place at applicable times.	Pass	Fail	N/A
2.	Reasonably aligned longitudinally.	Pass	Fail	N/A
3.	Clearly visible to approaching traffic during the day and night.	Pass	Fail	N/A
4.	Completely removed when no longer applicable.	Pass	Fail	N/A



<b>F. Flagging Stations</b>				
1.	Flagger properly stationed.	Pass	Fail	N/A
2.	Flagger following proper flagging procedures.	Pass	Fail	N/A
<b>G. Nighttime Operations</b>				
1.	Lighting not blinding or glaring to motorist.	Pass	Fail	N/A
2.	Sufficient lighting for the work area provided	Pass	Fail	N/A
<b>Perception Rating</b>		<b>Pass</b>	<b>Fail</b>	

<b>II. Mobility</b>				
<b>A. Traffic management</b>				
1.	Traffic moves at an acceptable pace.	Pass	Fail	N/A
2.	Appropriate speed limit set.	Pass	Fail	N/A
3.	No unnecessary excessive queues.	Pass	Fail	N/A
4.	No unnecessary excessive detour lengths.	Pass	Fail	N/A
<b>B. Physical Conditions</b>				
1.	Physical restrictions limited to areas of work and need.	Pass	Fail	N/A
2.	Appropriate length transitions.	Pass	Fail	N/A
3.	Adequately designed intersections and entrance/exit ramps.	Pass	Fail	N/A
4.	No unnecessary adverse pavement conditions (e.g., ruts, pot holes, bumps, debris, etc.).	Pass	Fail	N/A
5.	No adverse roadway alignments.	Pass	Fail	N/A
6.	Acceptable edge drop-off treatment.	Pass	Fail	N/A
<b>Perception Rating</b>		<b>Pass</b>	<b>Fail</b>	

<b>Comments</b>				

**Notes**

- For maintenance work, in the block labeled job number in the header, insert "Maint." and the type of work being performed, such as mowing, patching potholes, sealing cracks, etc.
- Individual ratings are based on the condition of the listed work zone components.
- Perception ratings will reflect public perception of the work zone. A favorable impression of the visibility or traffic flow attributes of the work zone is reflected in a 'Pass' rating. A negative impression, or the presence of an unsafe condition, is reflected in a 'Fail' rating.
- The inspector shall provide comment on all individual and overall 'Fail' ratings.
- Serious safety infractions noted during the inspection shall be immediately brought to the attention of the appropriate district personnel.



### Section 5: Review Questions

1. Which sign should be the first to be set up in a work zone?
  - a. The first sign the motorists will see.
  - b. The last sign a motorist would see.
  - c. Start in the middle and work your way to each end.
  - d. There are not any guidelines.
  
2. What is MoDOT's policy on having utilities marked?
  - a. Mark them only when you think you are in close contact.
  - b. Take paint and mark the area where you think they are.
  - c. Call utility marking company, and have them mark them before digging.
  - d. After you have begun digging, call utility marking company and they will tell you how close you are.
  
3. What determines the inspection frequency of a work zone?
  - a. An accident.
  - b. A change in weather conditions.
  - c. An increase in errant vehicles.
  - d. All of the above.
  
4. When removing devices, at what point do you begin?
  - a. The first devices the motorists see.
  - b. The last devices the motorists see.
  - c. Start with the middle signs and work your way out.
  - d. The speed reduction sign.
  
5. What should you do if an emergency vehicle approaches the work zone with flashing lights?
  - a. Run away screaming.
  - b. Contact your supervisor, and if authorized let them through.
  - c. Let them through.
  - d. When safe, let them through.
  
6. What should you do if you find an unacceptable device, while out on the job site?
  - a. Replace it as soon as possible.
  - b. Continue, there is nothing you can do.
  - c. All devices are acceptable.
  - d. As long as it is orange and white, its okay.



7. The maximum length of a work zone on a rural divided highway is
  - A. 1 mile
  - B. 2 mile
  - C. 3 mile
  - D. 4 mile
  
8. The maximum length of a work zone of an urban highway is
  - A. 1 mile
  - B. 2 mile
  - C. 3 mile
  - D. 4 mile



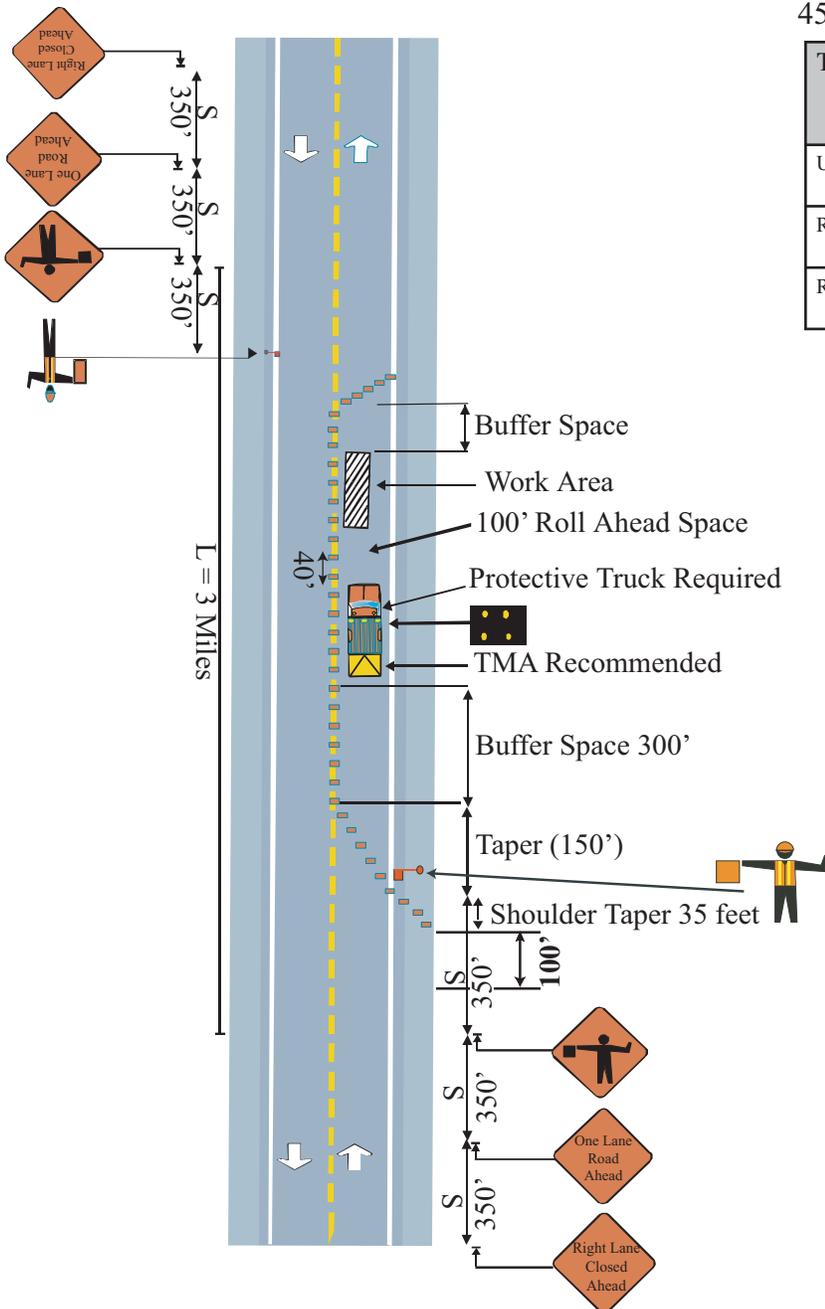
### Exercise 1 Stationary Flagging Operation

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	35	50
40-45	350	500	150	540	220	40	100
50-55	500	1000	185	660	335	50	100
60-70	1000	1000	235	840	550	60	100

1 Shoulder taper length based on 10 ft. (standard shoulder width) offset  
2 Lane taper length based on 12 ft. (standard width) offset

#### Rural Undivided 45 mph

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.



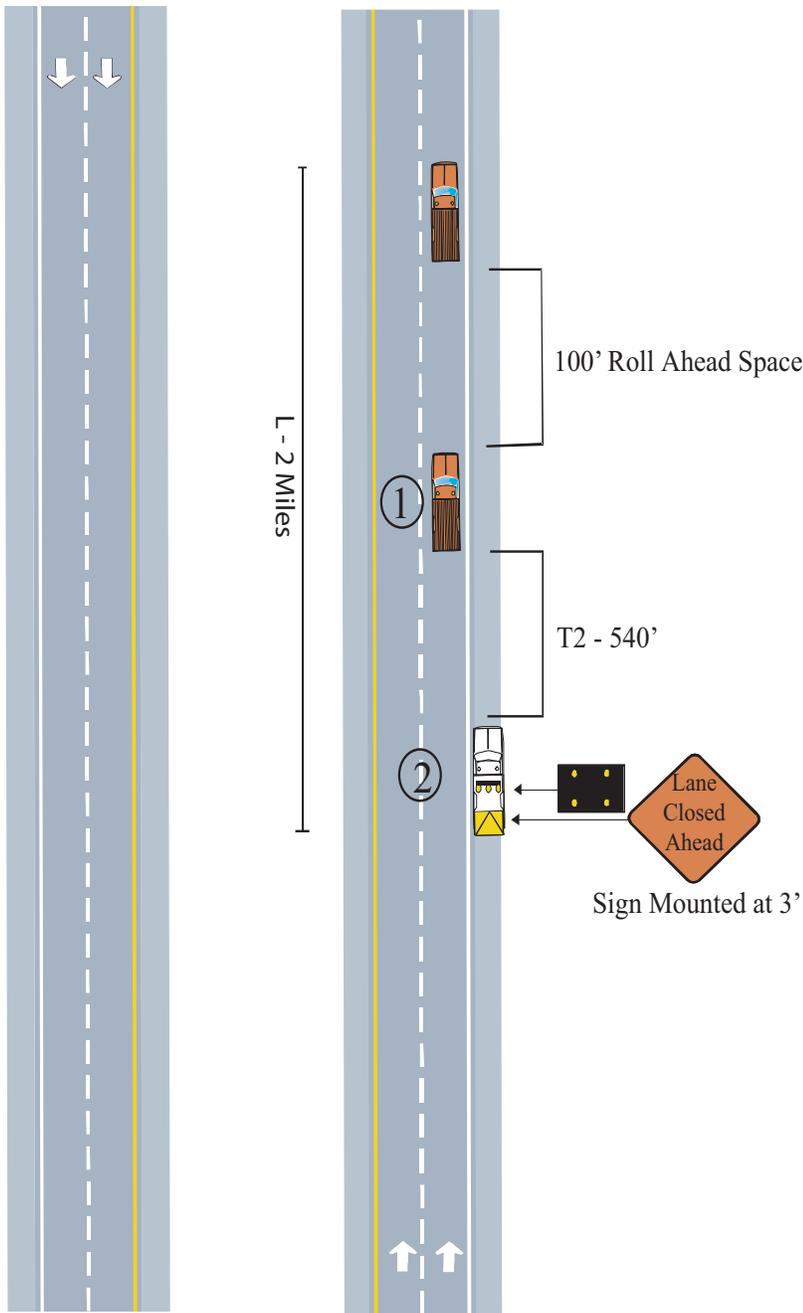
Identify five work-zone errors in the diagram and document the corrections on the lines below.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

**Exercise 2**  
**Mobile Operation**

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	35	50
40-45	350	500	150	540	220	40	100
50-55	500	1000	185	660	335	50	100
60-70	1000	1000	235	840	550	60	100

<sup>1</sup> Shoulder taper length based on 10 ft. (standard shoulder width) offset  
<sup>2</sup> Lane taper length based on 12 ft. (standard width) offset



**Rural Divided**  
**70 MPH**

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.

Identify five work-zone errors in the diagram and document the corrections on the lines below.

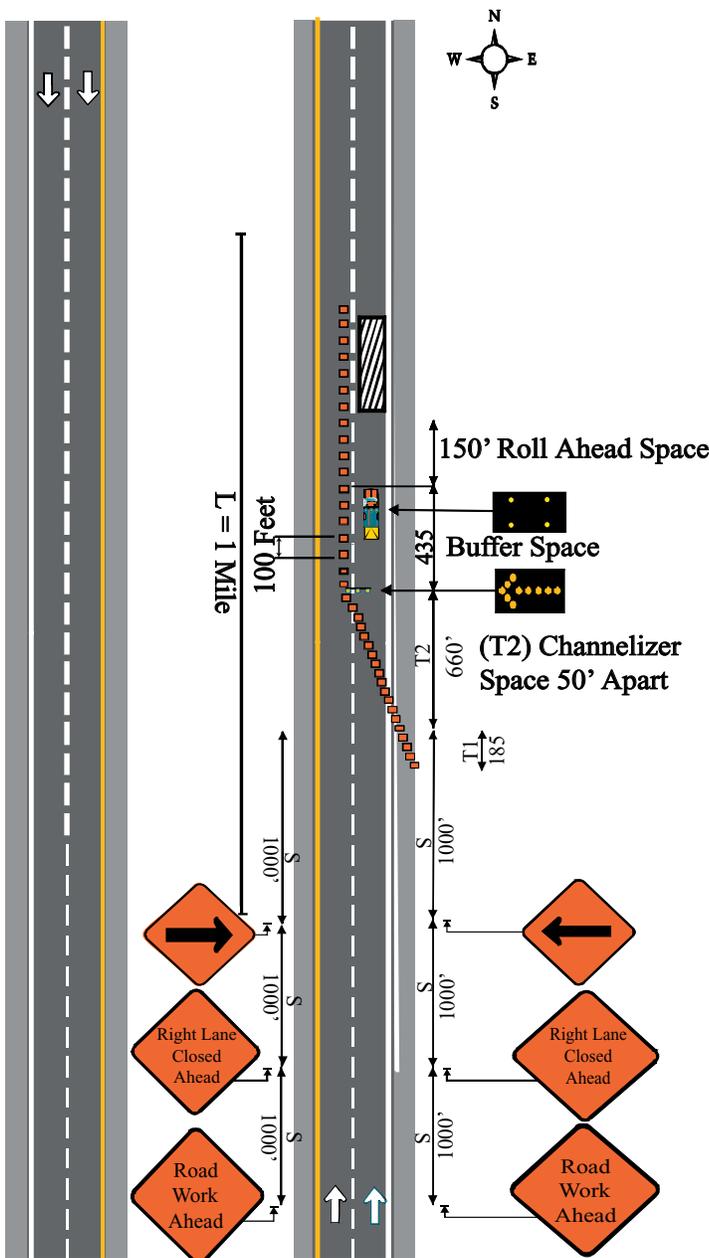
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

### Exercise 3 4-Lane Divided Highway

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	35	50
40-45	350	500	150	540	220	40	100
50-55	500	1000	185	660	335	50	100
60-70	1000	1000	235	840	550	60	100

<sup>1</sup> Shoulder taper length based on 10 ft. (standard shoulder width) offset

<sup>2</sup> Lane taper length based on 12 ft. (standard width) offset



Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.

Urban Area

55 mph Speed Limit

12' Lane Width

10' Shoulder

-  
-  Arrow Board
-  Work Space
-  TMA Truck
-  Caution

Identify five work-zone errors in the diagram and document the corrections on the lines below.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_



**Case Work  
Next 8 Studies**

**Workers  
On  
Roadway**

**Study  
with  
Care**



### Case Study #1

Your supervisor assigns you to be the work zone technician on a concrete replacement job. This job is being performed on Highway 28 north of the district office. This road is a rural two-lane highway and the posted speed limit is 55 mph. This job should take about one day to complete. You know that you will have 12-foot driving lanes with a 10-foot shoulder. Your task is to draw this work zone on the following page and present it to your supervisor for his/her approval.

The following list is equipment that may be used, additional items may also be used, but you must obtain permission from your supervisor prior to use. Your class facilitator will be your supervisor for this case study.

Equipment that might be used:

- ◆ Signs/Posts
- ◆ Cones
- ◆ Flags
- ◆ Protective truck with flashing arrow panel
- ◆ Loader
- ◆ Dump truck
- ◆ Cutting saw
- ◆ Cement truck
- ◆ All traffic control devices

Draw the complete work zone, place signs and all traffic control devices along with distances for each.



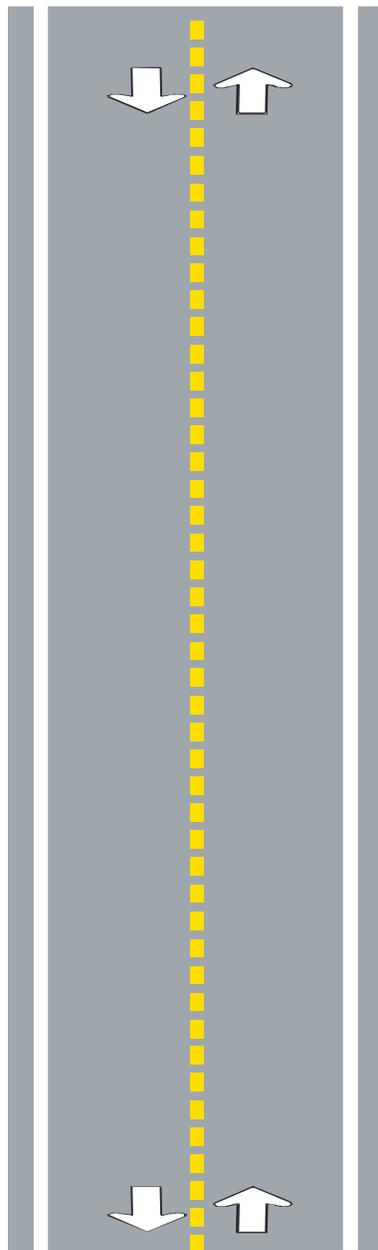
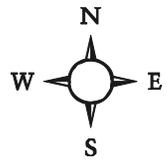
### Case Study #1 - Work Sheet

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	35	50
40-45	350	500	150	540	220	40	100
50-55	500	1000	185	660	335	50	100
60-70	1000	1000	235	840	550	60	100

1 Shoulder taper length based on 10 ft. (standard shoulder width) offset

2 Lane taper length based on 12 ft. (standard width) offset

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.





### Case Study #2

Your supervisor assigns you to be the work zone technician on a shoulder repair operation. This work will be a continuous moving operation on highway 27 south of Central Office. Your supervisor knows that many Central Office people will drive through this work zone and she wants it done right. This is a rural two-lane road with a speed limit of 55 mph. The lane width is 12 feet with a 10-foot shoulder and you know at times you will encroach 6 feet into the northbound lane. You know this job will take approximately 4 hours to complete and your supervisor also wants your team to fix potholes along the same area, so you will be required to have workers on foot. Your task is to draw this work zone on the following page and present it to your supervisor for his/her approval.

The following list is equipment that may be used, additional items may also be used, but you must obtain permission from your supervisor prior to use. Your class facilitator will be your supervisor for this case study.

Equipment that might be used:

- ◆ Signs/Posts
- ◆ Cones
- ◆ Flags
- ◆ (2) Motor graders
- ◆ Broom truck
- ◆ TMA truck
- ◆ Dump truck
- ◆ Pickup truck
- ◆ All traffic control devices

Draw the complete work zone, place signs and all traffic control devices along with distances for each.



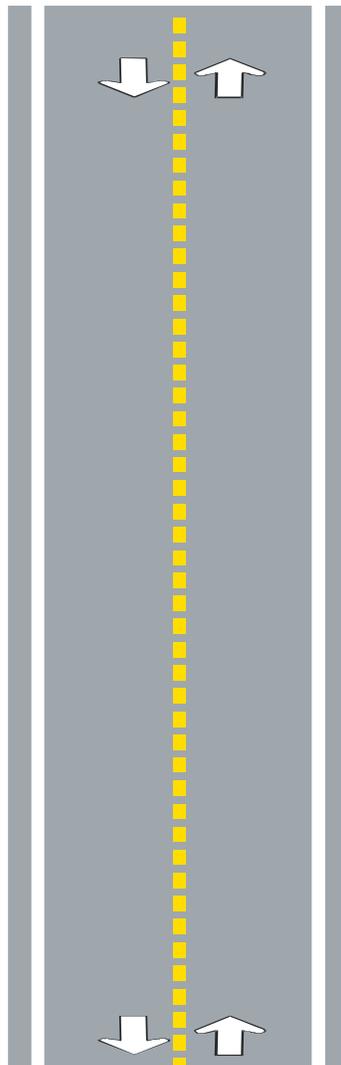
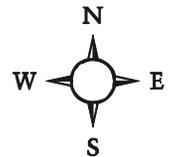
### Case Study #2 - Work Sheet

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	35	50
40-45	350	500	150	540	220	40	100
50-55	500	1000	185	660	335	50	100
60-70	1000	1000	235	840	550	60	100

1 Shoulder taper length based on 10 ft. (standard shoulder width) offset

2 Lane taper length based on 12 ft. (standard width) offset

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.





### Case Study #3

Your supervisor assigns you to be the work zone technician on a pavement failure job. You will be working on highway 44, which is a four-lane divided highway with a posted speed limit of 65 mph. Highway 44 runs through a business district and has a school that will be within ½ mile of your work zone. You will be working in the northbound lane that has a 12-foot lane width with a 10-foot shoulder. This job will take the majority of the day to complete, and you have been instructed not to reduce the speed. Your task is to draw this work zone on the following page and present it to your supervisor for his/her approval.

The following list is equipment that may be used, additional items may also be used, but you must obtain permission from your supervisor prior to use. Your class facilitator will be your supervisor for this case study.

Equipment that might be used:

- ◆ Signs/Posts
- ◆ Cones
- ◆ Flags
- ◆ Protective truck with flashing arrow panel
- ◆ Loader
- ◆ Dump truck
- ◆ Cutting saw
- ◆ Cement truck
- ◆ All traffic control devices

Draw the complete work zone, place signs and all traffic control devices along with distances for each.

Traffic Generators

The business district and the school will have high traffic volume at certain times of the day. Your work zone should not hinder the traffic flow if at all possible.

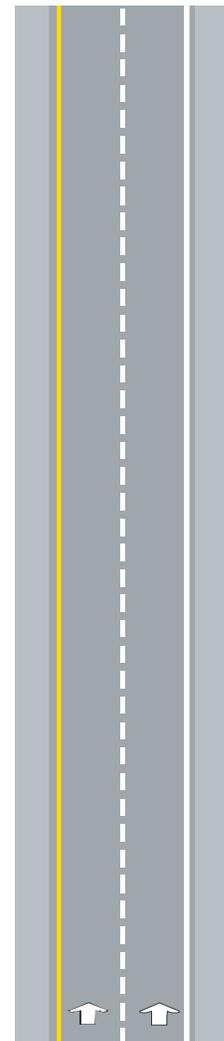
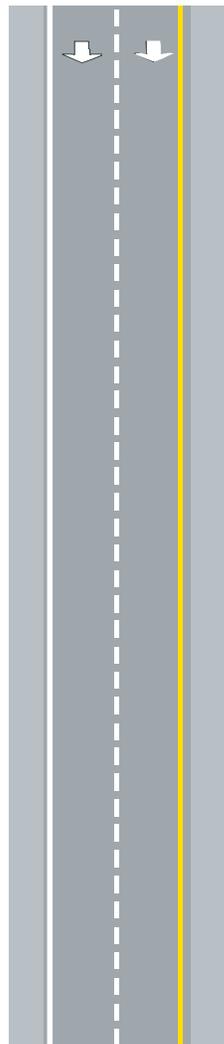
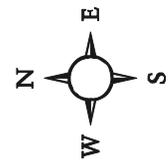


### Case Study #3 - Work Sheet

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	35	50
40-45	350	500	150	540	220	40	100
50-55	500	1000	185	660	335	50	100
60-70	1000	1000	235	840	550	60	100

1 Shoulder taper length based on 10 ft. (standard shoulder width) offset  
 2 Lane taper length based on 12 ft. (standard width) offset

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.





### Case Study #4

Your supervisor assigns you to be the work zone technician on a emergency/pavement failure job. You will be working on highway 63, which is a four-lane divided highway with a posted speed limit of 70 mph. You will be working near an exit ramp and have been instructed to keep the exit ramp open, and reduce the speed to 60 mph. You will be working in the northbound lane with 12-foot lane widths and 10-foot shoulders. In addition, a variable message board must be used. Your task is to draw the work zone on the next page and present it to your supervisor.

The following list is equipment that may be used, additional items may also be used, but you must obtain permission from your supervisor prior to use. Your class facilitator will be your supervisor for this case study.

Equipment that might be used:

- ◆ Signs/ posts
- ◆ Cones
- ◆ Flags
- ◆ Protective truck with flashing arrow panel
- ◆ Dump trucks
- ◆ Loader
- ◆ Broom
- ◆ All traffic control devices

Draw the complete work zone, signs, and all traffic control devices along with distances for each.



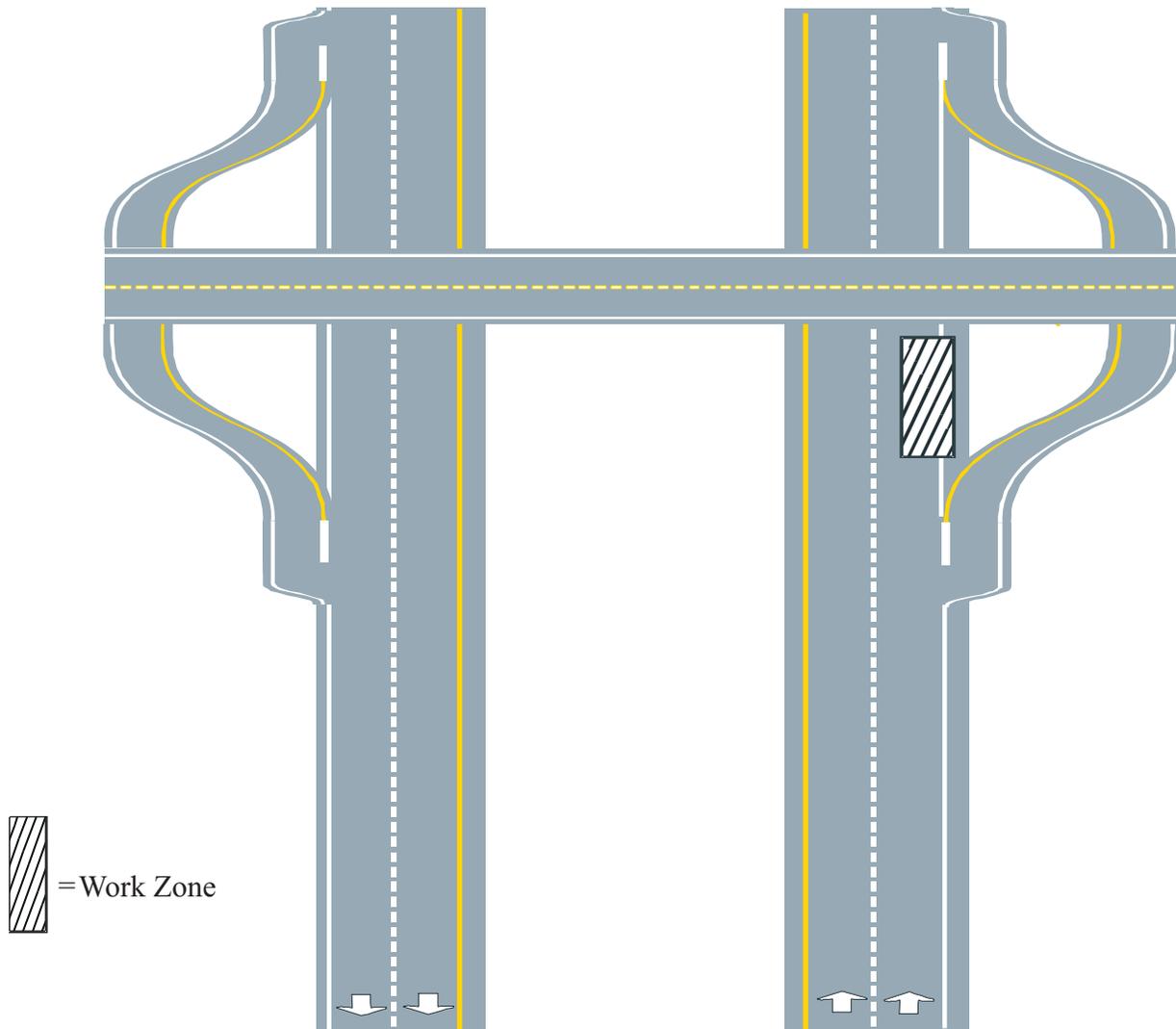
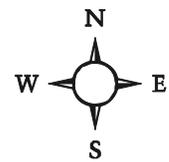
### Case Study #4 - Work Sheet

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Longitudinal Transition (ft) (X)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)			Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	120	35	50
40-45	350	500	150	540	220	270	40	100
50-55	500	1000	185	660	335	330	50	100
60-70	1000	1000	235	840	550	420	60	100

<sup>1</sup> Shoulder taper length based on 10 ft. (standard shoulder width) offset

<sup>2</sup> Lane taper length based on 12 ft. (standard width) offset

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.





### Case Study #5

Your supervisor assigns you to be the work zone technician on a scrub sealing operation. You will be working on highway 270, which is a six-lane divided highway, and the posted speed limit is 60 mph. You have 12-foot lanes with 10-foot shoulders. You will be sealing the right lane in the northbound direction. This job is expected to take 3 hours to complete 2 miles. Speed reduction is optional. Your task is to draw this work zone on the following page and present it to your supervisor for his/her approval.

The following list is equipment that may be used, additional items may also be used, but you must obtain permission from your supervisor prior to use. Your class facilitator will be your supervisor for this case study.

Equipment that might be used:

- ◆ Signs/Posts
- ◆ Cones
- ◆ Flags
- ◆ Portable changeable message board
- ◆ Flashing arrow board(s)
- ◆ Protective trucks with flashing arrow board
- ◆ All traffic control devices
- ◆ Dump truck
- ◆ Scrub sealing equipment

Draw the complete work zone, place signs and all traffic control devices along with distances for each.



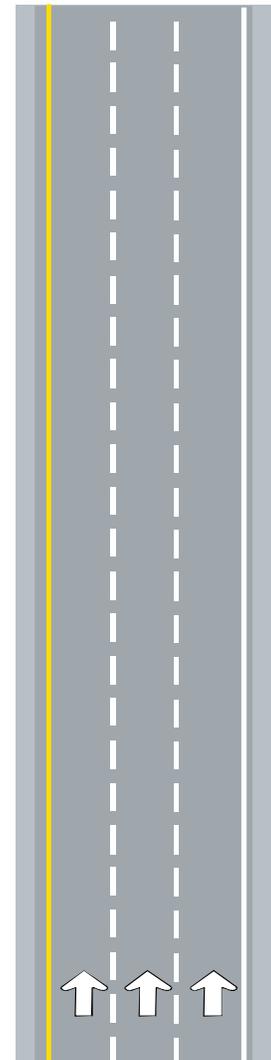
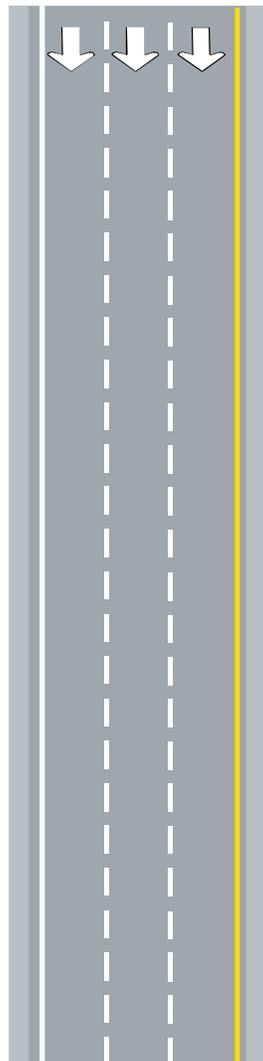
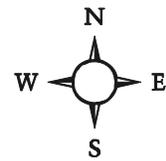
### Case Study #5 - Work Sheet

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	35	50
40-45	350	500	150	540	220	40	100
50-55	500	1000	185	660	335	50	100
60-70	1000	1000	235	840	550	60	100

1 Shoulder taper length based on 10 ft. (standard shoulder width) offset

2 Lane taper length based on 12 ft. (standard width) offset

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.





### Case Study #6

You have been assigned to be the work zone technician on a mowing operation. You are going to be mowing along Highway 50 in Cole County. This is a 4-lane divided highway with a posted speed limit of 55 mph. You will be in a rural area and be mowing from fence line to fence line, including the median. The mowers will not encroach the roadway. Your task is to draw this work zone on the following page and present it to your supervisor for his/her approval.

The following list is equipment that may be used, additional items may also be used, but you must obtain permission from your supervisor prior to use. Your class facilitator will be your supervisor for this case study.

Equipment that might be used:

- ◆ Signs
- ◆ Truck
- ◆ Mowers
- ◆ All traffic control devices

Draw the complete work zone, place signs and all traffic control devices along with distances for each.

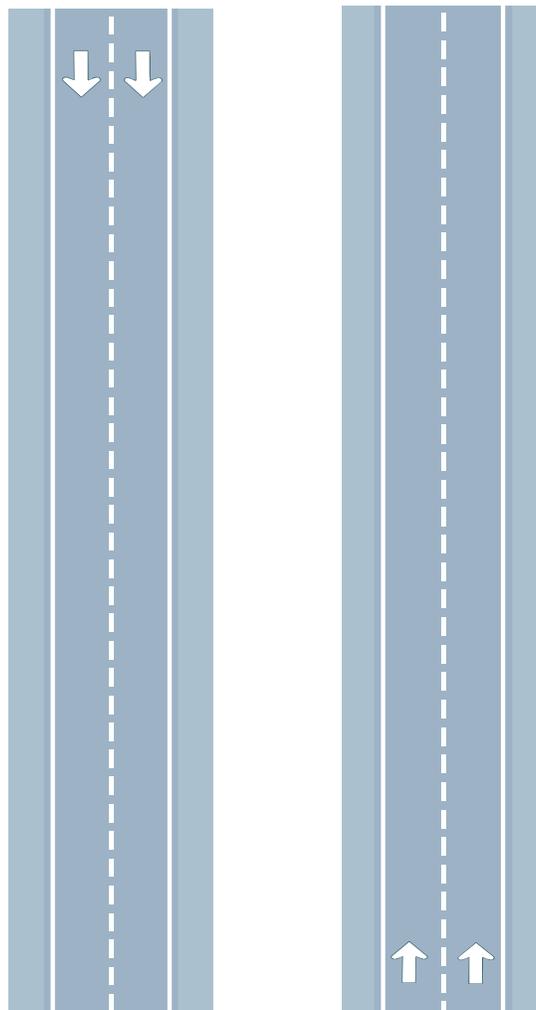
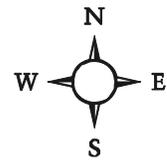


### Case Study #6 - Work Sheet

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	35	50
40-45	350	500	150	540	220	40	100
50-55	500	1000	185	660	335	50	100
60-70	1000	1000	235	840	550	60	100

1 Shoulder taper length based on 10 ft. (standard shoulder width) offset  
 2 Lane taper length based on 12 ft. (standard width) offset

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.





### Case Study #7

Your supervisor assigns you to be the lead worker on a pothole-patching job. You will be fixing potholes in a moving operation in the left lane only on a six-lane divided highway, 55 mph, in a moving operation covering two miles. You have a shoulder to work with and you will not be allowed to reduce the speed. Your task is to draw how you would set up this work zone using all traffic control devices and marking your spacing. List any special requirements that will be necessary to complete this job. Left lane will be closed covering a distance of 2 miles.

Equipment that might be used:

- ◆ Signs/Posts
- ◆ Cones
- ◆ Flags
- ◆ (2) Dump trucks
- ◆ (2) TMA trucks
- ◆ All traffic control devices

Draw the complete work zone, place signs and all traffic control devices along with distances for each.

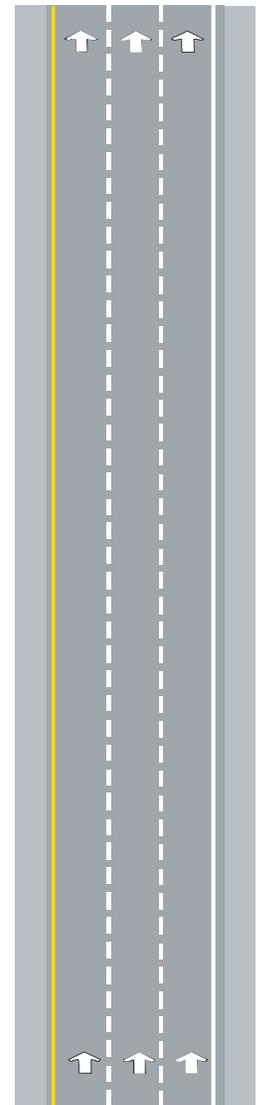
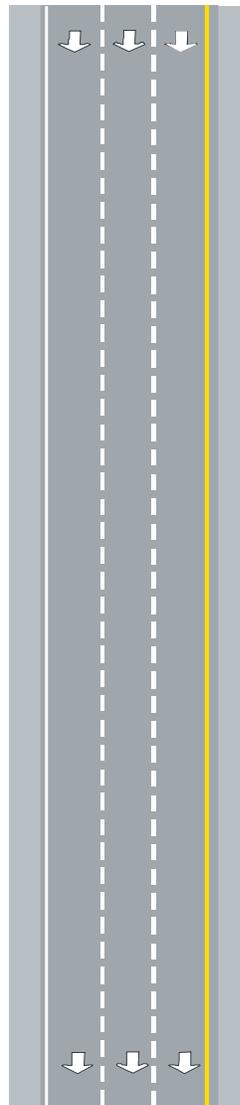
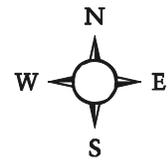


### Case Study #7 - Work Sheet

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	35	50
40-45	350	500	150	540	220	40	100
50-55	500	1000	185	660	335	50	100
60-70	1000	1000	235	840	550	60	100

1 Shoulder taper length based on 10 ft. (standard shoulder width) offset  
 2 Lane taper length based on 12 ft. (standard width) offset

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.





### Case Study #8

Your supervisor assigns you to be the work zone technician on a pavement repair operation on I-70 in St. Charles County. This job will be a short-term stationary operation. You will be working in the centerlane only on a 6-lane divided highway with a posted speed limit of 60 mph. Since traffic capacity is a concern, only the center lane may be closed. Your task is to draw this work zone on the following page and present it to your supervisor for his/her approval.

The following list is equipment that may be used, additional items may also be used, but you must obtain permission from your supervisor prior to use. Your class facilitator will be your supervisor for this case study.

Equipment that might be used:

- ◆ Signs/Posts
- ◆ Cones
- ◆ Flags
- ◆ Protective trucks
- ◆ Flashing arrow panel
- ◆ All traffic control devices

Draw the complete work zone, place signs and all traffic control devices along with distances for each.

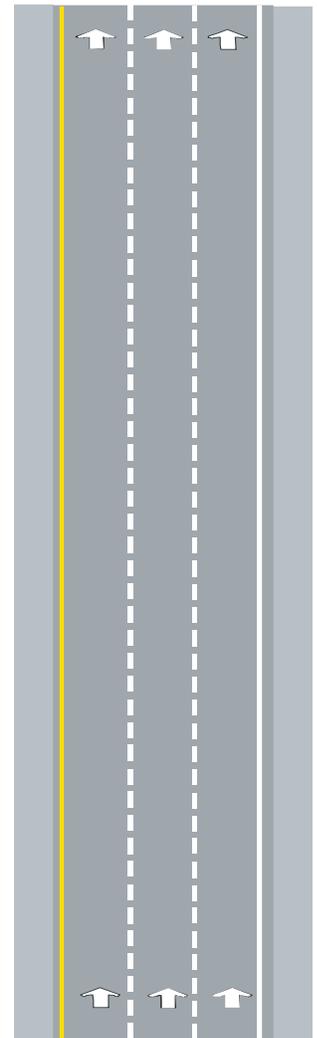
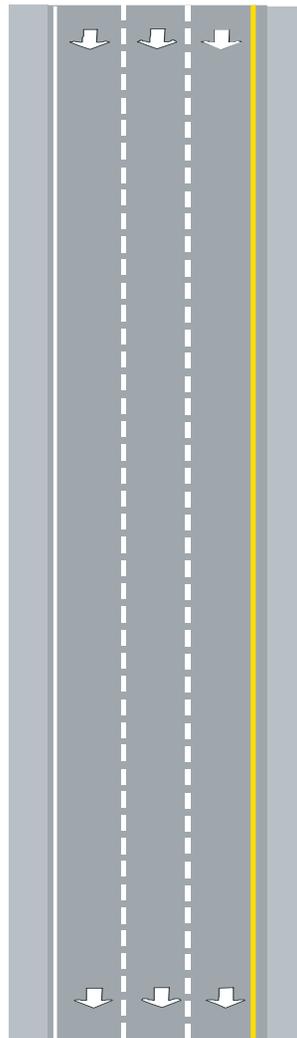


### Case Study #8 - Work Sheet

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	35	50
40-45	350	500	150	540	220	40	100
50-55	500	1000	185	660	335	50	100
60-70	1000	1000	235	840	550	60	100

1 Shoulder taper length based on 10 ft. (standard shoulder width) offset  
 2 Lane taper length based on 12 ft. (standard width) offset

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.





# Appendix



## Definitions

The following abbreviations, phrases and words, when used in this manual, have the following meanings:

**Activity Area** - Area of a temporary traffic control zone where work activity takes place. It is comprised of the work, traffic, and buffer spaces.

**Advance Warning Area** - Area of a temporary traffic control zone where traffic is informed of the upcoming temporary traffic control zone.

**Area Lighting** - Lighting used at night to guide traffic through the temporary traffic control zone.

**Average Daily Traffic (ADT)** - Volume of vehicular traffic using a section of highway on an average day.

**Barricade** - Temporary traffic control device consisting of one or three appropriately marked rails used to close, restrict, or delineate all or a portion of the right-of-way.

**Barrier-Mounted Sign** - Sign mounted on a temporary or permanent traffic barrier.

**Buffer Space** - Area within the activity area free of equipment, material, and personnel used to provide lateral and/or longitudinal separation of traffic from the work space or an unsafe condition.

**Channelizer** - Temporary traffic control device used to guide traffic or delineate an unsafe condition.

**Crash Cushion** - Temporary traffic control device used at fixed object and other desirable locations to reduce crash severity.

**Daytime/Daylight** - Period of time from one-half hour after sunrise to one-half hour before sunset.

**Detour** - Temporary rerouting of traffic onto an existing facility to avoid a temporary traffic control zone.

**Diversion** - Rerouting of traffic around an activity area using a temporary roadway or portions of an existing parallel roadway.

**Divided Highway** - Highway with physical separation of traffic in opposite directions.

**Downstream Taper** - Visual cue to traffic that access back into a closed lane is available.

**Emergency Operation** - Work involving the initial response to and repair/removal of Response Priority 1 items.

**Fine Sign** - Regulatory sign indicating the applicability of additional fines in a temporary traffic control zone.

**Flagger** - Person who provides temporary traffic control by assigning right of way.

**Flashing Arrow Panel** - Temporary traffic control device with a pattern of elements capable of flashing displays (i.e. left/right arrow, double arrow, caution mode) used to provide warning or guidance to traffic.

**Fleet Lighting** - Rotating or flashing lights used to increase the visibility of work-related vehicles and equipment in the temporary traffic control zone.

**Guide Sign** - Sign showing route designations, destinations, directions, distances, services, points of interest, or other geographical, recreational, or cultural information.



**High Speed** - Posted speed of 50 mph & above.

**Highway** - Any facility constructed for the purposes of moving traffic

**Incident Area** - Temporary traffic control zone where temporary traffic control devices are deployed in response to a traffic incident, natural disaster, special event, etc.

**Intermediate-Term Stationary Operation** - Daytime work occupying a location from more than one daylight period up to 3 days or nighttime work occupying a location more than 30 minutes.

**Interchange** - Grade separated junction of two or more highways.

**Intersection** - At-grade junction of two or more highways.

**Lane Taper** - Temporary traffic control measure used to merge or shift traffic either left or right out of a closed lane.

**Lateral Buffer Space** - Obstacle-free area adjacent to the work space or an unsafe condition that provides room for recovery of an errant vehicle.

**Lighting Device** - Temporary traffic control device illuminating a portion of the roadway or supplementing other traffic control devices.

**Long-Term Stationary Operation** - Work occupying a location more than 3 days.

**Longitudinal Buffer Space** - Obstacle-free area in advance of the work space or an unsafe condition that provides room for recovery of an errant vehicle.

**Low Speed** - Posted speed of 45 mph & below.

**Low Volume** - 500 or less ADT. (Rule of Thumb - count the number of vehicles passing a single reference point over a five-minute period. If not more than three vehicles pass the reference point in that period, then the road can be considered low volume for the purpose of installing work zone traffic control).

**May** - Permitted.

**Mobile Operation** - Work on the roadway that moves intermittently or continuously.

**Motorized Traffic** - Movement of vehicles and equipment on the roadway.

**Multi-Lane Highway** - Highway with two or more driving lanes in the same direction of travel.

**Nighttime** - Period of time from one-half hour before sunset to one-half hour after sunrise.

**Non-Motorized Traffic** - Movement of pedestrians, bicycles, horse-drawn vehicles, etc. on roadway or within the right-of-way.

**One-Lane, Two-Way Taper** - Temporary traffic control measure used to channelize traffic through an activity area occupying one lane of an undivided, two-lane roadway.

**Pavement Marking** - Lines, markers, words, and symbols affixed to the pavement surface to channelize and guide traffic.

**Pilot Car** - Vehicle used to guide a queue of vehicles through the temporary traffic control zone.

**Portable Changeable Message Signs (PCMS)** - Temporary traffic control device capable of displaying a variety of messages to traffic.

**Portable Sign** - Sign mounted on temporary supports (e.g. self-driving post, easels, fold-up stands, barricades, etc.).



**Post-Mounted Sign** - Sign mounted on a non-portable post (e.g. perforated square steel tube, u-channel, wood, etc.).

**Protective Vehicle** - Vehicle used to protect workers or work equipment from errant vehicles (e.g. pick up, dump truck, loader, etc.).

**Regulatory Sign** - Sign giving notice of traffic laws or regulations.

**Right-of-Way** - Land acquired for the construction and maintenance of a highway.

**Right of Way** - The permitting of certain traffic to proceed in a lawful manner in preference to other traffic.

**Roadway** - Portion of highway, including shoulders, intended for use by motorized traffic.

**Rural** - Area generally characterized by lower volumes, higher speeds, fewer turning conflicts and less conflict with pedestrians. Includes unincorporated areas designated by community boards.

**Safety Apparel** - Personal protective equipment worn by a worker to improve their visibility (e.g. vests, hats, etc.).

**Shall** - Mandatory.

**Short Duration Operation** - Daytime or Nighttime work occupying a location up to 30 minutes.

**Short-Term Stationary Operation** - Daytime work occupying a location more than 30 minutes, but less than 12 hours.

**Should** - Strongly recommended.

**Shoulder Taper** - Temporary traffic control measure used to close the shoulder.

**Sign** - Traffic control device conveying a static message to traffic through words or symbols.

**Speed Limit** - Maximum speed applicable to a section of highway as established by law.

**Stop Bar** - Solid white pavement marking extending across an approach lane to indicate the point at which traffic is to stop.

**Supplemental Warning Methods** - Temporary traffic control enhancements used to increase the effectiveness of select temporary traffic control devices or the awareness of the entire temporary traffic control zone.

**Taper** - Series of channelizing devices and/or pavement markings used to move traffic into the intended path.

**Temporary Traffic Barrier** - Temporary traffic control device used to create a physical separation between traffic and the work space, an unsafe condition, or non-motorized traffic.

**Temporary Traffic Control Device** - Item used to regulate, warn or guide traffic through a temporary traffic control zone.

**Temporary Traffic Control Plan** - Describes temporary traffic control measures to be used for moving traffic through a temporary traffic control zone.

**Temporary Traffic Control Signal** - Temporary traffic control device used to assign right of way through automatic means.

**Temporary Traffic Control Zone** - Section of highway where traffic conditions are changed due to a work zone or an incident area through the use of temporary traffic control devices, law enforcement or other authorized officials. It extends from the first warning sign or rotating/strobe lights on a



**Termination Area** - Area of a temporary traffic control zone returning traffic to their normal path.

**Traffic** - Highway user.

**Traffic Space** - Area within the activity area in which traffic is routed through the activity area.

**Transition Area** - Area of a temporary traffic control zone where traffic is redirected out of their normal path and into the traffic space.

**Traveled Way** - Portion of roadway intended for the movement of motorized traffic.

**Truck-Mounted Attenuator (TMA)** - Device designed to attach to the rear of protective vehicles to absorb the impact of an errant vehicle or inattentive driver.

**Undivided Highway** - Highway with no physical separation of traffic in opposite directions.

**Urban** - Area within the limits of incorporated towns and cities where the posted speed is 60 mph or less.

**Vehicle-Mounted Sign** - Sign mounted on a protective vehicle used in short duration and mobile operations or on a pilot car.

**Warning Light** - Flashing or steady-burn, amber light units attached to temporary traffic control devices to increase their target value.

**Warning Sign** - Sign giving notice of a situation or condition that might not be readily apparent.

**Work Duration** - Length of time an operation occupies a location.

**Work Lighting** - Lighting used at night to perform activities within the work space.

**Work Location** - Portion of right-of-way in which work is performed.

**Work Space** - Area within the activity area closed to traffic and set aside for workers, equipment, materials, and a protective vehicle, if one is used upstream. Work spaces are usually delineated by channelizing devices.

**Work Vehicle** - Any vehicle for which work is performed.

**Work Zone** - Temporary traffic control zone where temporary traffic control devices are deployed for construction, maintenance or utility-related work activities.

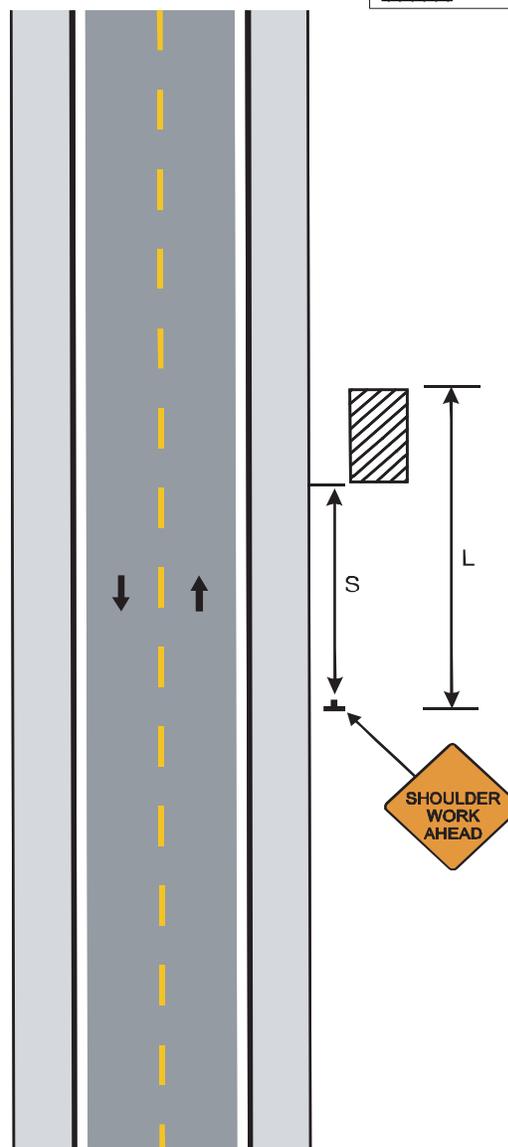
**Work Zone Length** - Distance from last sign in the advance warning area to the last temporary traffic control device in the same direction or the last sign in the advance warning area in the opposing direction, whichever is longest.

### Work Beyond the Shoulder on Divided and Undivided Highways

SPEED	SIGN SPACING (ft.)		TAPER LENGTH (ft.)		OPTIONAL BUFFER LENGTH (ft.) (B)	CHANNELIZER SPACING (ft.)	
	Undivided (S)	Divided (S)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/ Work Areas
0-35	200	200	-	-	-	-	-
40-45	350	500	-	-	-	-	-
50-55	500	1000	-	-	-	-	-
60-70	1000	1000	-	-	-	-	-

<sup>1</sup> Shoulder taper length based on 10 ft. (standard shoulder width) offset      <sup>2</sup> Lane taper length based on 12 ft. (standard lane width) offset

TYPE ROADWAY	SIGN HEIGHT	MAXIMUM WORK ZONE LENGTH (L)
URBAN	1' Portable 7' Post	1 Mi.
RURAL DIVIDED	1' Portable 7' Post	2 Mi.
RURAL UNDIVIDED	1' Portable 5' Post	3 Mi.



**Notes:**

If work vehicles or equipment are located on the shoulder, refer to appropriate shoulder work typical applications.

On multi-lane, divided highways, signs advising of shoulder work or the condition of the shoulder **should** be placed only on the side of the affected shoulder.

If work is being performed in the median, signs **may** be required for both directions of travel based on the following paragraph.

The SHOULDER WORK AHEAD sign **may** be omitted where the work space is 15 ft. or more from the edge of any shoulder, beyond the ditch line, or behind the curb. Should the roadway not have a shoulder, then 15 ft. or more from the edge of the roadway.

For short duration or mobile operations, signs **may** be reduced or eliminated if a work vehicle with activated rotating lights or strobe lights is used.

Other appropriate signs **may** be used in lieu of the SHOULDER WORK AHEAD sign.

Where sidewalks are impacted refer to TA-24 or TA-25 .

### Shoulder Work on Undivided Highways

SPEED	SIGN SPACING (ft.)		TAPER LENGTH (ft.)		OPTIONAL BUFFER LENGTH (ft.) (B)	CHANNELIZER SPACING (ft.)	
	Undivided (S)	Divided (S)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/ Work Areas
0-35	200	-	70	-	120	35	50
40-45	350	-	150	-	220	40	100
50-55	500	-	185	-	335	50	100
60-70	1000	-	235	-	550	60	100

<sup>1</sup> Shoulder taper length based on 10 ft. (standard shoulder width) offset      <sup>2</sup> Lane taper length based on 12 ft. (standard lane width) offset

TYPE ROADWAY	SIGN HEIGHT	MAXIMUM WORK ZONE LENGTH (L)
URBAN	1' Portable 7' Post	1 Mi.
RURAL UNDIVIDED	1' Portable 5' Post	3 Mi.

-  Channelizer
-  Cone or Drum
-  Sign
-  Truck or Trailer Mounted Arrow Panel
-  Protective Vehicle
-  Truck Mounted Attenuator (TMA)
-  Work Space

**Notes:**

In addition to shoulder work, this typical application is applicable to work beyond shoulder where vehicles and equipment are parked on the shoulder.

A protective vehicle **shall** be used while work is in progress. The protective vehicle **should** be equipped with a TMA and positioned at least 150 ft. in advance of the work space.

If encroachment onto driving surface occurs and there is not 10 ft. of driving surface available for the lane of traffic, that traffic lane **shall** be closed. Refer to appropriate lane closure typical applications.

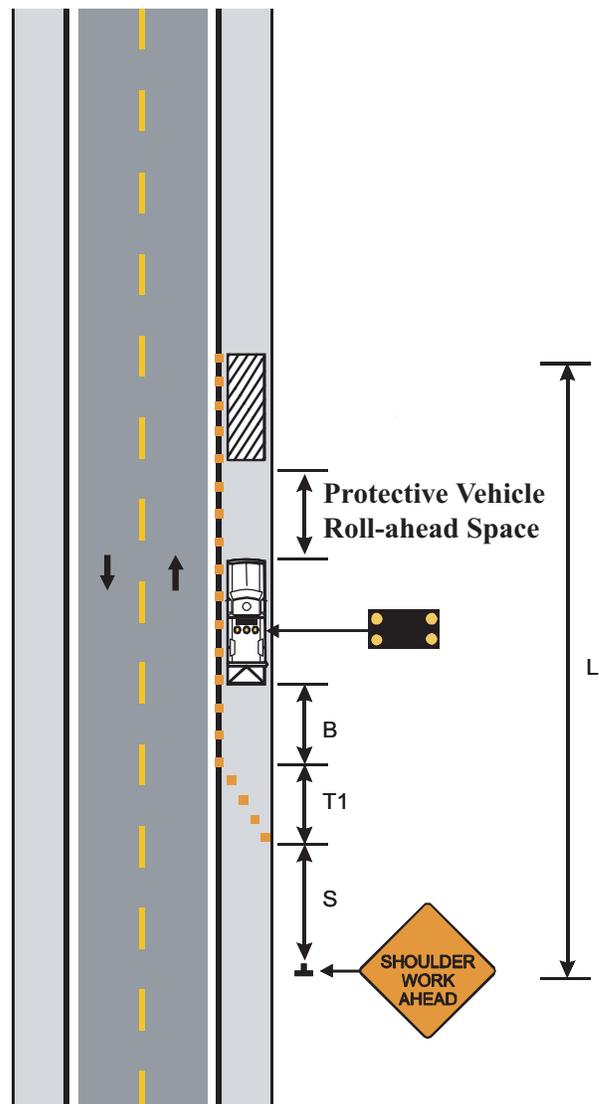
If an arrow panel is used for an operation on the shoulder, the caution mode **shall** be displayed.

For short duration or mobile operations, signs, channelization devices and protective vehicles **may** be reduced or eliminated if a work vehicle with activated rotating lights or strobe lights is used. However, if limited sight distance exists in a stationary operation or workers are on foot, a protective vehicle **should** be used. This protective vehicle **should** be equipped with a TMA and truck mounted flashing arrow panel and positioned at least 150 ft. in advance of the work space or work vehicle, as applicable. If a protective vehicle is used, a vehicle mounted sign **shall** be mounted at a recommended height of 48 in. above the road surface.

For work beyond shoulder, where vehicles and equipment are parked on the shoulder, the protective vehicle **may** be eliminated if a work vehicle with activated rotating lights or strobe lights is used.

Additional warning signs **shall** be erected at each intersection with another state highway within the work zone. Upon the discretion of the supervisor, additional warning signs **may** be erected at other intersections within the work zone.

Other appropriate signs **may** be used in lieu of SHOULDER WORK AHEAD sign.



### Shoulder Work on Divided Highways

SPEED	SIGN SPACING (ft.)		TAPER LENGTH (ft.)		OPTIONAL BUFFER LENGTH (ft.) (B)	CHANNELIZER SPACING (ft.)	
	Undivided (S)	Divided (S)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/ Work Areas
0-35	-	200	70	-	120	35	50
40-45	-	500	150	-	220	40	100
50-55	-	1000	185	-	335	50	100
60-70	-	1000	235	-	550	60	100

<sup>1</sup> Shoulder taper length based on 10 ft. (standard shoulder width) offset    <sup>2</sup> Lane taper length based on 12 ft. (standard lane width) offset

TYPE ROADWAY	SIGN HEIGHT	MAXIMUM WORK ZONE LENGTH (L)
URBAN	1' Portable 7' Post	1 Mi.
RURAL DIVIDED	1' Portable 7' Post	2 Mi.

-  Channelizer Cone or Drum
-  Sign
-  Truck or Trailer Mounted Arrow Panel
-  Protective Vehicle
-  Truck Mounted Attenuator (TMA)
-  Work Space

**Notes:**

In addition to shoulder work, this typical application is applicable to work beyond shoulder where vehicles and equipment are parked on the shoulder.

A protective vehicle **shall** be used while work is in progress. The protective vehicle **should** be equipped with TMA and positioned at least 150 ft. in advance of the work space.

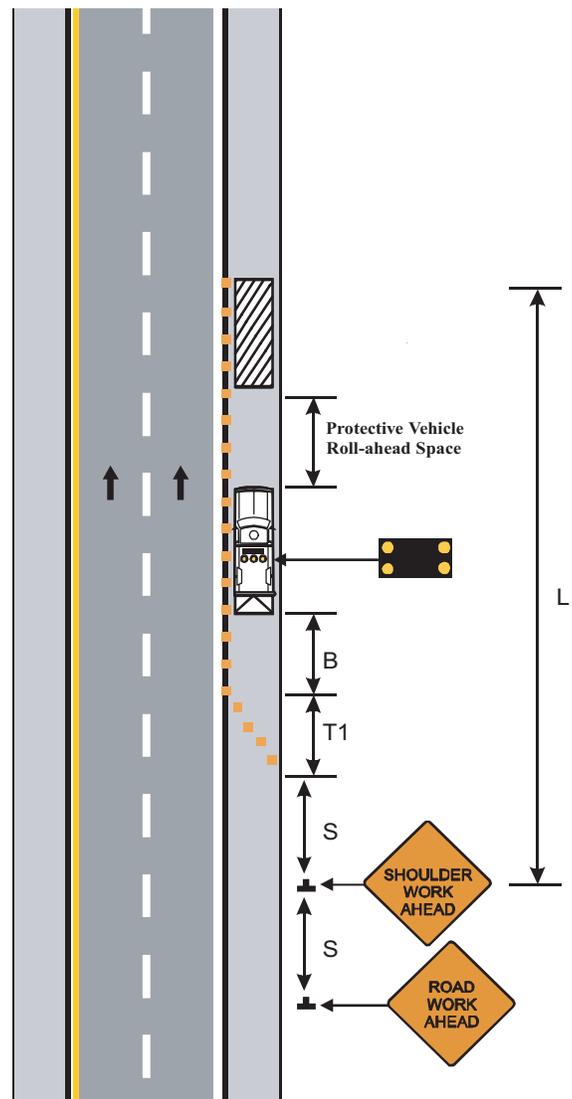
If encroachment onto driving surface occurs and there is not 10 ft. of driving surface available for the lane of traffic, that traffic lane **shall** be closed. Refer to appropriate lane closure typical applications.

If an arrow panel is used for an operation on the shoulder, the caution mode **shall** be displayed.

For short duration or mobile operations, signs, channelization devices and protective vehicles **may** be reduced or eliminated if a work vehicle with activated rotating lights or strobe lights is used. However, if limited sight distance exists in a stationary operation or workers are on foot, a protective vehicle **should** be used. This protective vehicle **should** be equipped with a TMA and truck mounted flashing arrow panel and positioned at least 150 ft. in advance of the work space or work vehicle, as applicable. If a protective vehicle is used, a vehicle mounted sign **shall** be mounted at a recommended height of 48 in. above the road surface.

For work beyond shoulder, where vehicles and equipment are parked on the shoulder, the protective vehicle **may** be eliminated if a work vehicle with activated rotating lights or strobe lights is used.

Additional warning signs **shall** be erected at each intersection with another state highway within the work zone. Upon the discretion of the supervisor, additional warning signs **may** be erected at other intersections within the work zone.



Other appropriate signs **may** be used in lieu of SHOULDER WORK AHEAD sign.

TA-3



### Mobile Operation on Two-Lane Highways



**Notes:**

A protective vehicle **shall** be used when work is in progress. The protective vehicle **shall** be equipped with a vehicle mounted sign and **should** be equipped with a TMA and flashing arrow panel.

For vehicle mounted signs, a mounting height of 48 in. from the bottom of the sign to the road surface is recommended.

If the flashing arrow panel is used, the caution mode **shall** be displayed.

Where practical and when needed, the work and protective vehicles **should** pull over periodically to allow traffic to pass.

Whenever adequate stopping distance exists to the rear, the protective vehicle **should** be positioned at least 150 ft. in advance of the work vehicle and proceed at the same speed. The protective vehicle **should** slow down in advance of vertical or horizontal curves that restrict sight distance.

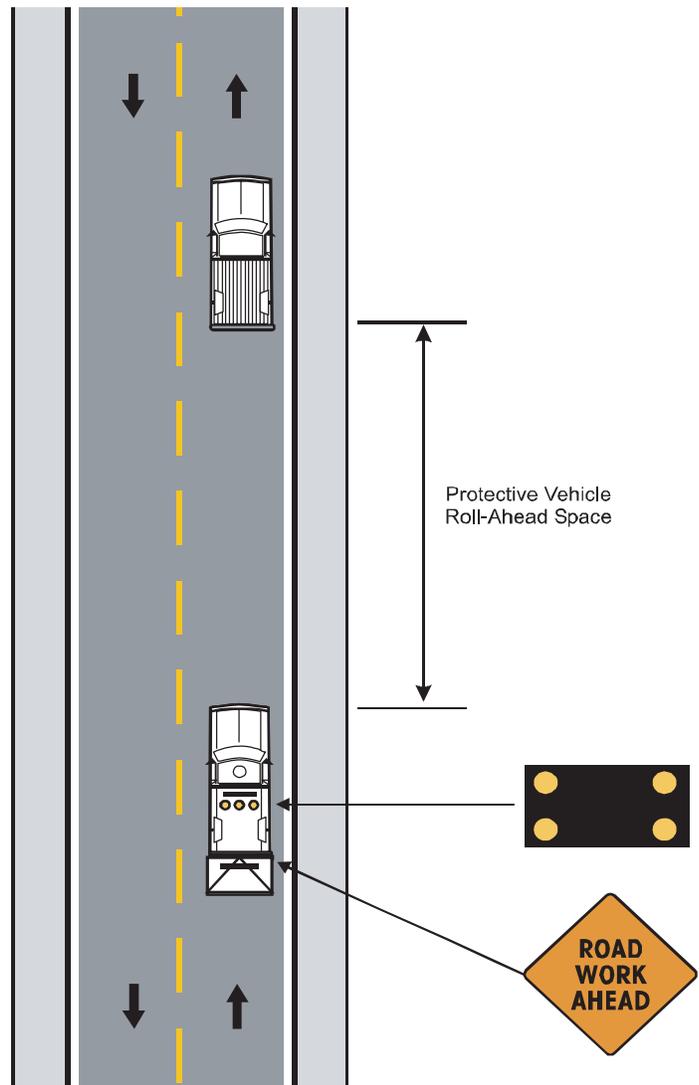
For mobile operations on roadways posted at 45 mph or below, the protective vehicle is optional provided the work vehicle uses activated rotating lights or strobe lights.

For mobile operations moving at a continuous speed within 15 mph of the posted speed and emergency snow removal operations, the protective vehicle is optional provided the work vehicle uses activated rotating lights or strobe lights.

For mobile operations where workers are on foot and move with the operation, the affected lane **shall** be closed. Refer to appropriate lane closure typical applications.

Other appropriate signs **may** be used in lieu of ROAD WORK AHEAD sign.

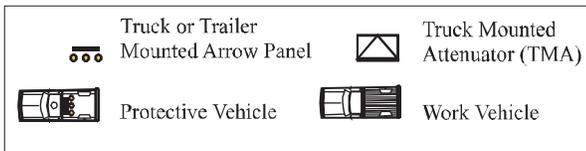
For pavement marking operations refer to **TA-4a**.



**Mobile Operation on Divided or Multi-Lane Highways**

SPEED	SIGN SPACING (ft.)		TAPER LENGTH (ft.)		OPTIONAL BUFFER LENGTH (ft.) (B)	CHANNELIZER SPACING (ft.)	
	Undivided (S)	Divided (S)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/ Work Areas
0-35	-	-	-	245	-	-	-
40-45	-	-	-	540	-	-	-
50-55	-	-	-	660	-	-	-
60-70	-	-	-	840	-	-	-

<sup>1</sup> Shoulder taper length based on 10 ft. (standard shoulder width) offset      <sup>2</sup> Lane taper length based on 12 ft. (standard lane width) offset



**Notes:**

A protective vehicle occupying any portion of a lane **shall** be equipped with a flashing arrow panel and a TMA.

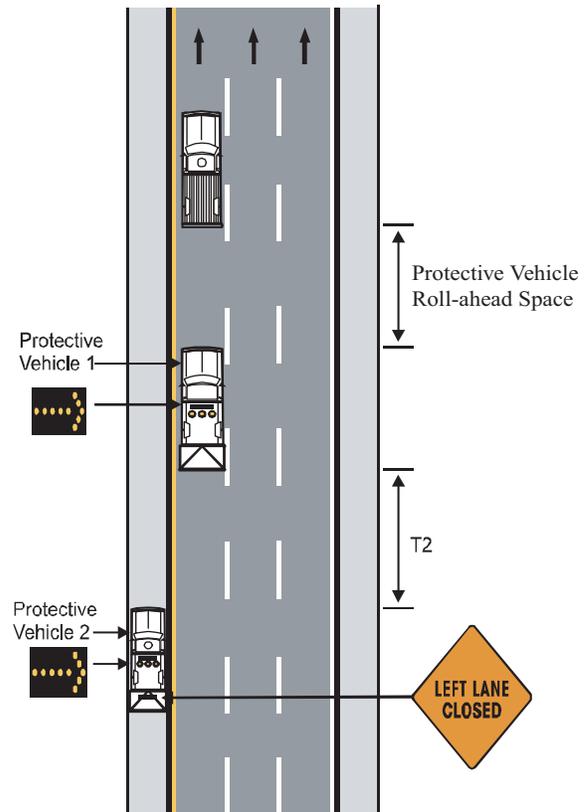
A protective vehicle on the shoulder **shall** be equipped with a flashing arrow panel. This protective vehicle **should** be equipped with a TMA.

Where adequate shoulder width is not available, Protective Vehicle 2, equipped with a TMA, **may** drive partially or fully in the lane.

Protective Vehicle 2 **shall** be equipped with an appropriate lane closure sign. A mounting height of 48 in. from the bottom of the sign to the road surface is recommended.

Protective Vehicle 1 **should** be positioned at least 150 ft. in advance of the work vehicle. This spacing may be minimized to deter traffic from driving in between the vehicles.

A third protective vehicle (not shown) **may** be used with Protective Vehicle 1 in the closed lane, Protective Vehicle 2 straddling the edge line, and Protective Vehicle 3 on the shoulder.



For interior lane closure, Protective Vehicles 1 and 2 **shall** travel in the same lane as the work vehicle. These vehicles **shall** be separated by at least 150 ft. A double headed arrow **shall** be displayed on the flashing arrow panels. On high speed roadways, a third protective vehicle **should** drive the right shoulder. This vehicle **shall** be equipped with a flashing arrow panel and an appropriate advance lane closure sign and be positioned a distance of T2 from Protective Vehicle 2. The caution mode **shall** be displayed on the flashing arrow panel. A mounting height of 48 in. from the bottom of the sign to the road surface is recommended.

For mobile operations on roadways posted at 45 mph or below, the protective vehicles and TMAs are optional provided the work vehicle uses activated rotating lights or strobe lights.

For mobile operations moving at a continuous speed within 15 mph of the posted speed and emergency snow removal operations, the protective vehicles are optional provided the work vehicle uses activated rotating lights or strobe lights.

For mobile operations where workers are on foot and move with the operation, the affected lane **shall** be closed. Refer to appropriate lane closure typical applications.

Additional advanced warning signs **should** be used when there is not adequate shoulder.

Supplemental warning methods **may** be used to call attention to the work zone.

For pavement marking operations refer to TA-5a through TA-5d.

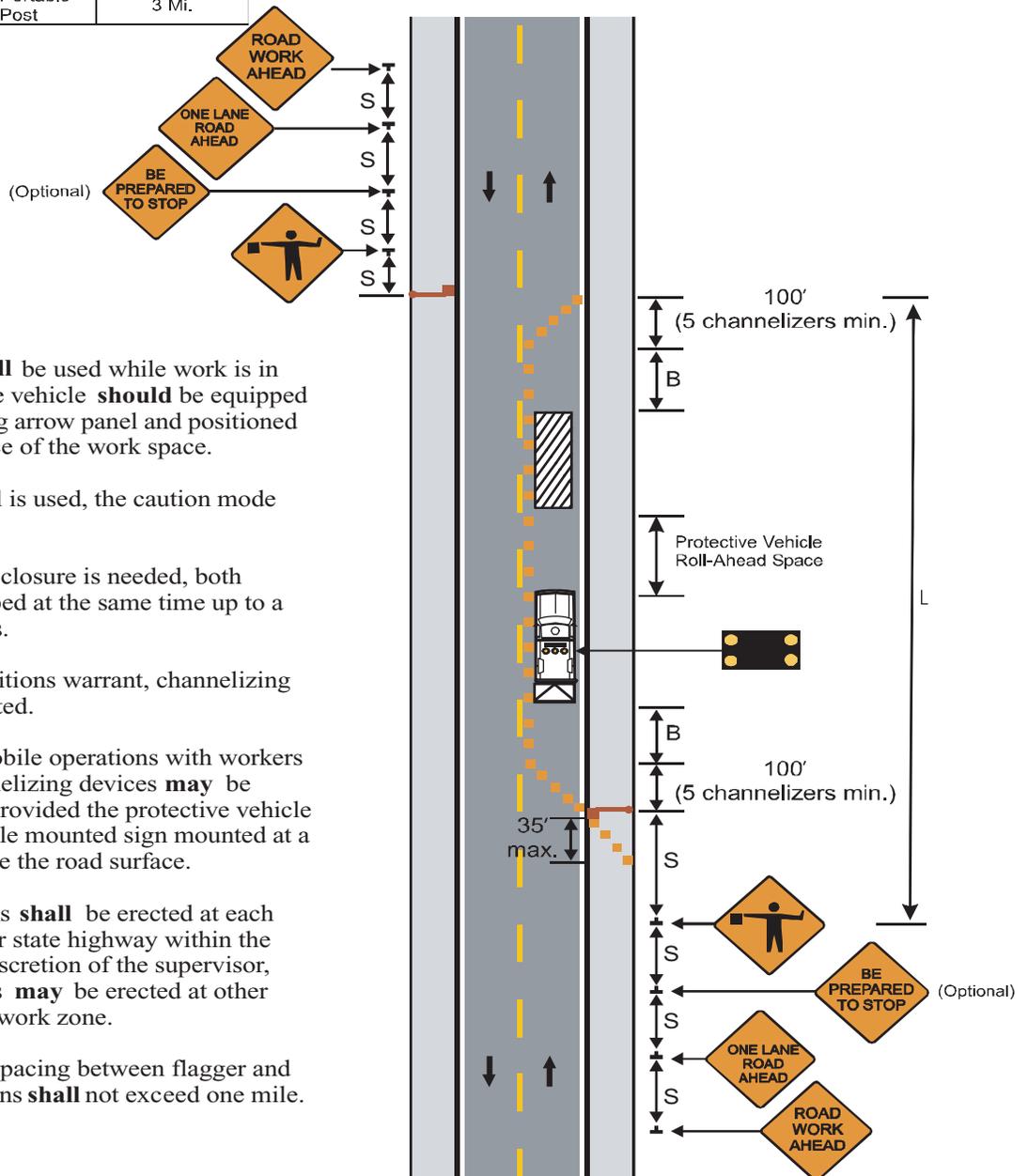
**Lane Closure on Two-Lane Highways Using Flaggers**

SPEED	SIGN SPACING (ft.)		TAPER LENGTH (ft.)		OPTIONAL BUFFER LENGTH (ft.) (B)	CHANNELIZER SPACING (ft.)	
	Undivided (S)	Divided (S)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/ Work Areas
0-35	200	-	-	-	120	-	50
40-45	350	-	-	-	220	-	100
50-55	500	-	-	-	335	-	100
60-70	1000	-	-	-	550	-	100

<sup>1</sup> Shoulder taper length based on 10 ft. (standard shoulder width) offset    <sup>2</sup> Lane taper length based on 12 ft. (standard lane width) offset

TYPE ROADWAY	SIGN HEIGHT	MAXIMUM WORK ZONE LENGTH (L)
URBAN	1' Portable 7' Post	1 Mi.
RURAL UNDIVIDED	1' Portable 5' Post	3 Mi.

- Channelizer Cone or Drum
- Truck or Trailer Mounted Arrow Panel
- Work Space
- Flagger
- Truck Mounted Attenuator (TMA)
- Protective Vehicle
- Sign



**Notes:**

A protective vehicle **shall** be used while work is in progress. The protective vehicle **should** be equipped with a TMA and flashing arrow panel and positioned at least 150 ft. in advance of the work space.

If a flashing arrow panel is used, the caution mode **shall** be displayed.

When a temporary road closure is needed, both directions **may** be stopped at the same time up to a maximum of 20 minutes.

Where operational conditions warrant, channelizing devices **may** be eliminated.

For short duration or mobile operations with workers on foot, signs and channelizing devices **may** be reduced or eliminated, provided the protective vehicle is equipped with a vehicle mounted sign mounted at a minimum of 48 in. above the road surface.

Additional warning signs **shall** be erected at each intersection with another state highway within the work zone. Upon the discretion of the supervisor, additional warning signs **may** be erected at other intersections within the work zone.

For mobile operations, spacing between flagger and FLAGGER AHEAD signs **shall** not exceed one mile.

**Operations in Two-Way Left Turn Lane on Multi-Lane Undivided Highways**

SPEED	SIGN SPACING (ft.)		TAPER LENGTH (ft.)		OPTIONAL BUFFER LENGTH (ft.) (B)	CHANNELIZER SPACING (ft.)	
	Undivided (S)	Divided (S)	Shoulder (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/ Work Areas
0-35	200	-	-	-	120	-	50
40-45	350	-	-	-	220	-	100
50-55	500	-	-	-	335	-	100
60-70	1000	-	-	-	550	-	100

<sup>1</sup> Shoulder taper length based on 10 ft. (standard shoulder width) offset    <sup>2</sup> Lane taper length based on 12 ft. (standard lane width) offset

TYPE ROADWAY	SIGN HEIGHT	MAXIMUM WORK ZONE LENGTH (L)
URBAN	1' Portable 7' Post	1 Mi.
RURAL UNDIVIDED	1' Portable 5' Post	3 Mi.

- Channelizer  
Cone or Drum
- Sign
- Truck or Trailer  
Mounted Arrow Panel
- Truck Mounted Attenuator (TMA)
- Protective Vehicle
- Work Space

**NOTES:**

A protective vehicle **shall** be used in each direction while work is in progress. Each protective vehicle **should** be equipped with a TMA and flashing arrow panel and positioned at least 150 ft. in advance of the work space.

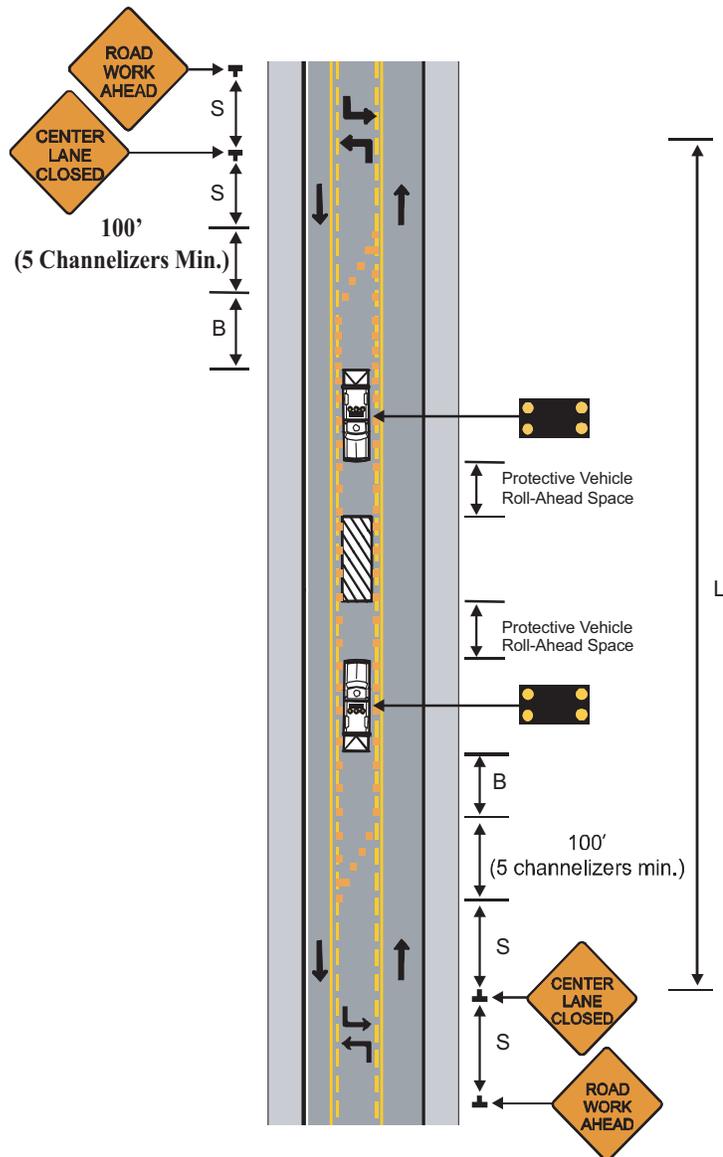
If a flashing arrow panel is used, the caution mode **shall** be displayed.

Channelizer spacing **may** be reduced to discourage turning traffic from entering into activity area.

For short duration and mobile operations, signs and channelizers **may** be reduced or eliminated. One protective vehicle **may** be eliminated if the roadway is posted at 45 mph or below, the work space is located between the remaining protective vehicles use activated rotating lights or strobe lights.

For mobile operations where workers are on foot and move with the operation, channelizers **may** be reduced or eliminated. One protective vehicle **may** be eliminated if the roadway is posted at 45 mph or below, the work space is located between the remaining protective vehicle and a work vehicle, and both vehicles use activated lights or strobe lights.

Additional warning signs **shall** be erected at each intersection with another state highway within the work zone. Upon the discretion of the supervisor, additional warning signs **may** be erected at other intersections within the work zone



TA-10

**Lane Closure on Left or Right Lane on Divided Highway**

SPEED	SIGN SPACING (ft.)		TAPER LENGTH (ft.)		OPTIONAL BUFFER LENGTH (ft.) (B)	CHANNELIZER SPACING (ft.)	
	Undivided (S)	Divided (S)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)		Tapers	Buffer/ Work Areas
0-35	-	200	70	245	120	35	50
40-45	-	500	150	540	220	40	100
50-55	-	1000	185	660	335	50	100
60-70	-	1000	235	840	550	60	100

<sup>1</sup> Shoulder taper length based on 10 ft. (standard shoulder width) offset    <sup>2</sup> Lane taper length based on 12 ft. (standard lane width) offset

TYPE ROADWAY	SIGN HEIGHT	MAXIMUM WORK ZONE LENGTH (L)
URBAN	1' Portable 7' Post	1 Mi.
RURAL DIVIDED	1' Portable 7' Post	2 Mi.

-  Channelizer Cone or Drum
-  Truck Mounted Attenuator (TMA)
-  Truck or Trailer Mounted Arrow Panel
-  Protective Vehicle
-  Sign
-  Work Space

**Notes:**

A protective vehicle **shall** be used while work is in progress. The protective vehicle **shall** be equipped with a TMA and flashing arrow panel and positioned at least 150 ft. in advance of the work space.

All vehicles, equipment, workers and their activities **should** be restricted to one side of the pavement.

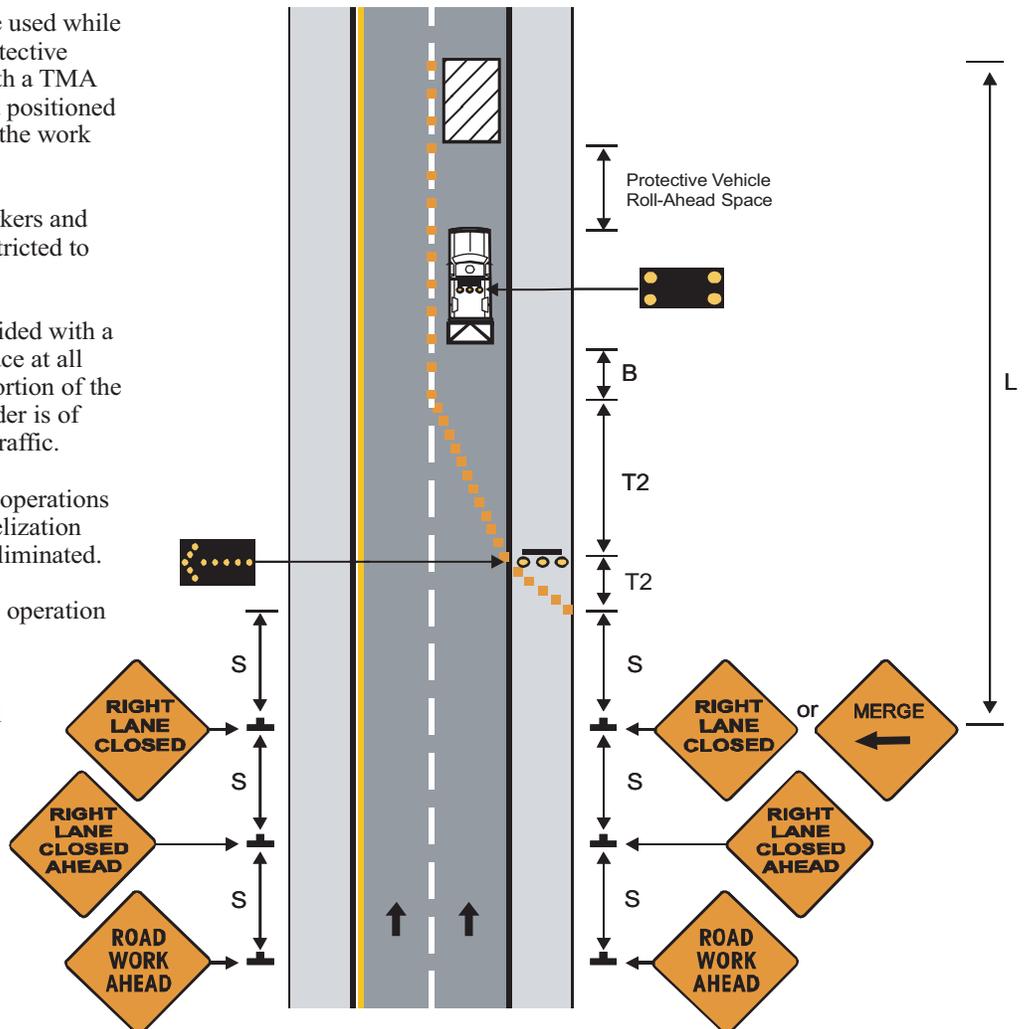
The open lane **shall** be provided with a 10 ft. minimum driving surface at all times. This may include a portion of the shoulder, provided the shoulder is of adequate strength to handle traffic.

For short duration or mobile operations with workers on foot, channelization devices **may** be reduced or eliminated.

For fully mechanized mobile operation refer to TA-5 .

Supplemental warning methods **may** be used to call attention to the work zone.

Additional warning signs **shall** be erected at each intersection with another state highway within the work zone. Upon the discretion of the supervisor, additional warning signs **may** be erected at other intersections within the work zone.



TA-12

### Lane Closure of Left Lane on Far Side of Intersection

SPEED	SIGN SPACING (ft.)		TAPER LENGTH (ft.)		OPTIONAL BUFFER LENGTH (ft.) (B)	LONGITUDINAL TRANSITION (ft) (X)	CHANNELIZER SPACING (ft.)	
	Undivided (S)	Divided (S)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)			Tapers	Buffer/ Work Areas
0-35	200	200	-	245	120	120	15	25
40-45	350	500	-	540	220	270	20	50
50-55	500	1000	-	660	335	330	50	100
60-70	1000	1000	-	840	550	420	60	100

1 Shoulder taper length based on 10 ft. (standard shoulder width) offset 2 Lane taper length based on 12 ft. (standard lane width) offset

TYPE ROADWAY	SIGN HEIGHT	MAXIMUM WORK ZONE LENGTH (L)
URBAN	1' Portable 7' Post	1 Mi.
RURAL DIVIDED	1' Portable 7' Post	2 Mi.
RURAL UNDIVIDED	1' Portable 5' Post	3 Mi.

- Channelizer
- Cone or Drum
- Sign
- Truck or Trailer Mounted Arrow Panel
- Truck Mounted Attenuator (TMA)
- Protective Vehicle
- Work Space

**Notes:**

This typical application is applicable to intersections with right of way control on all approaches.

A protective vehicle **shall** be used while working is in progress when space allows. The protective vehicle **should** be equipped with a TMA and positioned at least 150 ft. in advance of the work space. The protective vehicle **may** be eliminated if the roadway is posted at 45 mph or below, the work vehicle is positioned in advance of the workspace, and the work vehicle uses activated rotating lights or strobe lights.

At locations where left turn movements are minimal or where the inclusion of the turning traffic with the traffic using the adjacent open lane will not affect capacity of the approach, it is acceptable to close any lane not carried through the intersection prior to the intersection. Thereby, eliminating the turn bay shown. If left-turn movements are significant, however, the left lane **may** be left open prior to the intersection but restricted to left-turn movements only. In this case, all channelization devices prior to the intersection are eliminated except those that might be used to form a temporary island emphasizing the mandatory turning movement.

If the workplace extends across the sidewalk, the crosswalk **should** be closed using the information and devices shown in TA-25.

Buffer and taper lengths noted in table may be modified to fit conditions.

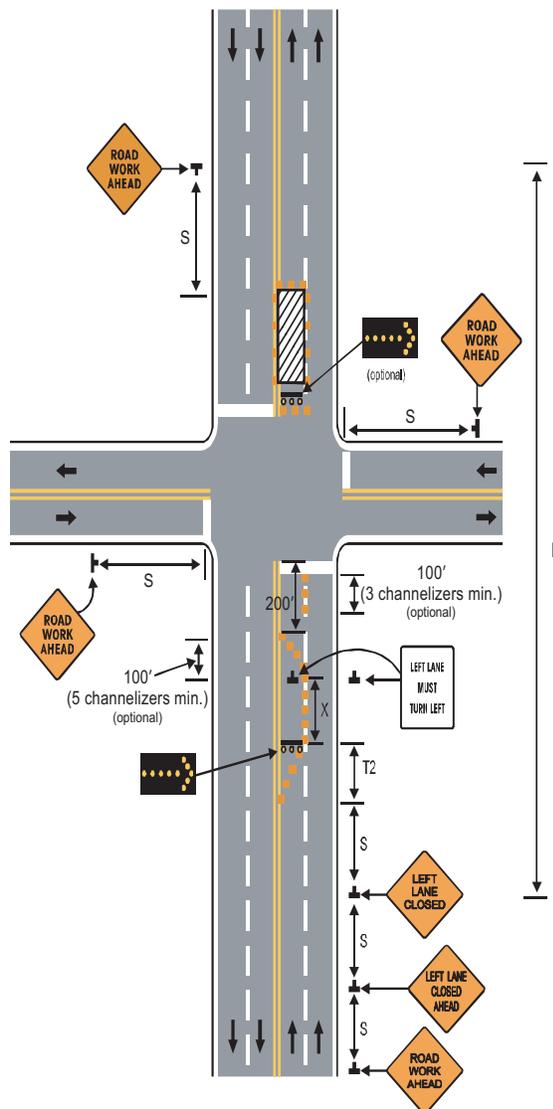
For short duration operations, signs and channelizers **may** be reduced or eliminated.

For mobile operations where workers are on foot and move with the operation, channelizers **may** be reduced or eliminated.

Where possible, signs **should** be provided on both sides of the affected approach when the approach is two or more lanes wide.

For high-speed facilities, channelizer spacing **may** be reduced to 1/2 spacing noted in table.

Other appropriate signs **may** be used in lieu of the ROAD WORK AHEAD sign.



TA-21



## Sign's Spacing Chart

Speed Limit (mph)	Spacing <sup>1</sup> (ft.)	
	Undivided Highway	Divided Highway
0-35	200	200
40-45	350	500
50-55	500	1000
60-70	1000	1000

<sup>1</sup> Sign spacing may be adjusted, normally by increasing it, to accommodate field conditions and visibility.

## Taper Spacing Chart

Speed Limit (mph)	Taper Length <sup>1</sup> (ft.)		Channelizer Spacing <sup>4</sup> (ft.)
	Shoulder <sup>2</sup>	Lane <sup>3</sup>	
0-35	70	245	35 <sup>5</sup>
40-45	150	540	40 <sup>5</sup>
50-55	185	660	50 <sup>6</sup>
60-70	235	840	60 <sup>6</sup>

<sup>1</sup> Taper lengths may be adjusted to accommodate crossroads, curves, intersections, ramps, or other geometric features.  
<sup>2</sup> Based on 10 ft. shoulder width.  
<sup>3</sup> Based on 12 ft. lane width  
<sup>4</sup> Channelizer spacing may be reduced to discourage traffic encroachment.  
<sup>5</sup> Spacing reduced to 1/2 at intersections.  
<sup>6</sup> Spacing may be reduced to 1/2 at intersections.

## Buffer Chart

Speed Limit (mph)	Buffer Length (ft.)	Channelizer Spacing <sup>1</sup> (ft.)
0-35	120	50 <sup>2</sup>
40-45	220	100 <sup>2</sup>
50-55	335	100 <sup>3</sup>
60-70	550	100 <sup>3</sup>

<sup>1</sup> Channelizer spacing may be reduced to discourage traffic encroachment.

<sup>2</sup> Spacing reduced to 1/2 at intersections.

<sup>3</sup> Spacing may be reduced to 1/2 at intersections.



Channelizer Spacing Chart

Speed Limit (mph)	Channelizer Spacing <sup>1</sup> (ft.)	
	Taper	Buffer/Work Areas
0-35	35 <sup>2</sup>	50 <sup>2</sup>
40-45	40 <sup>2</sup>	100 <sup>2</sup>
50-55	50 <sup>3</sup>	100 <sup>3</sup>
60-70	60 <sup>3</sup>	100 <sup>3</sup>

<sup>1</sup> Channelizer spacing may be reduced to discourage traffic encroachment.  
<sup>2</sup> Spacing reduced to 1/2 at intersections.  
<sup>3</sup> Spacing may be reduced to 1/2 at intersections.

TMA Usage Chart

Highway Type	Operation Location and Duration		
	In Lane		On Shoulders and Ramps and at Intersections
	Mobile	Stationary	
Two-Lane Undivided	Recommended	Recommended	Recommended
Multi-Lane Undivided	Required	Recommended	Recommended
Multi-Lane Divided	Required	Required	Recommended



Sign Height Chart

Type Roadway	Sign Height	Maximum Work Zone Length (L)
Urban	1' Portable 7' Post	1 Mi.
Rural Divided	1' Portable 7' Post	2 Mi.
Rural Undivided	1' Portable 5' Post	3 Mi.

This chart contains all chart info on previous page

Speed	Sign Spacing (ft.)		Taper Length (ft.)		Optional Buffer Length (ft.) (B)	Longitudinal Transition (ft) (X)	Channelizer Spacing (ft.)	
	Undivided (s)	Divided (s)	Shoulder <sup>1</sup> (T1)	Lane <sup>2</sup> (T2)			Tapers	Buffer/Work Areas
0-35	200	200	70	245	120	120	35	50
40-45	350	500	150	540	220	270	40	100
50-55	500	1000	185	660	335	330	50	100
60-70	1000	1000	235	840	550	420	60	100

<sup>1</sup> Shoulder taper length based on 10 ft. (standard shoulder width) offset

<sup>2</sup> Lane taper length based on 12 ft. (standard width) offset

