MoDOT
Work Zone Technician

April 2011

Contents

CHAPTER 1

Work Zone Course Objectives

- Discuss work zone safety and mobility policy
- Identify the different components that make up a temporary traffic control zone
- Describe each step involved in temporary traffic control zone operations
- Apply temporary traffic control devices in accordance to the EPG and MUTCD
- Recognize temporary traffic control device quality requirements
- Apply traffic control plans to site conditions, through inspecting, monitoring traffic controls, and changing traffic control devices indicated by traffic incidents

Work Zone Safety and Mobility Policy

MoDOT is committed to providing safe and efficient movement of both motorized and non-motorized traffic through or around temporary traffic control zones and protecting workers and equipment located within those areas. As such, MoDOT focuses on the visibility of temporary traffic control devices and traffic flow through work zones located on the state highway system. Our staff's and partners' attention to improved work zone visibility and mobility, from the preliminary planning stages through the end of all work, results in safer work zones with minimal impact on the traveler - a benefit to all.

Goals

Compliance with the guidelines enables MoDOT and its partners to meet the following work zone goals:

1. Provide an environment conducive to roadway user and worker safety.
   - Work toward zero work zone fatalities
   - Reduce crashes in all types of work zones
2. Minimize impact of work zones on roadway user.
   - Limit traffic delays to 15 minutes or less
   - Provide customers real-time work zone information

Guidelines

The two purposes for establishing a temporary traffic control zone while working within the highway right of way are:

1. to provide for the safe and efficient movement of both motorized and non-motorized traffic through or around the workspace, and
2. to provide protection for workers and equipment located within the workspace.

Work in or adjacent to the highway does violate traffic expectations and is performed in vulnerable conditions. However, a properly designed and executed temporary traffic control plan will enable the temporary traffic control zone to provide the above noted functions in the most effective manner possible.

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 should enhance the safety performance of the 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 MoDOT Work Zone Guidelines
- Provide adequate warning, delineation and channelization in advance of and through the affected area
- 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 effective, in good working order and reasonably consistent with the traffic control plan
- 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 as to reduce the probability of being hit
- Involve the media to assist in information dissemination

Training

Prior to operating any equipment employees shall complete the appropriate required 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.

All MoDOT personnel, contractors, law enforcement, and permittees will be trained in temporary traffic control design, deployment, operation, enforcement and maintenance commensurate with their level of responsibility. Individuals may gain this training through either department-provided courses or outside sources. MoDOT currently provides training on flagging, TMA operation, and basic and advanced technical principles pertaining to design, setup, maintenance, management and evaluation of work zones.

Work Zone User Manual, Web Version.

Temporary Traff c Control Elements

Traff c Control Plan

A traffic control plan describes temporary traffic control measures to be used for facilitating the movement of traffic through a temporary traffic control zone. The plan plays a vital role in providing continuity of safe and efficient traffic flow when a work zone or an incident area temporarily disrupts normal traffic flow.

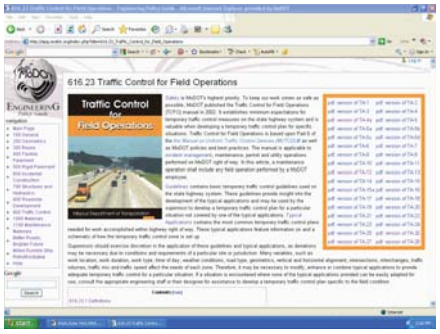
Several temporary traffic control plans, referred to as typical applications, are included in this manual. These plans are also referenced in 616.1 Preparation of Traffic Control Plan (TCP) and depict the most common applications of temporary traffic control devices used in highway-related operations.

Guidance, plans, manuals and drawings that pertain to temporary traffic control can be found electronically in the ***Engineering Policy Guide in article 616 Temporary Traffic Control and is MoDOT's official guide.***

Traff c Control for Field Operations Manual 616.23

The Traffic Control for Field Operations can be found in the ***Engineering Policy Guide (EPG article 616.23) and contains current printable pdf links for the Typical Applications.***

Safety is MoDOT's highest priority. To keep our work zones as safe as possible,



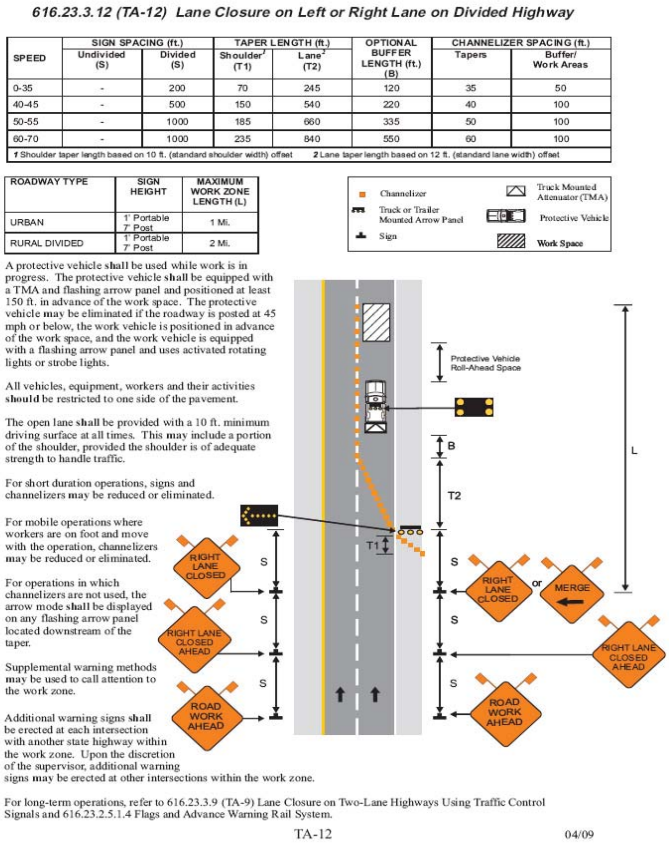
MoDOT published the Traffic Control for Field Operations (TCFO) manual in 2002. It establishes minimum expectations for temporary traffic control measures on the state highway system and is valuable when developing a temporary traffic control plan for specific situations. Traffic Control for Field Operations is based upon Part 6 of the *Manual on Uniform Traffic Control Devices (MUTCD)* as well as MoDOT policies and best practices.

The manual is applicable to incident management, maintenance, permit and utility operations performed on MoDOT right of way. In this article, a maintenance operation shall include any field operation performed by a MoDOT employee.

Guidelines contains basic temporary traffic control guidelines used on the state highway system. These guidelines provide insight into the development of the typical applications and may be used by the supervisor to develop a temporary traffic control plan for a particular situation not covered by one of the typical applications.

Typical Applications (TA) contain the most common temporary traffic control plans needed for work accomplished within highway right of ways. These typical applications feature information on and a schematic of how the temporary traffic control zone is set up. ***Current Typical Applications can be found on the main page of the EPG/ TCFO article 616.23. Here the Typical Applications (pdf format) can be viewed and or printed.***

Supervisors should exercise discretion in the application of these guidelines and typical applications, as deviations may be necessary due to conditions and requirements of a particular site or jurisdiction. Many variables, such as work location, work duration, work type, time of day, weather conditions, road type, geometrics, vertical and horizontal alignment, intersections, interchanges, traffic volumes, traffic mix and traffic speed affect the needs of each zone. Therefore, it may be necessary to modify, enhance or combine typical applications to provide adequate temporary traffic control for a particular situation. If a situation is encountered where none of the typical applications provided can be easily adapted for use, consult the appropriate engineering staff or their designee for assistance to develop a temporary traffic control plan specific to the field condition.



616.23.3.12 (TA-12) Lane Closure on Left or Right Lane on Divided Highway

SPEED	SIGN SPACING (ft.) Undivided (S)	SIGN SPACING (ft.) Divided (S)	TAPER LENGTH (ft.) Shoulder[1] (T1)	TAPER LENGTH (ft.) Lane[2] (T2)	OPTIONAL BUFFER LENGTH (ft.) (B)	CHANNELIZER SPACING (ft.) Tapers	CHANNELIZER SPACING (ft.) 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

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

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

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

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. 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 work space, and the work vehicle is equipped with a flashing arrow panel and uses activated rotating lights or strobe lights.

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 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.

For operations in which channelizers are not used, the arrow mode **shall** be displayed on any flashing arrow panel located downstream of the taper.

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.

Protective Vehicle Roll-Ahead Space
B
T2
T1
L
S
RIGHT LANE CLOSED
RIGHT LANE CLOSED AHEAD
ROAD WORK AHEAD
or
MERGE

For long-term operations, refer to 616.23.3.9 (TA-9) Lane Closure on Two-Lane Highways Using Traffic Control Signals and 616.23.2.5.1.4 Flags and Advance Warning Rail System.

TA-12 04/09

Key Terms

May – permitted
Should – strongly recommended
Shall – mandatory

Pedestrian and Worker Safety

Pedestrian Considerations

While the majority of temporary traffic control situations involve providing safe and efficient movement of motorized traffic, there are times when this function must also be extended to include pedestrians. In these instances, consideration of the following provisions, in addition to those previously noted in Fundamental Principles, should enhance the safe and efficient movement of pedestrians within the temporary traffic control zone.

- Separate pedestrian movements from the activity area and motorized traffic (in some cases it may be necessary to use a physical barrier instead of channelizers to provide this separation)
- Provide a clearly delineated and usable travel path that nearly replicates the existing path
- Provide advance notification of sidewalk closures to discourage unsafe pedestrian movements
- Avoid accessing activity area across pedestrian paths

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 *Safety Policies, Rules & Regulations Employee Handbook*)
- Inspect and operate vehicles and equipment within the temporary traffic control zone appropriately (for MoDOT employees, refer to *Safety Policies, Rules & Regulations Employee Handbook*)
- Use physical barriers instead of channelizers to separate traffic from the activity area

- 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

Clothing

- Class II apparel, hi-vis vest for daytime operations
- Class III apparel, hi-vis vest and pants worn during nighttime operations
- Clothing shall be in accordance with safety rules and regulations
- All PPE (Personal Protective Equipment) worn during nighttime operations shall be retroreflective
- A neat appearance helps gain respect and makes your job more effective

Retroref ective clothing

Daytime

All employees, salaried and wage, working on or near the right of way during daytime operations, and/or where there is a routine exposure to traffic and/or equipment shall properly wear a minimum of a MoDOT approved Class II Safety vest or shirt, which meets or exceeds the ANSI/ISEA 107-2004, American National Standard for High Visibility Safety Apparel.

Nighttime

All employees, salaried and wage, working on or near the right of way during nighttime hours, and/or where there is a routine exposure to traffic and/or equipment shall properly wear MoDOT approved Class III Safety Apparel (Class II or Class III top and Class E pants), which meets or exceeds the ANSI/ISEA 107-2004, American National Standard for High Visibility Safety Apparel.

Nighttime hours shall be def ned as one-half hour before sunset to one-half hour after sunrise.

Safety apparel shall be worn per the manufacturer’s design. Safety Apparel with zipper and/or hook and loop(Velcro) closures should be fastened in the front and on the sides, to meet the visibility requirements of the ANSI/ISEA 107-2004 Standard. The apparel should be worn properly and snug as to reduce issues associated with loose or baggy clothing.

Retroreflective clothing shall be visible for at least 1000 ft. during nighttime flagging and shall identify the wearer as a person.

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 traffic 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.

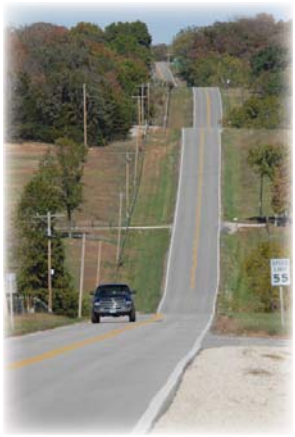
Special Considerations

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 driving 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 that adjustments are needed to typical plans.

Consider factors that may affect visibility/location



- Hills
- Curves
- Intersections
- Shade
- Color contrast
- Driveways
- Trees
- Other signs
- Buildings
- Bad weather
- Darkness
- Bridges and overpasses
- Time of day

Consider factors that affect stopping distance

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

Consider factors that may influence traffic control

- Traffic factors
- Duration of work
- Location of work
- Work activity (type of work to be performed)
- Weather
- Roadway characteristics
- Speed of traffic
- Overhead obstructions
- Typical application

Consider traffic generators. Some examples may include:

- Peak rush hours
- Holidays
- Sporting events
- Special events
- Schools
- Shopping malls
- Business district

Chapter 1 Review Questions

1. Define
   a. May
   b. Should
   c. Shall

2. Who should be trained properly in safe-work zone practices?
   a. College students
   b. All MoDOT employees
   c. Contractors
   d. Any whose actions affect temporary traffic control zones

3. A schematic that provides information on how to set up most common temporary zones is referred to as a:
   a. MUTCD
   b. TCFO
   c. TA
   d. EPG

4. During nighttime operations, MoDOT employees are required to wear what type of safety apparel?
   a. Hi-Vis safety vest
   b. Class VI safety apparel
   c. Class II or III top and Class E pants
   d. Class E pants only

5. People overrate their _____.
   a. Braking time
   b. Visual perception
   c. Driving ability
   d. None of the above

6. From which manual was the MoDOT Traffic Control for Field Operations/EPG 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

7. Why are standards and uniformity important to MoDOT and the public?
   a. They cut down cost
   b. Standards and uniformity help motorist know what to expect
   c. Keeps everything from becoming metric
   d. Standards and uniformity help track inventory

8. 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

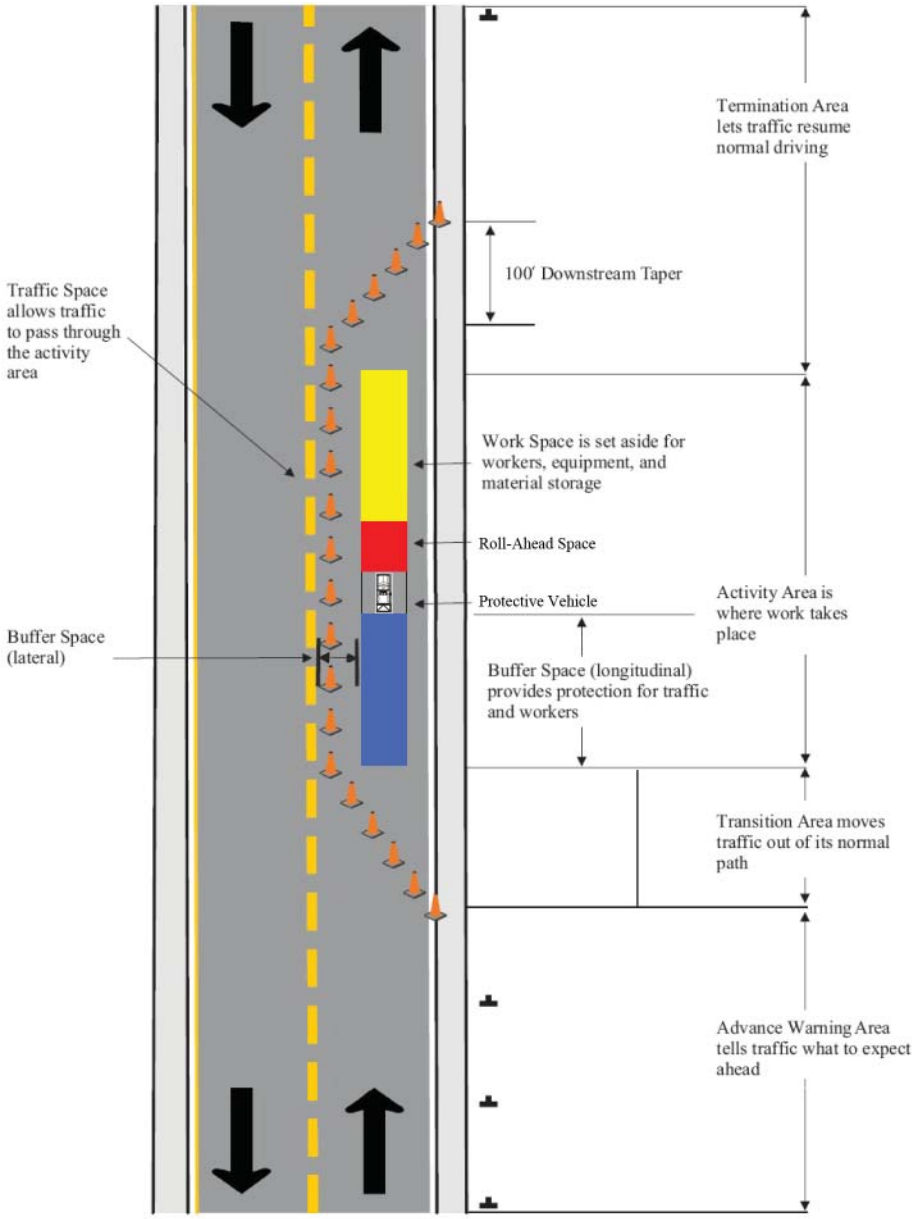
CHAPTER 2

Temporary Traff c 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 basic components: advance warning, transition, activity and termination.

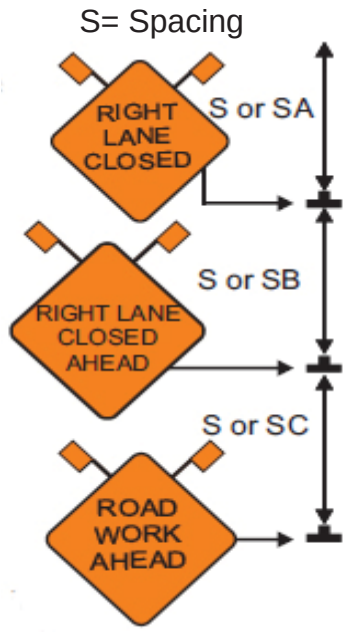
These areas are illustrated in the following figure.



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.

The advance warning area contains warning signs with appropriate legends, regulatory signs, such as speed reduction signing, changeable message signs and other warning devices. The signs or other warning devices are positioned to give the driver sufficient time to react to the conditions. Warning devices are not to be placed too far in advance, as the warning message will lose effectiveness. Suggested advance sign spacing information is shown below.



In some cases on high volume routes, traffic backups due to the work activity may extend past the normal advance warning area. In this case, additional signing may be required to warn drivers before they reach the backup. For longer-term activities, alternate route signing and interactive devices or changeable message signs may be considered. Computer programs are available to aid in estimating back ups and delays due to work zones.

In some cases, particularly in urban areas, the advance warning area may extend through an intersection or interchange. ***Special considerations such as additional advance signs or adjustments to sign spacing may be needed to assure all approaching drivers are informed of the conditions.***

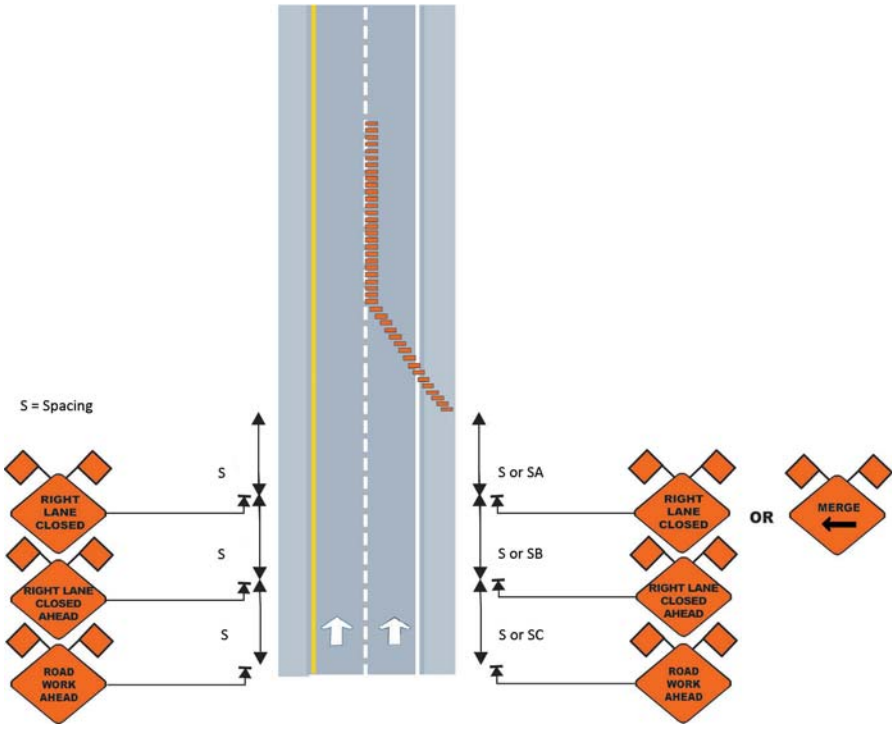
Recommended sign spacing in this area is shown in the following table.

Table 616.23.2.2.2 Sign Spacing

Speed Limit (mph)	Spacing[1] (ft.)	
	Undivided Highway	Divided Highway
0-35	200	200
40-45	350	500
50-55	500	1000
60-70	SA - 1000, SB - 1500, and SC - 2640	

[1] Sign spacing may be adjusted, normally by increasing it, to accommodate field conditions and visibility.

Note: Sign spacing may be adjusted *normally* 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. Mile markers and deliniators also are a great way to calculate distances for signs.

- A pavement dash is 10 feet long with a 30 foot space between markings
- Delineators are spaced 1/10 of a mile apart (approximately 500 feet)
- Interstate mile markers are spaced 2/10 of a mile apart (approximately 1000 feet)
- The odometer on your vehicle is another useful tool to measure distances when laying out a work zone

Transition Area

When redirection of the driver's normal path is required, traffic must be channelized from the normal path to a new path. Transition areas usually involve strategic use of tapers, channelizing devices, signing, pavement marking and other traffic control devices.

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
- 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 ft. (5 channelizers at 20 ft. spacing). In addition to the channelizers, a flagger, STOP or YIELD sign, pilot car or temporary traffic signal controls traffic through this.

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

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

[1] Taper lengths may be adjusted to accommodate crossroads, curves, intersections, ramps, or other geometric features.
[2] Based on 10 ft. shoulder width.
[3] Based on 12 ft. land width.
[4] Channelizer spacing may be reduced to discourage traffic encroachment.
[5] Spacing reduced to ½ at intersections.
[6] Spacing may be reduced to ½ at intersections.

Note: Taper lengths may be adjusted whenever they are located close to a crossroad, curve, intersection, ramp or other geometric feature. Whenever tapers are 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 may encourage motorists to delay lane changing. ***The real test of taper length involves observing motorists after the traffic control plan has been implemented.***

Type of Taper

Taper Length. The length of taper used to close a lane (L) is determined by the speed of traffic (posted speed prior to construction) and the width of the lane to be closed (lateral distance traffic is shifted). Taper lengths and formulas are available in the EPG.

Merging Tapers. Merging tapers are used to close a lane or combine traffic lanes on multilane facilities. It is important to provide full-length tapers (L) where practical. For long-term operations, lane line markings are removed through the merging taper and temporary edge lines are to be provided to guide drivers through the taper and the work area.

Shifting Tapers. Shifting tapers are used to laterally shift a lane or lanes of traffic where merging is not required. Shifting tapers typically have a length of L, although where space is limited, shifting tapers may be reduced to 1/2 L. Where 1/2 L shifting tapers are used, REVERSE CURVE or REVERSE TURN signs, along with any required advisory speed plaques, are to be posted prior to the shift. For long-term operations, conflicting pavement markings are removed and temporary markings are provided to guide drivers through the tapers and work area. For short-term operations where it is not practical to modify pavement markings, a device spacing of 10 ft. is used.

Shoulder Tapers. It is important to close shoulders prior to shoulder work or through lane closures. This helps prevent drivers from entering the work zone on the shoulder and helps prevent collisions with flashing arrow panels and other traffic control devices. Shoulder tapers typically have a length of 1/3 L.

One-Lane, Two-Way Tapers. Where one lane of a two-lane two-way roadway is closed, a short taper of 100 ft. with a device spacing of 20 ft. is used to guide drivers into and out of the one-lane two-way section. For long-term operations, centerline markings are removed and temporary edgeline markings are provided to guide drivers through the tapers and the work area.

Two-Way Center Turn Lane Tapers. A taper length of 1/2 L is used to close a center turn lane. Where space is limited, a shorter taper may be used.

Activity Area

The activity area is the area of the roadway where the work takes place. It is composed of the workspace, traffic space and buffer space.

- The ***workspace*** is the area closed to traffic and set aside for workers, equipment, materials and a protective vehicle, if one is used upstream (this area is usually delineated by channelizers or temporary barriers to exclude vehicles and pedestrians)
- The ***traffic space*** is the area in which traffic is routed through the activity area
- The ***roll-ahead space*** (when a protective vehicle is added to the activity area) is located in front of the protective vehicle and is free of workers, materials, equipment and tools (this space allows for the protective vehicle to move or “roll” upon impact by an errant vehicle without entering the workspace and striking workers, materials or equipment and tools)
- The ***buffer space*** provides a recovery space for an errant vehicle (buffer spaces may be placed longitudinally or laterally with respect to the direction of traffic flow)

Longitudinal buffer spaces are to be used whenever practicable. Lateral buffer spaces may be considered based on the type of work.

Lateral buffer spaces are to be used when practicable between the traffic space and fixed objects or pavement drop-offs. Guidelines for the length of longitudinal buffer spaces are given below:

Recommended longitudinal buffer length in the activity area is shown in the following table.

Recommended Length of Longitudinal Buffer Spaces

Speed Limit (mph)	Buffer Length (ft.)
0-35	250
40	305
45	360
50-55	495
60-70	730

Termination Area is where traffic is returned to their 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 ft. (5 channelizers at 20 ft. spacing) per lane.

Chapter 2 Review Questions

1. 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

2. 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

3. The area of roadway where work takes place is called:
   a. Advance warning area
   b. Termination area
   c. Activity area
   d. Buffer space

4. 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

5. Signs are spaced according to
   a. Height
   b. Posted speed limit
   c. Type of highway
   d. B and C

6. The longitudinal buffer allows employees a place in the activity area to store materials and equipment.
   a. True
   b. False

7. Sign spacing on an undivided highway at a posted speed limit of 55 mph during a daytime operation is:
   a. 200 feet
   b. 300 feet
   c. 500 feet
   d. 1000 feet

CHAPTER 3

Temporary Traff c Control Zone Operations

Type of Highway

Considerations are to be made as to the type of highway where the temporary traffic control is to be used. There are three types of highways to consider.

- **Urban** - Area within the limits of incorporated towns and cities where the posted speed is 60 mph or less.
- **Rural Divided -** Highway with physical separation of traffic in opposite directions. Area generally characterized by lower volumes, higher speeds and fewer turning conflicts and conflicts with pedestrians. Includes unincorporated areas designated by community boards.
- **Rural Undivided -** Highway with no physical separation of traffic in opposite directions. Area generally characterized by lower volumes, higher speeds and fewer turning conflicts and conflicts with pedestrians. Includes unincorporated areas designated by community boards.

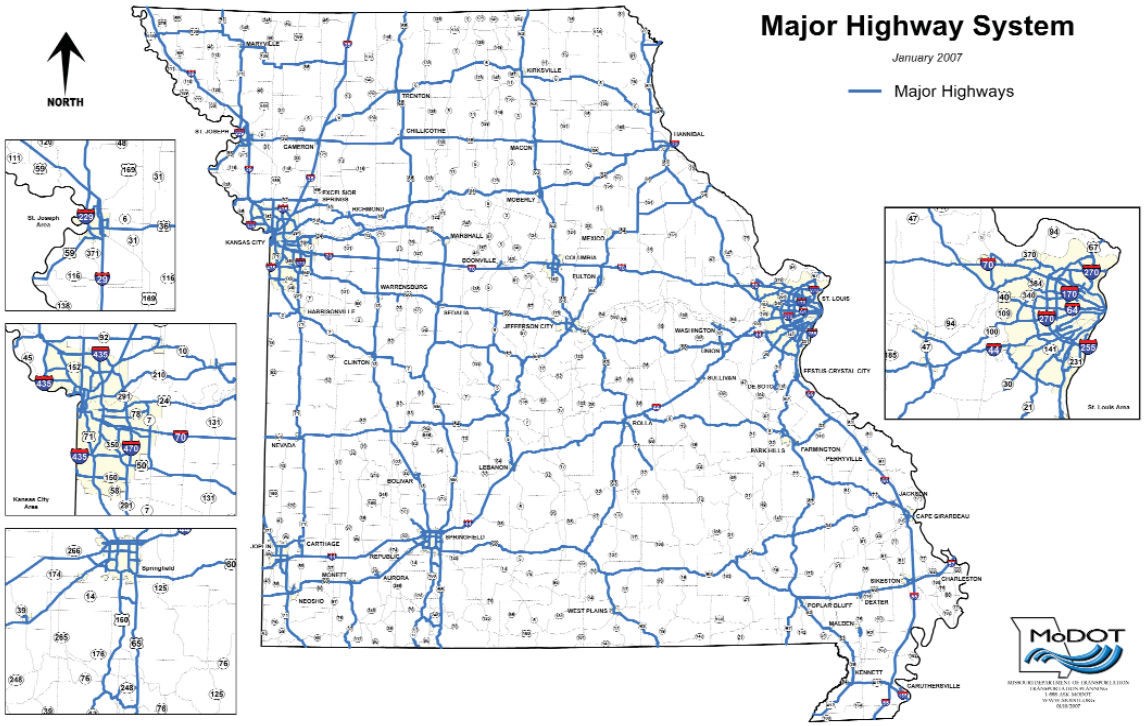
Major and Minor Road Def nitions

Major Highway - consists of all routes functionally classified as principal arterials. The principal arterial system provides for statewide or interstate movement of traffic. The major highway system in Missouri totals 5,402 centerline miles or 17 percent of the total state highway miles. The major highways carry 76 percent of the total vehicle miles traveled in the state.

Minor Highway – consists of all routes functionally classified as minor arterials, collectors or outer roads. These routes mainly serve local transportation needs and include highways commonly referred to as lettered routes, such as Route A, Route C, and Route DD. The public sometimes refers to these routes as farm-to-market roads. The minor highways total 27,000 centerline miles or 83 percent of the total state highway miles and carry about 24 percent of the total vehicle miles traveled in the state.

Major highway system map that details routes considered being Major Roads.

Consult District for specific route classifications. Major highway system map can be found online through the ***EPG in Article " Brighter Roads Better Future"*** which is linked on the main EPG page in the navigation box.



Work Zone Length

While it is important to grab the motorist's 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, should be kept to a minimum.

The work zone length is def ned as the distance from the last sign in the advance warning area to the last temporary traff c control device in the same direction or to the last sign in the advance warning area in the opposing direction, whichever is longest.

The recommended maximum work zone length is shown in the following table.

Table 616.23.2.7.1 Maximum Work Zone Lengths

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

Duration of work

- ***Long-term Stationary*** – planned work occupying a location more than three (3) days
- ***Intermediate-term Stationary*** – planned work occupying a location more than one (1) daylight period up to 3 days, or night time work lasting more than 30 minutes
- ***Short-term Stationary*** – planned daytime work occupying a location more than 30 minutes and less than twelve (12) hours
- **Short duration** – planned day time or night time 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 *MoDOT's Incident Response Plan Manual*

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. There are six categories of work duration: long-term stationary, intermediate-term stationary, short-term stationary, short duration, mobile and emergency.

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 for more than one daylight period up to three days or planned nighttime work occupying a location more than 30 minutes. ***Nighttime work - work beginning one-half hour before sunset and ends one-half hour after sunrise.***

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.*** 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 only 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.

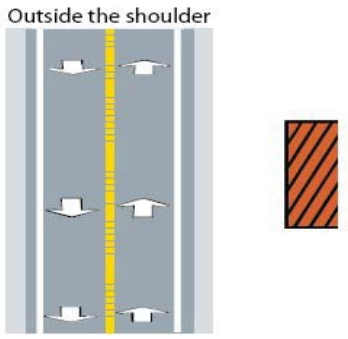
Therefore, total mobility of the temporary traffic control zone is important and devices should be chosen accordingly. In some continuously moving operations, a work vehicle equipped with fleet lighting may be sufficient. In others, a protective vehicle equipped with fleet lighting, a truck-mounted attenuator, 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).

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 outside the shoulder includes any work performed between the edge of the shoulder, the edge of the travelway 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 travel 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 10 ft. of driving surface cannot be maintained for traffic.***

Work within the travel 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.

Chapter 3 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 of the above

2. Which group classifies road types according to the Traffic Control for Field Operations Manual?
   a. Urban, rural, rural undivided
   b. Urban, rural divided, rural undivided
   c. Two lane or four lane highways
   d. Supplementary route, primary route

3. Which of the following defines an intermediate-term stationary operation?
   a. Last more than 3 days
   b. The placement of signs without channelizers
   c. 3 hours of evening work
   d. Safety needs to be addressed before working

4. 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 the shoulder with at least 10 feet of driving lane available

5. Which of the following is a short-term stationary operation?
   a. Work performed at night but only lasting one day
   b. Painting pavement markings at railroad crossings
   c. New highway construction
   d. None of the above

6. Mobile operations often involve frequent short stops where workers are on foot. These stops can last up to:
   a. 30 minutes
   b. 1 hour
   c. 15 minutes
   d. 20 minutes

7. The maximum length of a work zone on a rural divided highway is:
   a. 1 mile
   b. 2 miles
   c. 3 miles
   d. 4 miles

8. The maximum length of a work zone on an urban highway is:
   a. 1 mile
   b. 2 miles
   c. 3 miles
   d. 4 miles

CHAPTER 4

Temporary Traff c Control Devices

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 arrow panels, channelizers, barricades, temporary traffic barriers, pavement markings, lighting devices, temporary traffic signals, crash cushions, protective vehicles and truck-mounted attenuators.

Crashworthy Devices and Manual for Assessing Safety Hardware (MASH)

The purpose of Manual for Assessing Safety Hardware (MASH) is to present uniform guidelines for the crash testing of both permanent and temporary highway safety features and recommended evaluation criteria to assess test results. Guidelines are also presented for the in-service evaluation of safety features. These guidelines and criteria, which have evolved over the past 40 years, incorporate current technology and the collective judgment and expertise of professionals in the field of roadside safety design. They provide: (1) a basis on which researchers and user agencies can compare the impact performance merits of candidate safety features, (2) guidance for developers of new safety features, and (3) a basis on which user agencies can formulate performance specifications for safety features. MASH is an update to and supersedes NCHRP Report 350, Recommended Procedures for the Safety Performance Evaluation of Highway Features, for the purposes of evaluating new safety hardware devices. MASH does not supersede any guidelines for the design of roadside safety hardware, which are contained within the AASHTO Roadside Design Guide.

FHWA (Federal Highway Administration) will formally adopt MASH as our crash test standard during the next revision of 23 CFR 625.4 “Standards, Policies, and Standard Specifications.” It will also be included in the FHWA Policy & Guidance Center. However, MASH will not be mandated as a design standard for safety hardware. The Roadside Design Guide fulfills that function.

- All highway safety hardware accepted prior to adoption of *MASH* using criteria contained in *NCHRP Report 350* may remain in place and may continue to be manufactured and installed.
- Highway safety hardware accepted using *NCHRP Report 350* criteria is not required to be retested using *MASH* criteria.
- If highway safety hardware that has been accepted by FHWA using criteria

contained in *NCHRP Report 350* fails testing using *MASH* criteria, AASHTO and FHWA will jointly review the test results and determine a course of action.

- Upon adoption of *MASH* by AASHTO, any new highway safety hardware not previously evaluated shall utilize *MASH* for evaluation and testing.
- Highway safety hardware installed on new construction and reconstruction projects shall be those accepted under *NCHRP Report 350* or *MASH.*
- Agencies are encouraged to upgrade existing highway safety hardware that has not been accepted under *NCHRP Report 350* or *MASH:*
    - o during reconstruction projects,
    - o during 3R projects (changes to the roadway that may change the safety design), or
    - o when the system is damaged beyond repair.

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 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.***

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.

Work zone warning signs are typically 48 in. x 48 in., diamond-shaped, black on orange signs with MoDOT fluorescent orange sheeting. Retroreflective sheeting is required for nighttime activities.

Therefore, it is important all permanent and temporary signs not applicable to conditions present in the temporary traff c control zone be removed, covered, or turned away from the roadway so they are not visible to traff c.

To ensure maximum visibility, existing signs and other physical features (trees, sidewalks, billboards, commercial signs, etc.) must be considered when locating work zone signs.

Sign Design

Details, descriptions, and ordering information for signs used for temporary traffic control are specified in 616.2 Work Zone Signing and Applications, in the EPG.

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 may be used and f ags shall be used to supplement these signs provided they do not block the sign face.

Work zone regulatory signs are identical to permanent regulatory signs with MoDOT Type 3 sheeting. Work zone guide signs are generally rectangular in shape and have a black legend on orange background with MoDOT fluorescent orange sheeting; but may come in different sizes, shapes, colors and sheeting depending on the type and purpose of the signing. Sometimes a plate or plaque is affixed to a work zone sign or mounted below it to customize the sign. For additional discussion on enhancements, refer to 616.2.9 Flags and Advance Warning Rail System.

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 (mandatory)***
- 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

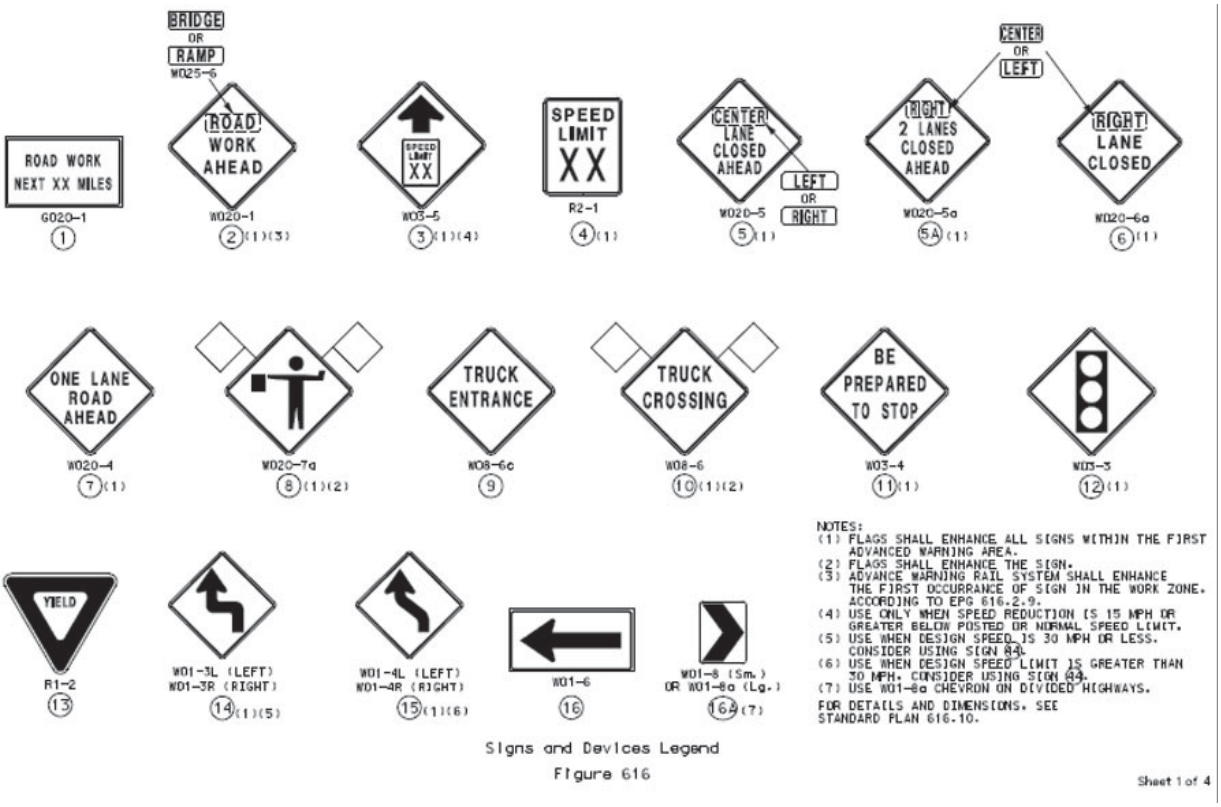
Flags and Advance Warning Rail System

All signs within the first advance warning area shall be enhanced with flags. Flagger Ahead (WO20-7a) and TRUCK CROSSING (WO8-6) shall have flags regardless of the location within the work zone.

Sign and Device Legend

Additional signs within the work zone may be enhanced with flags at the district's discretion, although such practice should be infrequent. The sign and device legend can be found in the EPG article 616 Temporary Traffic Control within the work zone figures quick link box.

Sign and device legend below page 1 of 4 (Example)



Using the example above the first set of advanced warning signs shall be flagged. Additional flagging requirements can be found in the device legend.

Identify the sign to be used and follow the key along with notes to determine supplemental warning requirements.

Example:

Sign #2 (Road Work Ahead) will follow notes 1 and 3.
Flags required in first advance warning area.
Advanced warning rail enhancement required if used under conditions set in EPG 616.2.9 (long term stationary).

Sign #8 (Flagger Symbol) will follow notes 1 and 2.
Flags required in the first advance warning area. Flags shall enhance the sign (shall have flags installed at all times regardless of location).

The Advance Warning Rail System (AWRS) shall consist of three barricade rails used to enhance the target value of certain signs on long-term stationary operations. The AWRS is only installed on the first occurrence of the ROAD/BRIDGE WORK AHEAD (WO20-1) signs on the mainline roadway.

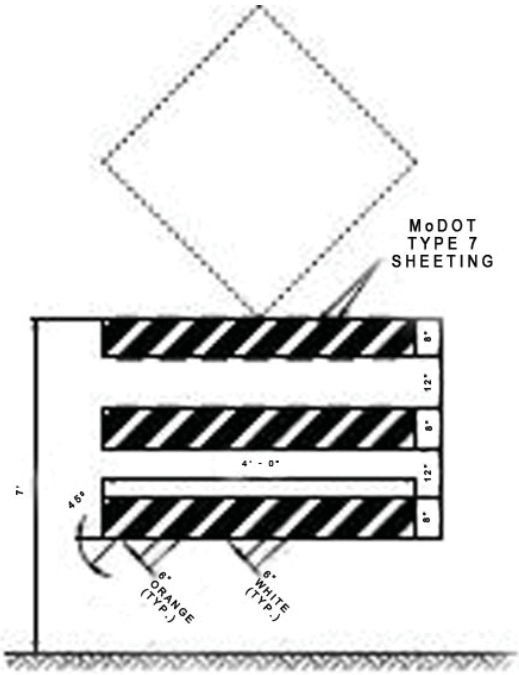
(Long-term stationary operations)

The following are, but are not limited to, ways to install the AWRS:

1. The three barricade rails may be attached to U-channel, wood or PSST posts, according to the minimum sign area (sign and rails) as located in ***Table B of Standard Plan 616.10.***

2. A crashworthy skid-mounted sign and rail assembly.

3. The sign and three-rail system may be mounted as separate crashworthy devices. The rail system shall be located directly in front of the sign with 7 ft. to 10 ft. separating the two devices.



ADVANCED WARNING RAIL SYSTEM

MAXIMUM WEIGHT OF SIGN MUST NOT EXCEED 25 LBS.

THE SIGN AND RAIL SYSTEM MAY BE MOUNTED AS TWO SEPARATE CRASHWORTHY DEVICES. THE RAIL SYSTEM SHALL BE LOCATED DIRECTLY IN FRONT OF THE SIGN WITH 7 TO 10 FEET SEPARATING THE TWO DEVICES.

WHERE MARKING IS NOT PROVIDED ONT HE BACKSIDE. STRIPS OF 3" WIDE MODOT TYPE 7 ORANGE SHEETING MAY BE APPLIED TO THE ENDS OF EACH RAIL TO HELP DELINEATE THE DEVICE.

Sign Classif cation

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 have a black legend on white background. Noteworthy exceptions to this rule are the STOP, YIELD, DO NOT ENTER and WRONG WAY signs.

Warning Signs give notice of situations or conditions that might not be readily apparent. These signs are generally diamond-shaped and, when used in a temporary traffic control zone, have a black legend or symbol on an orange background.

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 have a black legend on an orange background.

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. 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.

Signs shall be:

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

Recommended sign spacing is shown in Table 616.23.2.2.2, Sign Spacing.

Signs may be supported in one of four methods: on a portable support, break-away post, vehicle or traffic barrier.

Signs may be supported in one of four methods:

- portable support
- break-away post
- vehicle
- traffic barrier

Sign Height

Sign mounting requirements can be found in the EPG article 616.2 Work Zone Signing and Applications or in Standard Plan 903.03

The following table shows typical sign heights:

Type of Roadway	Sign Height
Urban	1’ Portable 7’ Post
Rural Divided	1’ Portable 7’ Post
Rural Undivided	1’ Portable 5’ Post

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

A minimum mounting height of one ft., 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 the visibility of the sign.

Mounting heights for regulatory and guide signs 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 ft.,*** measured horizontally from the edge of the sign to the 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 signs 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.

Break-Away 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 ft., 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 f ve ft., 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 ft. less than the heights specified.

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

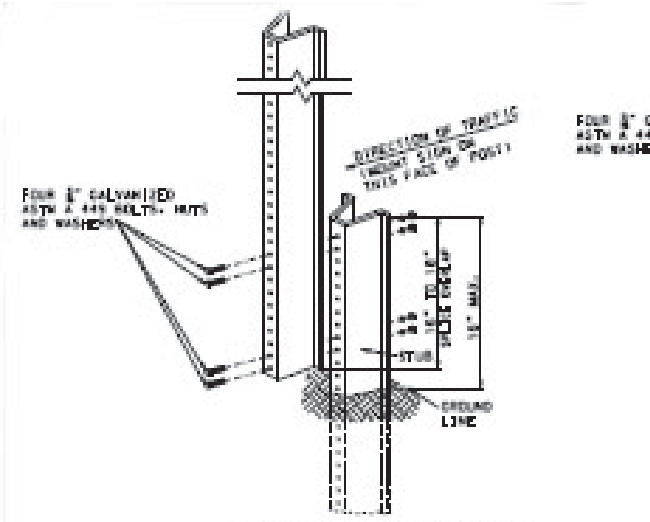
U-Channel Post

When mounting signs using U-channel post, use of full length post is acceptable. However use of the optional splice is acceptable as well. There are two (2) options available when using the splice installation.

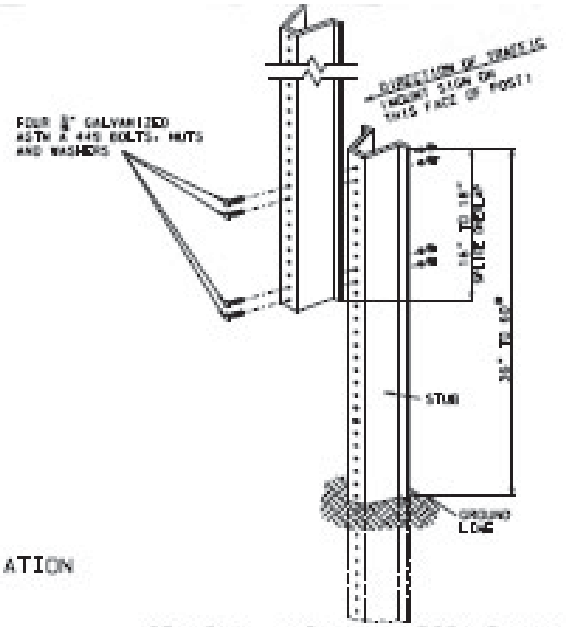
Mounting guidance can be found in the EPG article 616.2 Work Zone Sign Applications. ***Use standard plan 903.03 Drawing 903.03BG for sign mounting guidance.***

- **Permanent and Temporary Installation**
  - o 18” from the ground line to the top of the stub
  - o Splice overlap shall be positioned entirely between the ground line and 16” to 18” above the ground line

- **T emporary Installation**
  - o 36” to 60” from the ground line to the top of the stub
  - o Overlap shall be between 16” and 18”
- Splices shall have four (4) sign grade bolts installed at the top 2 bolt holes of the stub and the bottom 2 bolt holes of the overlap sign post
- Stub shall face traffic
- If a plaque is used, neither the sign or the plaque shall be positioned within the splice



U-CHANNEL POST DETAIL
PERMANENT AND TEMPORARY INSTALLATION



OPTIONAL U-CHANNEL POST DETAIL
TEMPORARY INSTALLATION ONLY

Vehicle-mounted signs, when allowed in 616 Temp. Traffic Control are temporary traffic control signs affixed to a protective vehicle or pilot car at a ***recommended minimum height of (4) 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 regulatory and guide signs are as specified for post-mounted signs.***

Signs in Narrow Medians

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

Where signs are installed in narrow medians, the size of signs may need to be reduced to provide sufficient lateral clearance. It is important to retain the diamond shape of warning signs as much as possible. It is not acceptable to use rectangular shapes in lieu of diamond shapes, but the corners of the diamond shaped signs may be clipped to reduce sign width. It is preferable to use 36 in. warning signs rather than to cut the corners of 48 in. signs. Refer to Figure 616.2.4 in the EPG, which provides guidelines for signs in narrow medians. Any other sign sizes or shapes used that are not shown in the standard plans are shown in the plans with a layout including lettering size and series.

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, not as a replacement for or a repeat of, static temporary traffic control signing. In temporary traffic control applications, these units are generally mounted on a trailer.

Some typical situations where 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 guidelines 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 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.

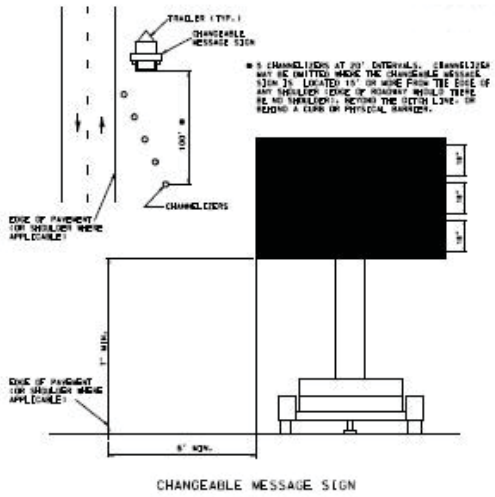
A minimum lateral clearance of three ft., measured horizontally from the edge of the sign to edge of the traveled way, is recommended.

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 ft., 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 ft. For a sign located in the median, the sign should be delineated from both directions.



CHANGEABLE MESSAGE SIGN

Channelizers may be omitted where the CMS is located 15’ or more from the edge of any shoulder (edge of roadway where there is no shoulder), beyond the ditch line, or behind a curb or physical barrier.

Information can be found in Article 616 in the EPG within Standard Plan 616.10 drawing 616.10A

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.

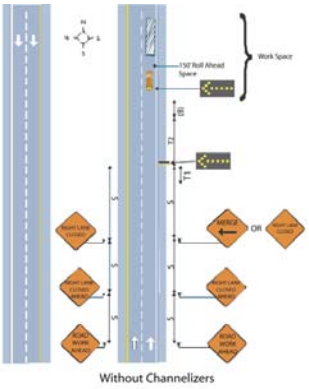
The overall minimum dimensions of the panels are 60 in. wide x 30 in. high for truck-mounted units and 96 in. wide x 48 in. high for trailer-mounted units. Panels for both units shall include 15 yellow elements.

Panels may be operated in one of three operating modes:

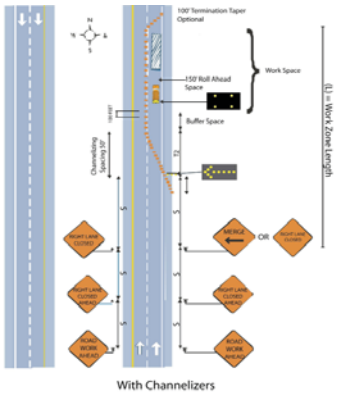
- Arrow (Right or Left)
- Double arrow
- Caution

- The arrow and double arrow modes are used for stationary or moving lane closures on multilane highways
- The arrow mode is used when traffic has no choice but to go left or right, while the double arrow mode is used when traffic has the choice to go left or right
- The caution mode is used for shoulder work, blocking the shoulder, work within a lane where the lane is not closed, and lane closures on two-lane, undivided highways

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



Without Channelizers



With Channelizers

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 (When used during night operations, these displays shall be dimmed by 50 percent)

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

For stationary lane closures, the panel should be deployed on the shoulder or within an adjacent closed lane at the beginning of the lane or one-lane, two-way taper. Where adequate space or the temporary traffic control plan does not permit this placement, the unit may be placed within the taper of the closed lane. When closing multiple lanes, a separate unit shall be used to close each lane.

For moving lane closures on two-lane, undivided highways, the panel shall be deployed within the lane to be closed.

For moving lane closures on multi-lane highways, one panel should be deployed on the shoulder and another shall be deployed within the lane to be closed. Where adequate space does not permit deployment of the unit on the shoulder, the unit may be positioned partially in the lane to be closed. When an interior lane is being closed by itself, both units shall be deployed within the lane to be closed. When closing multiple lanes, a separate unit shall be used to close each lane.

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 ft., 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 ft.

Channelizers

Channelizing devices are commonly used to delineate the traffic path through a work area. Guidance for channelizer spacing is available in the EPG. In addition, channelizers may be used as a warning device to mark specific hazards or as described in Article 616.1.3.3.1, Workspace. Channelizer spacing may be reduced at the discretion of the designer to one-half the spacing shown for off ramp gore areas, intersections, sharp curves, etc. For hazards in or adjacent to the roadway, use a spacing of 20 ft. or less.

The function of channelizers 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:

- Trim-line channelizers
- Cones
- Drums
- Direction indicator barricades

Trim-line channelizers (preferred option) are conical-shaped devices that are orange in color, 42 in. tall, 8 in. diameter at the base and augmented with alternating bands of orange and white retroreflective sheeting.

These devices 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.

Cones are conical-shaped devices that are orange in color and 28 inches in height. Cones shall be used on daytime operations only.

- Cones may be used in lieu of trim-line channelizers for daytime operations <u>on minor roads only.</u>
- ***Cones may be used in incident response or emergency applications.***

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

Direction indicator barricades are 36 in. tall devices consisting of a 24 in. wide x 12 in. tall retroreflective orange panel with a horizontal arrow on top and a 24 in. wide x 8 in. tall panel of alternating orange and white retroreflective stripes at a 45 degree angle on bottom.

<u>Channelizer spacing shown in the following table below:</u>

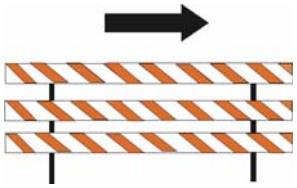
Speed Limit, mph	Channelizer Spacing [1] ft.	
	Taper	Buffer/Work Areas
0-35	35[2]	50[2]
40-45	40[2]	100[2]
50-55	50[3]	100[2]
60-70	60[3]	100[3]

[1] Channelizer lengths may be reduced to discourage traffic encroachment.
[2] Spacing reduced to 1/2 at intersections.
[3] Spacing may be reduced to 1/2 at intersections.

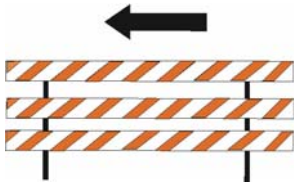
Barricades

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.

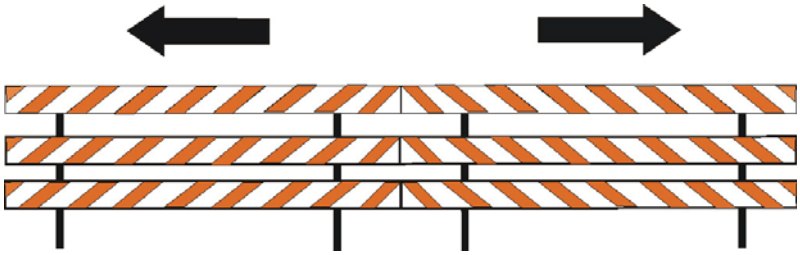


(Traffic passes to right)



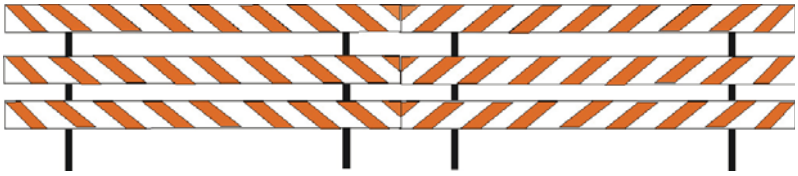
(Traffic passes to left)

- Where both right and left movements are provided, the stripes should slope downward at a 45 degree angle away from the center of the barricade array.



(Left and right traffic movement is provided)

- Where no movements are provided, the stripes should slope downward at a 45 degree angle toward the center of the barricade array.



(No movement of traffic provided)

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.***

One barricade is required for every 8 ft. of pavement, so a typical roadway with two 12 ft. lanes will require three barricades and with two 4 ft. shoulders will require four barricades.

(Typical installation of Type III Barricade with 12' lane no shoulder)

Type C warning lights may also be specified where additional impact is deemed appropriate.

Barricade Signs and Lights

Signs may be attached to the barricade and shall:

- Be light weight (roll up or plastic)
- Not obscure more than 50% of the top two (2) rails
- Not obscure more than 33% of all three (3) rails

Type C warning lights may be attached to the barricade and shall:

- Be light weight (3.3 lbs. or less)
- Have battery pack mounted no higher than 18" (lights over 3.3 lbs.)
- Shall not cover any portion of the barricade face

If signs and lights can not meet the above requirements they shall:

- Be mounted on a separate crashworthy device
- Be located 7 to 10 feet behind the barricade

Temporary Traffic Barrier

A temporary traffic barrier may be used in lieu of or in addition to channelizers separating motorized traffic from the workspace, an unsafe condition, or non-motorized traffic. It is not used to form tapers.

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

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

When used, the barrier should 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, back slope or curb provided the side slope is 1V:6H (6:1) or flatter.

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 may be a possibility but should be considered on a case-by-case basis.

No Center Stripe

These 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 ft. or more. These signs are used in combination with temporary pavement marking. These signs are placed in advance of the missing no-passing zone centerline markings 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 ft. after the intersection of a state route and at two-mile spacing throughout the affected area. Upon the discretion of the engineer or supervisor, additional NO CENTER STRIPE signs may be installed within 150 ft. after other intersections. When a sign placed at the two-mile interval and another sign placed after an intersection fall within one-eighth mile of each other, the sign placed at the two-mile interval may be eliminated. Standard Plan 620.10 shows the configuration for these signs and pavement markers on a two-lane roadway. This layout is to also be included in the TCP.

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:

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

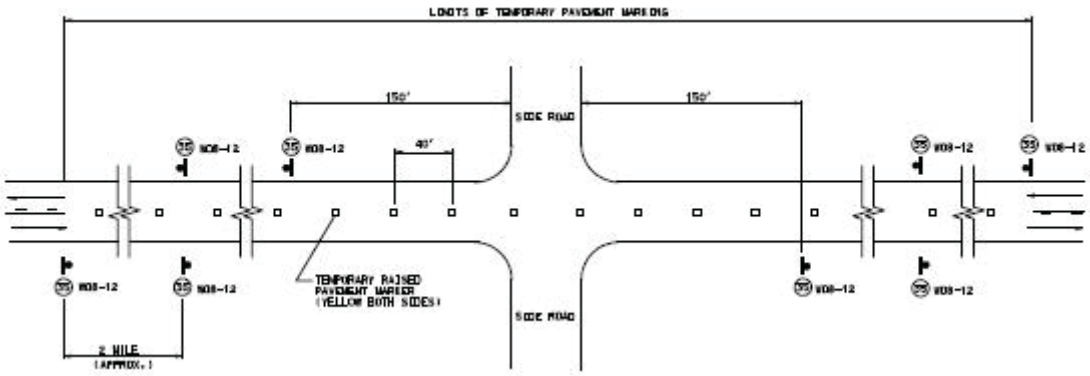
1,000, certain material and operations do not allow the practical application of these markings (e.g., chip seal, cold mix curing, fly coating, etc.), installation of temporary pavement markings may be delayed up to 5 working days, initiated by the elimination of the permanent pavement markings, provided the required NO CENTER STRIPE signs are in place as prescribed previously prior to opening the facility to traffic.

Contract Projects – Permanent pavement marking shall be installed in accordance with Sec 620 Pavement Marking.

Maintenance Operations – Permanent pavement markings should be installed no later than 14 calendar days after any operation has been completed. However, delays in installation should be minimized where possible.

Removal or obliteration of all pavement markings shall be complete and leave minimal pavement scarring. Concealing any pavement marking with black paint or asphalt is not acceptable.

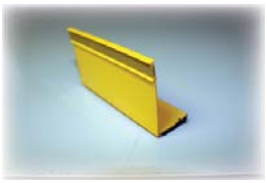
Guidelines for installation of temporary pavement markings along with a diagram can be found in Standard Plan 620.10



Temporary Pavement Marking

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. ***Refer to Standard Plan 620.10 for diagrams listing temporary pavement marking application requirements.***

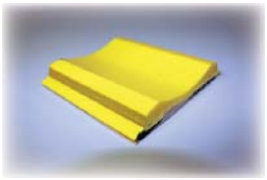
Type 1 temporary raised pavement markers consist of an L- or T-shaped flexible tab with a retroreflective sheeting on both faces of the vertical section and a pressure-sensitive adhesive on the base. These markers, available in white and yellow, are typically ***used to temporarily mark centerlines and lane lines by applying them to the road surface at 40-ft. intervals*** prior to or after, depending on the type of surface treatment, an operation and removing the protective film covering the retroreflective sheeting upon completion of the operation. This spacing may be reduced by one-half when marking intersections, ramp gores and other transitional areas.



Type 1 markers are the preferred means of providing temporary marking on rough surfaces.

- Type 1 temporary markers are used on surface treatment projects and are installed before the surface treatment is applied.
- Type 1 temporary markers are also used for temporary edgeline marking and may be used as part of the “cluster marking” for lane lines on divided highways.

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 by applying them to the road surface at 40-ft. intervals.*** This spacing may be reduced by one-half when marking intersections, ramp gores and other transition areas.



Type 2 markers work well on concrete and smooth asphaltic surfaces.

- The Type 2 temporary marker may be used on final surfaces on paving projects.
- The Type 2 markers are also part of the “cluster marking” for lane lines on divided highways.

Preformed short-term pavement marking tape consists of a 4-in. 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 4-ft. long sections and applied to the road surface at 40-ft. intervals as a temporary pavement marking. The length and spacing of the latter pavement marking may be reduced by one-half when

marking intersections, ramp gores and other transitional 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 materials 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, since the material will not adhere well under these conditions.

Pavement marking paint consists of applying a 4-in. 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 4-ft. long sections at 40-ft. 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.

Work zone lighting consists of two components, work area lighting and overhead lighting, as described in Section 616 of the EPG. Work zone lighting is specified on the plans and is included as a pay item when work is required at night or when lighting needs to be present during non-working hours (i.e. lighting gore areas, crossovers, etc.).

Typical work zone lighting may include dirigible lighting, portable light towers, balloon lighting, lights attached to equipment or post-mounted lights. In some cases, existing lighting or ambient lighting may meet lighting level requirements and negate the need for including work zone lighting.

When stationary operations exceed 15 consecutive days, such as a bridge replacement, interchange or intersection work that occurs at night, temporary fixed lighting is considered in lieu of work zone lighting. Temporary fixed lighting shhould also be considered for islands, temporary bypasses, crossovers and connections and areas of potential conflict, such as temporary ramps, intersections and one-lane, two-way traffic operations that are in place for more than 15 consecutive days. These conditions may require lighting even though the work may not be conducted at night. This type of lighting, while more difficult to design and install, provides more uniform light distribution thereby enabling the motorist to better navigate the work zone at night. If temporary fixed lighting is chosen, it must be designed, as shown in the plans. Temporary fixed lighting generally includes wood poles, luminaries and power supplies.

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 footcandles 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 so that it does not cause glare for motorists, spill onto adjacent properties, create shadows within the workspace 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 footcandles 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. Flagger stations in operation at night are required to be lit.

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.

Warning lights are available that provide two types or all three types in a single unit. Ensure proper mode is selected when implementing this style of warning light.

Type A (Low Intensity Flashing). These flashing lights may be used on drum-like channelizers to warn of an unexpected, isolated hazard. This device is not used in shifts, tapers or long runs of channelizing devices.

Type A are low-intensity, flashing light units capable of being visible from a distance of 3000 ft. 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 (High Intensity Flashing). These flashing lights may be used on advanced warning signs when geometrics, traffic volumes or other conditions warrant increased visibility.

Type B are high-intensity, flashing light units capable of being visible from a distance of 1000 ft. 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 (Steady-Burn). These steady burn lights may be used on drum-like channelizers to delineate traffic in shifts, tapers or long runs or on direction indicator barricades in merging tapers in the work area at night at the designer's discretion.

Type C are steady-burn light units capable of being visible from a distance of 3000 ft. 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 similar conditions. 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 in., 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. Ensure warning lights meet crashworthy requirements.

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 workspace 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 Traff c 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 EPG Article 902, Signals. 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 3 ft., 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 ft.***

Automatic Flagger Assistance Device (AFAD)

Intellistrobe

Autoflagger

RC Flagman

Intellistrobe- The Intellistrobe model has the light indicators and a stop arm. The unit can be controlled from a transmitter carried by the operator who is located away from the unit. It is also equipped with a Lane Intrusion Alarm, which is activated when traffic crosses the safety pneumatic hoses and enters the work activity area.

Autof agger-The Autoflagger is solar powered and includes an octagonal STOP silhouette and triangular SLOW insignia, and conforms to existing human flagger operations. Lights are also used to enhance the sign. The operator has visual status of the signs and the handheld controller can activate the emergency warning horns to alert workers when traffic enters the work area.

RC Flagman-The mechanical flagger system consist of a red and amber indication signal head, and a PVC flagger arm. The RC Flagman is placed at one end of the work zone substituting one human flagger, and is remotely controlled by a human flagger located at the other end of the work zone.

Crash Cushions

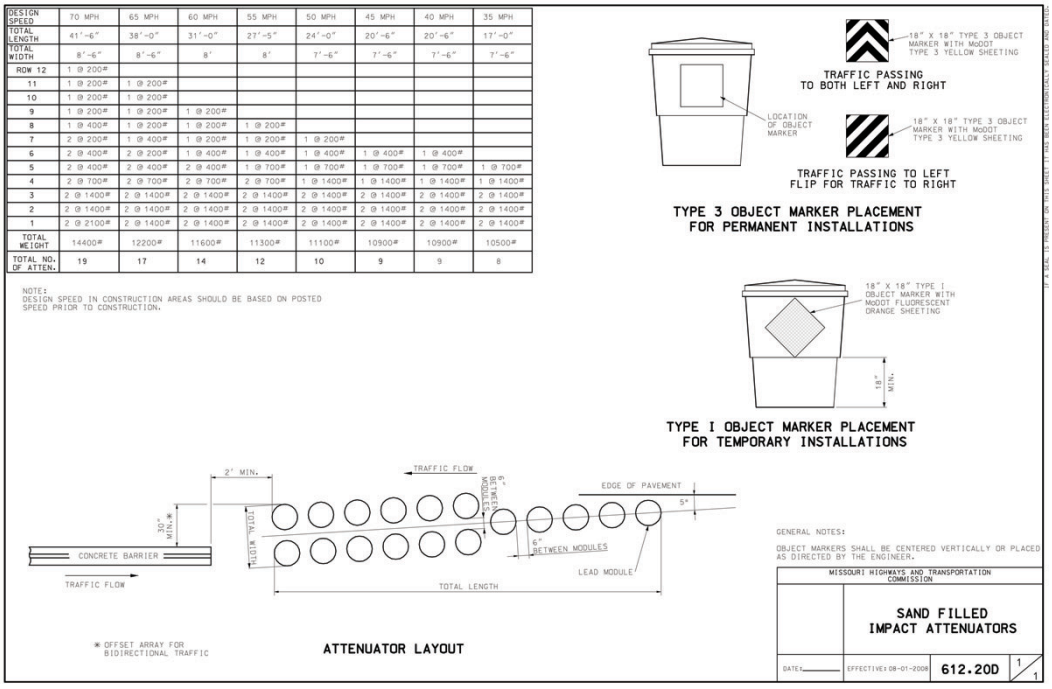
Crash cushions mitigate the effects of errant vehicles impacting roadside obstacles such as fixed objects or exposed barrier and guardrail ends. The system is designed to accomplish this by either smoothly decelerating the vehicle to a stop or redirecting the vehicle.

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

This system consists of a group of freestanding plastic barrels configured in increasing weights from the impact point toward the object. Such an array transfers the vehicle's momentum to the increasing masses of sand in the barrels and provides a gradual deceleration.

Each barrel is designed with a specific weight of sand to absorb the energy of an errant vehicle.

The sand barrel array's "footprint" length and width and the number of barrels will change based upon the vehicle speed. ***Refer to Standard Plan 612.20 for details.***



DESIGN SPEED	70 MPH	65 MPH	60 MPH	55 MPH	50 MPH	45 MPH	40 MPH	35 MPH
TOTAL LENGTH	41'-6"	38'-0"	31'-0"	27'-5"	24'-0"	20'-6"	20'-6"	17'-0"
TOTAL WIDTH	8'-6"	8'-6"	8'	8'	7'-6"	7'-6"	7'-6"	7'-6"
ROW 12	1 @ 200#							
11	1 @ 200#	1 @ 200#						
10	1 @ 200#	1 @ 200#						
9	1 @ 200#	1 @ 200#	1 @ 200#					
8	1 @ 400#	1 @ 200#	1 @ 200#	1 @ 200#				
7	2 @ 200#	1 @ 400#	1 @ 200#	1 @ 200#	1 @ 200#			
6	2 @ 400#	2 @ 200#	1 @ 400#	1 @ 400#	1 @ 400#	1 @ 400#	1 @ 400#	
5	2 @ 400#	2 @ 400#	2 @ 400#	1 @ 700#	1 @ 700#	1 @ 700#	1 @ 700#	1 @ 700#
4	2 @ 700#	2 @ 700#	2 @ 700#	2 @ 700#	1 @ 1400#	1 @ 1400#	1 @ 1400#	1 @ 1400#
3	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#
2	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#
1	2 @ 2100#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#	2 @ 1400#
TOTAL WEIGHT	14400#	12200#	11600#	11300#	11100#	10900#	10900#	10500#
TOTAL NO. OF ATTEN.	19	17	14	12	10	9	9	8

Protective Vehicles

Protective vehicles are used to safeguard the workspace 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.

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 workspace, and ***maintains a recommended minimum of 150 ft. clear roll ahead distance*** between the vehicle and the workspace.

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.

The National Cooperative Highway Research Project tests and sets crash criteria for TMAs and has approved two types of TMA devices: the **230 and 350. Only 350-tested units can be used on MoDOT construction projects. MoDOT crews can continue to use both types on the state highway system, but the 230 TMAs can only be used on minor routes. The 230 units are to be marked "for use on minor routes only" and must be relocated to maintenance areas that maintain a large proportion of minor routes.**

Trailer-Mounted Attenuator

In 2006, MoDOT began using several trailer-type TMAs. These TMAs are pulled by the host vehicle as opposed to being loaded in or on the vehicle. The trailer-type TMAs comply with NCHRP 350.

TMA Positioning

Proper positioning of the TMA vehicle within the work zone is critical to its effectiveness. The TMA vehicle location should provide sufficient warning to approaching traffic and maximum protection for workers. It should:

- Maintain a minimum of 150 ft roll ahead distance
- Be parallel to traffic at all times
- Wheels aligned with traffic

In general, the guidelines for the use of these devices are shown in Table 612.1 Use of TMA's

Highway Type	Operation Location and Duration		
	In Lane		On Shoulder and Ramps and at Intersections
	Mobile	Stationary	
Two-Lane Undivided	Recommended	Recommended	Recommended
Multi-lane Undivided	Required	Recommended	Recommended
Multi-lane Divided[1]	Required	Required	Recommended

[1] On MoDOT's internal interstate maintenance operations, the host vehicle shall be a Heavy-Duty Single Axle Truck style or heavier, and meet the truck-mounted and trailer-mounted attenuator manufacturer's recommendations.

Chapter 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 of the following is NOT a sign classification?
   a. Regulatory
   b. Mandatory
   c. Warning
   d. Guide

3. Each portable 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 each
   d. Maximum of three phases with three lines each

4. The protective vehicle should position the front wheels:
   a. Aligned with the traffic
   b. Turned away from the traffic towards the shoulder
   c. Turned towards the traffic away from the work space
   d. None of the above

5. If a protective vehicle is used, a vehicle-mounted sign is recommended and should be mounted _____ inches above the road surface.
   a. 24
   b. 36
   c. 48
   d. 54

6. Which sign is not regulatory?
   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 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. When deployed, the bottom of a portable changeable message sign should be a minimum of _____ feet, vertically, from the bottom of the sign to the roadway.
   a. 1
   b. 3
   c. 5
   d. 7

CHAPTER 5

Quality Requirements

Temporary traffic control devices shall be installed and maintained in an acceptable condition. Unless specified otherwise, this requirement does not mandate the use of new devices. However, it does 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 MoDOT's representative.

Quality Standards

It is with this possibility in mind and to provide the means to comply with the *Manual on Uniform Traffic Control Devices'* Section 1A-05 that MoDOT established ***Article 616.19 in the EPG***. These quality standards are applicable to all temporary traffic control devices and are to 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
- Routinely during the course of work

Such scrutiny will ensure the effectiveness of the temporary traffic control devices throughout the life of the work zone.

General

All temporary traffic control devices shall be:

- In conformance with the requirements of the 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; or, are cause for 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
- Refer to sign covering practices and, for examples of unacceptable devices, refer to unacceptable standards

Warning Lights

These devices shall be:

- Visible from a distance of 3,000 ft. on a clear night for Type A (low-intensity, flashing) and Type C (low-intensity, steady-burn) and from a distance of 1,000 ft. 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 the 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
- 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

These devices shall be/have:

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

Temporary Pavement Markings

These devices shall be:

- In place at applicable times
- Reasonably aligned longitudinally
- Clearly visible to approaching traffic during the day and night
- Completely removed when no longer applicable

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

Examples of acceptable sign covering practices:

Examples of unacceptable sign covering practices:

Unacceptable Devices

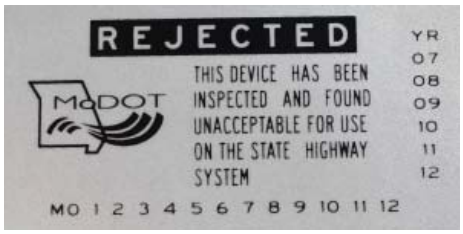
Shown below are examples of unacceptable temporary traffic control devices. These examples apply to all such devices.

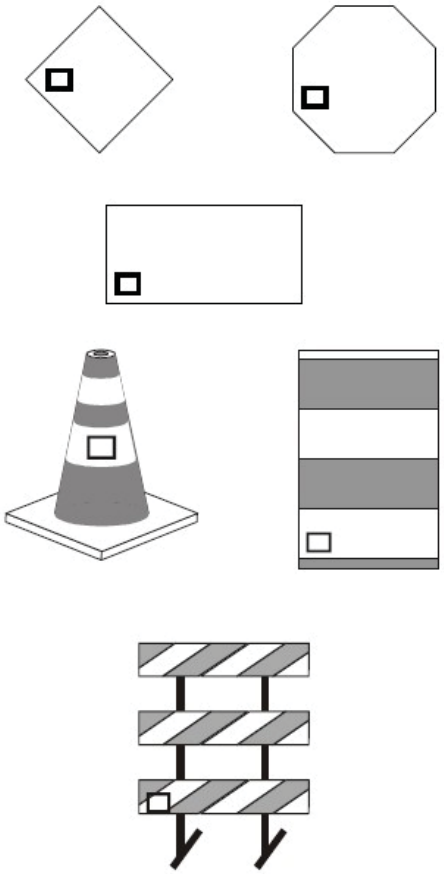
Rejection Stickers

R11-52 REJECTED Decal (Order No. MoDOT 46)

REJECTED stickers, with appropriate month and year designated, may be used by MoDOT personnel to identify unacceptable temporary traffic control devices. For barricades, channelizing devices and signs, the sticker should be located on the front, left and lower-most retroreflective area on the device. For other devices, the sticker should be located in a conspicuous place on the device.

Below are examples of rejection sticker locations:





Speed Limits

MoDOT 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 motorists and a false sense of security for workers.

Should a reduced speed limit be deemed appropriate, the table on pg. 63 shows the recommended maximum speed reductions or the minimum speed that may be imposed in temporary traffic control zones.

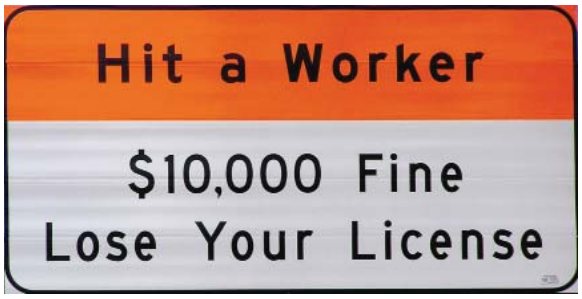
After selecting a reduced speed limit based upon the speed table, the following guidelines will assist in the proper installation and application of that reduced speed limit in the temporary traffic control zone.

- 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.
- For two-lane roadways, normal SPEED LIMIT signs are typically installed opposite the work zone SPEED LIMIT sign on the opposite approach facing traffic leaving the work zone.
- Reduced SPEED LIMIT signs are not to be installed on side street approaches or ramps for work limited to main line only. Reduced SPEED LIMIT signs may be installed downstream from the ramp or side street to inform drivers of the work zone speed limit. If the work is on the ramp, or affects the ramp, reduced SPEED LIMIT signs are to be used.
- Posted work zone speed limit shall not be below 35 mph, except when local ordinance provides for a lower speed. The lower speed shall be used when applicable.
- Appropriate warning signs with advisory speed plaques should be used to advise of any specialized situations (i.e., temporary bypass, narrow lanes, etc.).
- For approved speed reductions greater than 10 mph, additional notification should be provided through the use of the SPEED LIMIT XX AHEAD sign. Refer to EPG 616.29.3 Work Zone SPEED LIMIT Figures.

- For approved speed reductions greater than 20 mph, the speed limit should be reduced in two stages. Refer to EPG 616.29.3 Work Zone SPEED LIMIT Figures.

Activity (i.e. Workers, Equipment or Material) Location	Recommended Work Zone Speed Reduction (When Applicable)
10 ft. beyond edge of travelway to edge of right of way	No speed reduction
In traffic lane or within 10 ft. of the traffic lane	10 mph
Head-to-head on multilane	10 mph
Special circumstances within a temporary traffic control work zone may warrant a lower speed limit than recommend above. All speed limit reductions greater than 10 mph shall be documented, submitted to and approved by the District Work Zone Coordinator.	

Fine Signs



In an attempt to improve work zone safety, the legislature passed a bill in 2001 and amended it in 2006, to provide for increased fines for speeding or speeding and passing in properly posted temporary traffic control zones when workers are present. The required posting is accomplished though the installation of fine signs.

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 include:

- 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

To be fined an offender must be found guilty of one or more of the following:

1. Exceeding the posted speed limit by 15 mph or more
2. Passing another vehicle in a work zone and such offense results in the death or injury of a highway worker
3. Failing to stop for a work zone flagman or fails to obey traffic control signals erected in the work zone
4. Physically assaulting or attempting to assault a highway worker with a motor vehicle or other instrument
5. Intentionally striking or moving 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
6. Commiting 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)

- 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

Fine signs provide the motorist with information on the amount of fine and for what action the fine will be assessed. As with other regulatory signs, these signs are most effective if they are properly applied and enforced.

The implementation of the speeding portion of this provision may be considered when all four of the following criteria are met or where, upon the judgment of the supervisor, there is a need to control speed through the temporary traffic control zone.

- Work duration longer than 4 hours
- Reduced speed limit in effect
- Normal posted speed is greater than or equal to 60 mph
- Workers on roadway without barrier protection

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 multilane highway consisting of a maximum of two lanes in the affected direction.

CHAPTER 6

Applications

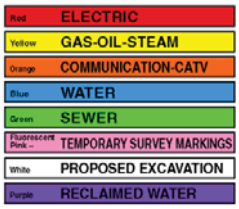
Railroads

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.

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 shall be placed at the start of the project. ***Signs should also be installed within 150 ft. after the intersection of a state highway. Upon the discretion of the supervisor, additional signs may be installed within 150 ft. after other intersections.*** Where the FRESH OIL/LOOSE GRAVEL affected area is discontinuous, additional signs should be considered.

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
   - Determine the location of the work space
   - From the work space, measure the appropriate distance for any buffer space
   - From the “upstream” end of the buffer space, measure the appropriate distance for the transition area taper
   - From the “upstream” end of the transition, measure appropriate distance for the shoulder taper
   - 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)

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.

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.

When to inspect:

Work zone supervisors need to check the flow of traffic to ensure traffic is flowing as it was designed:

- Immediately after work zone set up
- After any modifications
- At night
- Intermittently throughout the duration of the job
- Under adverse weather conditions such as wind, rain, fog or snow

Work Zone Inspection Form

Work Zone Information

District_____ County_____ Designation/Route/Direction_____ Project #_____ Work Zone # _____

Route/Intersection_____(Beginning) Route/Intersection_____(Ending)

Weather: Clear___Cloudy___ Rain___ Snow___ Ice___ Windy____

Date:_____ Time:_____AM/PM Reviewer User ID: _____

Yes/No/Not Applicable	Items Reported
Yes/No	Does this work zone present an immediate danger to the traveling public or workers and need to be addressed immediately?

Warning

Y /N /NA	1. The changeable message sign (CMS) and/or dynamic message sign (DMS) is aligned with the road user's line of vision.	Y /N /NA	3. The CMS/DMS has an acceptable lateral clearance from the roadway.
		Y /N /NA	4. All signs were present and in proper sequence.
Y /N /NA	2. The CMS/DMS cycle is consistent with the driver's operating speed.	Y /N /NA	5. Signs are free from obstructions (vegetation, traffic control devices, etc.).

Signing - Vision

Y /N /NA	1. The CMS/DMS has the proper light intensity for the work zone conditions.	Y /N /NA	4. The arrow board has the appropriate light intensity for the work zone conditions.
Y /N /NA	2. Sign(s) location and placement is appropriate for field and geometric conditions.	Y /N /NA	5. The temporary traffic signal(s) is clearly visible to oncoming traffic.
Y /N /NA	3. The arrow board is aligned with the road user's line of vision.	Y /N /NA	6. The arrow stem did not have in excess of one lamp out.

Signing - Message

Y /N /NA	1. The CMS and/or (DMS) is reporting the proper message.	Y /N /NA	5. The arrow board is functioning in the appropriate mode.
Y /N /NA	2. The CMS/DMS display is understandable.	Y /N /NA	6. The arrow head did not have any lamps out.
Y /N /NA	3. The work zone signs convey the proper message.	Y /N /NA	7. The stop bar or sign clearly indicates where to stop for a signal.
Y /N /NA	4. There was appropriate sign coverage, when required.	Y /N /NA	8. Appropriate use of "No Center Stripe" sign(s).

Personnel

Y /N /NA	1. The flagger was using proper safety attire and equipment for the work zone activity.	Y /N /NA	4. The flagger is attentive and focused on traffic control.
		Y /N /NA	5. The flagger has an escape route.
Y /N /NA	2. The flagger is in a safe and appropriate location in relation to the work zone activity, equipment, and travel roadway.	Y /N /NA	6. The flagger location was properly illuminated.
		Y /N /NA	7. All workers are safely within the boundaries of the work zone.
Y /N /NA	3. If more than one flagger is present, they are communicating properly with each other.		

Channelizing Devices/Barricades

Y /N /NA	1. Channelizer location and placement is appropriate for field and geometric conditions.	Y /N /NA	4. The pavement markings are installed and removed properly and are not in conflict with other markings.
Y /N /NA	2. The work zone uses appropriate transition (taper). If no, is it too long or too short (please circle)?	Y /N /NA	5. The pavement markings are visible in current environmental conditions.
		Y /N /NA	6. The barricade(s) have appropriate striping for work zone usage.
Y /N /NA	3. The pavement markings are complete and appropriate for the work zone activity.	Y /N /NA	7. The barricade location and placement is appropriate for field and geometric conditions.

Speed

Y /N /NA 1. The appropriate speed limit is set for the work zone. If no, was it too high or too low (please circle)?

Yes/No/Not Applicable	Items Reported

Timeliness

Y /N /NA	1. Lane closures are appropriate for the work performed.	Y /N /NA	4. The temporary traffic signal(s) is operating at an appropriate timing to accommodate traffic queues.
Y /N /NA	2. Traffic flow did not slow or stop unnecessarily.	Y /N /NA	5. If a detour was used, the length of the detour was acceptable.
Y /N /NA	3. The traffic queue is not unnecessarily excessive.		

Cleanliness

Y /N /NA	1. Sign(s) are clean, visible, and suitable for work zone conditions.
Y /N /NA	2. Channelizer(s) are clean, visible, and suitable for work zone conditions.
Y /N /NA	3. Barricade(s) are clean, visible, and suitable for work zone conditions.

Safety

Y /N /NA	1. The traffic queue is within the work zone signs.	Y /N /NA	9. Work zone lighting location, placement, and intensity is appropriate for the field and geometric conditions.
Y /N /NA	2. The arrow board lateral clearance is at an acceptable distance from the roadway.	Y /N /NA	10. Fleet lighting location, placement, and intensity is appropriate for the field and geometric conditions.
Y /N /NA	3. The channelizers use proper and approved ballasts.	Y /N /NA	11. Equipment and/or vehicles are moving in the same direction as traffic flow.
Y /N /NA	4.The barricades use proper and approved ballasts.	Y /N /NA	12. Edge drop-off is appropriate for the field and geometric conditions.
Y /N /NA	5. The signs use proper and approved ballasts.	Y /N /NA	13. There were no unnecessary adverse pavement conditions (e.g., ruts, pot holes, bumps, debris, etc.).
Y /N /NA	6. The temporary traffic signal is operating correctly.		
Y /N /NA	7. The Automatic Flagger Assistance Device is operating correctly.		
Y /N /NA	8. The Truck or Trailer Mounted Attenuators were located properly within the stationary or moving operation work zones.		

Provide necessary detail on "No" ratings:

Reviewer shall convey any comment(s) to appropriate district staff. The above comment(s) were conveyed to

Name: _____

Title: _____

Date and Time of Review: / / _____:_____a.m./p.m.

If necessary, immediate feedback given to :_____

Phone Numbers for Work Zone Issues

D1	816.387.2350	D6	314.340.4100
D2	660.385.3176	D7	417.629.3300
D3	573.248.2490	D8	417.895.7600
D4	816.622.6500	D9	417.469.3134
D5	573.751.3322	D10	573.472.5333

Chapter 6 Review Questions

1. What sign should be the first to set up in a work zone?
   a. The first sign the motorist's see
   b. The last sign the motorist's see
   c. Start in the middle and work your way to each end
   d. There are no guidelines

2. What is MoDOT's policy on having utilities marked?
   a. Mark them only when you think you are in close contact of a utility
   b. Take paint and mark the area where you think a utility is
   c. Call a utility marking company, have them mark the utility before digging
   d. After you begin digging, call a utility marking company and they will tell you how close you are

3. What determines an inspection frequency of a work zone?
   a. An accident
   b. A change in weather
   c. An increase in errant vehicles
   d. All of the above

4. When removing devices, at what point do you begin?
   a. The first device motorist's see
   b. The last device motorist's see
   c. Start in the middle and work your way to each end
   d. There are no guidelines

5. What should you do if an emergency vehicle approaches the work zone with lights and/or sirens on?
   a. Run away screaming
   b. Contact your supervisor, and if authorized let the vehicle through
   c. Let the vehicle through
   d. When safe let the vehicle through

6. What should you do if you find an unacceptable work zone device while out on the job?
   a. Replace it as soon as possible
   b. Continue working, there is nothing you can do
   c. All devices are acceptable
   d. As long as it is orange and white it is ok

Def nitions

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.

Advance Warning Rail System - Three barricade rails installed to enhance a warning sign and flags.

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

Annual Average Daily Traff c (AADT) - 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 workspace or an unsafe condition.

Changeable Message Signs (CMS) - portable signs capable of displaying several messages in a sequence and display pertinent traffic operational and guidance information as well as advise drivers of unexpected work zone traffic and routing situations.

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

Cluster Marking - A group of Type I and/or Type II temporary pavement markings installed on the roadway shoulder or centerline, as described in Standard Plan 620.10.

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.

Delineator - Device used to mark the edge of the roadway.

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.

Flag System – A flag bracket and two flag assemblies. Flags are used to enhance signs.

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 and 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.

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 workspace 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 longer 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 and below.

Low Volume - 500 or less AADT. The rule of thumb is to 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; is for optional practice(s) with no requirement or recommendation.

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

Motorized Traff c - Movement of vehicles and equipment on the roadway.

Multilane 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 Traff c - 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.

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

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

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

Shall – Mandatory; **Shall** and **Will** indicate mandatory practice. Contract documents often contain independent definitions.

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; indicates something is expected or typically necessary. The action is not absolutely mandatory but deviation from this practice calls for engineering documentation.

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 where 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 channelizers and/or pavement markings used to move traffic into the intended path.

Temporary Traff c Barrier - Temporary traffic control device used to create a physical separation between traffic and the workspace, an unsafe condition, or non-motorized traffic.

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

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

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

Temporary Traff c 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 vehicle to the last temporary traffic control device.

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

Traff c - Highway user.

Traff c 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 the 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 workspace.

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

Workspace - Area within the activity area closed to traffic and set aside for workers, equipment, materials and a protective vehicle, if one is used upstream. Channelizers usually delineate workspaces.

Work Vehicle - Any vehicle by 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.

Refer to ***902.12*** Glossary for definitions of interchange, intersection and right of way.