



COLORADO

Department of Transportation

**Variable Message Sign (VMS)
Statewide Guidelines**

Revised December 2022



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Quick Start Guide

Overview

This Quick Start Guide provides the operator with a quick summary of the required steps of the principles governing the use of Variable Message Sign (VMS) messages to ensure messages are used in a consistent and orderly manner statewide while adhering to Federal standards. Not all projects will follow this typical pattern. This Quick Start Guide addresses if and when exceptions or deviations from these guidelines can be made in addition to the following:

- When to Use VMS messages
- Exceptions or Deviations
- Prioritization of VMS Messages
- Improper Use of VMS messages

When to Use VMS Messages

CDOT Operation Center staff members (i.e. operators) have the authority and ability to create individual messages or message sets as needed, and place messages on VMS boards in their respective areas of responsibility as defined by **Table 2**. Messages should adhere to established guidelines and should be approved by Operations Managers.

Message initiation is determined by operations staff, or when message activation is requested (informal or formally) from a verifiable and credible source (e.g. Regional Leadership, CDOT Incidents Commanders, Colorado State Patrol).

Each Operation Center (OC) and their staff will be responsible for removal of subject messages when applicable. The individual CDOT Regions, through their PIO or Regional Leadership, however, will have override authority for the VMS boards in their jurisdiction when requested, through email, through the respective OCs and approved by Operation Managers. Those messages shall adhere to the standards set forth in this document. Typical CDOT VMS messages have been developed for operators and are provided in [Appendix A](#). Please reference Appendix A before creating, activating, or displaying a new message.

Exceptions or Deviations

CDOT uses the **MUTCD** standards for signage located in its right-of-way. It is understood, however, that each highway event has its own unique attributes, and that pre-formatted message content may not be suitable in all cases. While it is possible to change, adapt or modify messaging on signage, certain criteria should still be met when deviating from standard message content. The Real-Time Operations branch is responsible for providing

guidance on VMS messaging. The Region and/or Staff Traffic should determine the when and where for messaging with input from DMO (Operations Centers) and Regional Maintenance Teams. The ITS branch is responsible for resolving system issues (i.e. device malfunction, new installations).

Portable VMS messages used in work zones shall comply with CDOT's Standard Specifications and consult the Resident Construction Engineer for guidance on when, where and how to use a Portable VMS.

Newly composed messages that are exceptions or deviations from these guidelines must be reviewed and approved by CDOT Headquarters, including the Real-Time Operations Branch, the CDOT Office of Communications and the Regional Operations Managers prior to displaying these messages. Operations Staff have authority to display exceptions or deviations as needed for unique situations, but these exceptions should be approved by the Operations Manager.

Prioritization of VMS Messages

Messages dealing with traveler safety and road conditions shall take precedence over informational messages. In addition, in alignment with the **MUTCD**, typically Regulatory messages (e.g. Wind Restriction) supersedes Warning messages (e.g. Crash Ahead). The table below provides a Prioritization Matrix to help Operators with message priority guidelines.

Table 1: VMS Prioritization Levels

1	Full Road Closure
2	Active Regulatory Restriction (e.g. Chain Law/Traction Law/Wind Restriction)
3	Lane Restriction (e.g. Crash, Stalled Vehicle, Debris, Emergency Road Work)
4	Active Weather/Road Condition Information (e.g. Wind Advisory, Storm Messaging)
5	AMBER/Silver/Blue/Medina Alert/Missing Endangered Person Advisory (MEPA) Utilized only when an email notification is received from the Colorado Bureau of Investigation (CBI) have established an AMBER Alert Policy in the event of child abduction. VMS procedure is detailed in that policy. CDOT will comply with VMS messaging as requested for other Alert types through CBI to the extent that viable and credible information is available. Message duration will be set at 3 hours unless directed otherwise from CBI.
6	Pre-Storm Messaging (e.g. Winter Weather)
7	Planned Events (e.g. Races)
8	<p>Sign Testing Acceptable messages should state “TEST MESSAGE” or “SIGN UNDER TEST.”</p> <ul style="list-style-type: none"> • The operator of a VMS board may use an SSM for testing purposes <p>To ensure that there are no missing pixels, and the message can be clearly understood, the operator shall closely monitor signs utilizing an SSM for testing.</p>
9	Public Service Announcements (e.g. Safety)
10	Travel Time Messages: Trip Travel Time messages generally post in conjunction with other messages when possible



Improper Use of VMS messages

Improper VMS use, or inaccurate information can erode motorist confidence and reduce overall sign effectiveness. Therefore, the following shall not be applied to VMS messages.

- Display advertising messages or messages that could be considered advertising displays.
- Detour motorists to arbitrary routes. Prior to displaying a detour route, the VMS operator should know the current traffic conditions. Operators should have all of the detour route constraints from region, incident command, law enforcement, and/or emergency services.
- Use message techniques that include fading, flashing, exploding, dissolving, or moving messages.
- Display of the following graphic:
 - A flashing flagger symbol on a portable message sign in lieu of a live flagger.
- Display any safety or transportation-related message if doing so would adversely affect the public's respect for the sign

Overview

The purpose of these guidelines is to establish Colorado’s standards for messaging on Variable Message Signs (VMS) and ensure VMS messages are used in a consistent and orderly manner statewide while adhering to Federal standards. VMS messages are designed for the purpose of traffic control, traffic management, public services messaging and timely traveler information. CDOT personnel should use this document when making decisions on when, where, and how to effectively deploy VMS for providing real-time motorist information.

These guidelines supersede the VMS Guidelines - October 2019.

Introduction

Variable Message Signs (VMS), also known as Dynamic Message Signs (DMS), Variable Message Boards (VMB), or Changeable Message Signs (CMS), are a valuable and effective information tool used to disseminate information to motorists related to construction activities, incident management, traveler information, and maintenance activities. In addition, they can be effective for large special events that significantly impact traffic flow. Care must be taken, however, that the VMS is not used for advertising or for events outside of traffic or travel information. Ultimately, the successful use of VMS depends upon the accuracy, reliability and timeliness of the information being displayed. Used effectively, the VMS will provide changing—but specific information to the driver. The text on all VMS and DMS signs appear as all capital letters. For example:

A roadway problem	LEFT LANE CLOSED
The approximate location	1 MILE AHEAD
The instruction to the motorist	MERGE RIGHT

There are several possible roadway elements that a VMS can be utilized to notify the traveling public about. These include:

- Construction or Maintenance Activities
- Incident Management
- Traveler Information
- Weather or Roadway condition Alerts
- Specialty messages such as Amber, Silver and Blue alerts

As with other traffic control devices, **credibility of the message is critical**. Without credibility, even the best message will go unheeded. Care must be taken not to display a message that motorists become desensitized by, disregard or discover to be incorrect. Signs are a primary channel of communication to the motorist and message content must

be concise, consistent across the state and nation as well as understandable and pertinent.

Principles

This guideline sets forth the basic principles governing the use of VMS messages. All standards cited in these guidelines are required by the Federal Highway Administration's (FHWA) Manual on Uniform Traffic Control Devices for Streets and Highways - 2009. Exceptions or deviations from these guidelines should be discussed with CDOT Headquarters including ITS Resident Engineer, Public Information Office, and / or the Operations Director. As stated in the **MUTCD, Section 1A.02**, to be effective, the VMS message should meet the following requirements:

- Fulfill a need
- Command attention
- Convey a clear, simple meaning
- Command respect of road users
- Give adequate time for proper response

Each VMS message shall be displayed for a specific purpose such as those provided in this guideline. VMS messages requested for roadway conditions or restrictions should be removed immediately when those conditions cease to exist or the restrictions are withdrawn. Identical conditions should always be given the same VMS message irrespective of where the conditions occur, message content should not vary from road to road or region to region.

Improper Use of VMS Messages

Improper VMS use, or inaccurate information can erode motorist confidence and reduce overall sign effectiveness. Therefore, the following shall not be applied to VMS messages.

- Display advertising messages or messages that could be considered like advertising displays. Detour motorists to arbitrary routes. Prior to displaying a detour route, the VMS operator should know the current traffic conditions and route constraints.
- Use message techniques that include fading, flashing, exploding, dissolving, or moving messages.
- Display of the following graphic:
 - A flashing flagger symbol on a portable message sign in lieu of a live flagger.
- Display any safety or transportation-related message if doing so would adversely affect the public's respect for the sign.

When to Use A VMS

As stated in this document, the CDOT Operations Centers (also known as Traffic Management Center) shall have the authority to place messages on VMS in their respective areas of responsibility. Messages are to be determined by operations staff, or, when message activation is requested from a verifiable and credible source (e.g. CDOT, Colorado State Patrol). Each Traffic Management Center (TMC) will be responsible for removal of said messages when applicable. The individual CDOT Regions, however, will have override authority for the VMS boards in their Region when requested through the respective TMC as shown in **Table 2** but those messages shall adhere to the standards set forth in this document. Messages dealing with traveler safety and road conditions shall take precedence over informational messages.

Table 2: Statewide Traffic Management Centers:

These numbers are not public numbers and should not be displayed on public websites.

1 & 4	<ul style="list-style-type: none">● Golden (Sections 1 and 5)● Golden (Section 9)	303.512.5830 303.512.5757
2	<ul style="list-style-type: none">● Pueblo	719.562.5555
3 & 5	<ul style="list-style-type: none">● Hanging Lake Tunnel	970.945.3840

* Note as of Feb 1, 2022, all Eisenhower-Johnson Memorial Tunnel "operations" were relocated to Golden (Section 9).

As stated in the **2009 MUTCD, Section 2L.02**: "Changeable message signs shall display only traffic, operational, regulatory, warning and guidance information. Advertising messages shall not be displayed on changeable message signs or its supports or other equipment."

With these facts in mind, the following are examples of when to use a VMS.

Table 3: VMS Message Types and Uses

Regulatory	Chain Law/Traction Law/ Wind Restriction	VMS may be utilized to communicate regulatory restrictions to commercial motor vehicles or the public.
s	Crashes/Incidents	A crash with a minimum of blockage and with short time duration may be appropriate for a VMS warning. In rural areas, the distance between the crash site and the closest VMS should also be considered. Incidents that block lanes are ideal for getting information to the traveling public. Messages near the incident can inform motorists of the problem and move cars into open lanes. Signs farther away from the incident can suggest alternate routes.
Advisory	Traffic Diversion	VMS may be used when viable alternate routes are indicated.
Advisory	Traffic Incident Management Plan (TIMP)	Use VMS signs per the traffic management strategies outlined in existing TIMP. Statewide, regional, corridor-wide as well as project-wide incident management plans have been developed to facilitate response to incidents and help mitigate traffic congestion. As directed by the Incident Commander, implementation of various levels of traffic management plans for events (i.e. use of pre-identified traffic detour routes) incorporate strategic use of VMS signs. Reference the TIM website for an overview and the Resources webpage for more information.

Advisory	Notice of Roadwork	This warns motorists of construction or maintenance activities that will impact traffic flow. This may include lane closures, lane shifts, two-way traffic, shoulder work, and construction traffic entering the highway, detours, etc. This will supplement normal roadwork signing as required by the MUTCD .
Advisory	Regulatory messaging	VMS are currently allowed by law to be used for regulatory purposes in two situations: during the use of High Occupancy Vehicle (HOV) lanes, High Occupancy Toll (HOT) lanes, Express Lanes and to inform drivers the chain/traction laws are in effect. VMS can be used to supplement regulatory signs in these two situations.
Advisory	Current Weather or Roadway Conditions	Messages will be used to display current adverse weather or roadway conditions that may impact roadway safety. These conditions may include snow, ice, fog, dust storms, falling rocks, high winds, storm warnings etc.
Advisory	Operation with Lane Control Signals	Typically used in the tunnels and managed lanes, these signs have a red 'X' in the closed lane and a green arrow in the open lane and yellow chevrons to direct traffic.
Traveler Information	Display of Future Roadwork	Motorists will be warned of road construction activities in the near future (within a week) that will adversely affect traffic. These messages will give the regular traveler a chance to change routes or travel times.
Traveler Information	Display information for Other States	Adjacent states may have incidents that force the closure of a major highway. Messages on the same corridor or connecting corridor can inform interstate travelers of the incident.

Traveler Information	Test Messages	During initial VMS burn-in or during maintenance, test messages are a necessary function. These messages are for limited duration.
Traveler Information	Trip Travel Time	Trip Travel Time (TTT) Estimations have been established along several main corridors. TTT should be maintained whenever possible as a second panel of a message set and should be omitted or disabled if message content extends to 3 panels.
Traveler Information	Special Events that Impact Traffic Flow	These messages display information about future or current events that impact traffic flow and roadway safety. There may be times where static signs would be a more appropriate use. The messages should be displayed within a week of or during the event.
Traveler Information	Chain Station Information	According to Colorado Revised Statute 42-4-106 VMS may be used to convey chain station information to commercial transportation. Information may include parking availability, station location or other pertinent safety information.
Traveler Information	Weather Warning/ Pathfinder Messaging	Pathfinder messaging is utilized to forewarn drivers of expected weather events that are anticipated to impact travel conditions. Messages are intended to be as specific as possible as to expected conditions and content may be aligned with other states or regions messaging. Message examples include, Watches, Warnings and Advisories, Heavy Snow, Freezing rain, Icy Bridges, High Winds, Blizzard conditions etc. Generic or vague descriptions such as “Winter driving conditions” should be avoided.

Public Service Announcements	General Public Service Messages	Public service announcements (PSA) may be displayed on a limited, short-term basis, so that the primary purpose of the signs will not be degraded. PSA messages should be used sparingly in urban areas during peak traffic periods. Care should be taken to avoid PSA messages running for long periods of time. When possible, messages should be rotated for campaigns lasting more than one week.
Public Service Announcements	Amber Alert/Silver Alert/ Blue Alert/Hit and Run (Medina) Alerts	CDOT, in partnership with the Colorado Bureau of Investigation (CBI) have established an Amber Alert Policy in the event of child abduction. VMS procedure is detailed in that policy. CDOT will comply with VMS messaging as requested for other Alert types through CBI to the extent that viable and credible information is available. Message duration will be set at 3 hours unless directed otherwise from CBI.
Public Service Announcements	High Fire Danger / No Open Burning	Due to the nature of travel across Colorado, messages such as controlled burn, forest fire and high fire danger and no open burning information are considered appropriate messages. The U.S. Forest Service or local law enforcement will notify CDOT in the event of a high or extreme fire danger or no open burning requiring public notice.
Public Service Announcements	Driver Safety Campaigns	Messages related to driver safety campaigns will be allowed if other media is used, such as radio, TV, newspapers, billboards, etc. This is necessary since the message could be confusing to drivers if they have not been exposed to the information.

<p>Public Service Announcements</p>	<p>CDOT Public Education</p>	<p>Messages informing travelers about information sources such as 511, COtrip.org and the availability of wireless alerts can be rotated in as with PSA messages. This includes programs such as trucker education including messages similar to “Truckers Winter is coming, Got Chains?” and “Trucks must carry chains west of Denver.”</p>
<p>Public Service Announcements</p>	<p>COtrip.org Only</p>	<p>VMS may only be used to show “URL” info only when it is directed to a CDOT or Government site such as cotrop.org. Such sites should only be used for traveler information or other important data. Use of web addresses on VMS should be posted on a limited basis and shall not be used to advertise for projects or services. Addresses should be short and easily read at highway speeds and should refrain from using the HTTP:// and “WWW” prefixes. Messages falling outside these restrictions will require review by CDOT Public Information or the Chief Engineers office.</p>

<p>Public Service Announcements</p>	<p>Remembrance messages/Dignified Honors</p>	<p>Sadly, CDOT is often asked to post messages for Law Enforcement or Highway workers killed in the line of duty. In addition, Federal Protection Agency agents will request similar signage for fallen soldiers when transporting these heroes to their final resting place. CDOT will support these requests in the following manner. For first responders killed in the line of duty: Prior to the memorial motorcade, regional VMS may be used to warn travelers of pending road closures, delays or other roadway impacts during the staging, services or motorcade. When possible, signage close to the staging or along the route, may be used to post a “remembrance” message such as “COLORADO REMEMBERS (RANK/NAME)” and should be left for the family to see the message before its removal. For CDOT personnel, Remembrance messages may be posted along a route when a procession is traveling. CDOT remembrance messages are usually posted prior to the motorcade traveling under the sign then removed after the passage of the vehicles. Location of the motorcade being communicated along the route with the area TMC. Regional signage may be requested by executive or regional management, but it is suggested that it be used only along the procession route or in localized areas for a short duration. For Dignified honors, message placement should be along the procession route and removed as the motorcade passes. Message content may vary, but in general “DIGNIFIED HONORS (RANK/NAME) ROLLING CLOSURES BRIEF DELAYS POSSIBLE” is a suitable message.</p>
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Blank Signs

As noted in the **MUTCD**, it is preferred that VMS be in a blank mode when traffic, roadway, environmental, or pavement conditions or public service announcements do not warrant the display of a message.

Message Content

Variable Message Signs provide a versatile means of communication. Motorists have difficulty perceiving, processing, and remembering a large amount of traffic information at one time. Therefore, information must be properly presented to motorists in a concise and clear format for the drivers to interpret at high speeds to reduce potential distractions. This section will illustrate how to write and display the message to give brief, clear and accurate information to the motorists that avoid confusion, improve traffic flow, and enhance safety.



Timing

Messages should provide motorists with enough information to make a timely driving decision. The reading time is the time it actually takes a driver to read a sign message. The exposure time is the length of time a driver is within the legible distance of the message. Therefore, the exposure time must always be equal to or greater than the reading time. Depending upon the speed of the drivers, the message length must be adjusted to ensure the reading time can fit into the exposure time.

The Traffic Control Devices Handbook by the Institute of Transportation Engineers states the **MUTCD** requires minimum legibility of variable message signs at 650 feet and 1,000 feet for higher speed facilities. The following shows how many seconds it takes to travel 1,000 feet at various speeds.

45	15.2
55	12.3
65	10.5
75	9.1

When the VMS displays a series of message panels, 2-4 seconds per message panel is recommended. The following table shows the maximum number of message panels that can be displayed for each speed limit provided there is at least 1,000 feet of site distance.

65	2
75	2

Limit Panels

The limitations to the number of message panels to use is twofold:

1. Motorists should be able to read the message twice while traveling at the posted speed.
2. As Per the 2009 **MUTCD**, section 2L-05, each message shall consist of no more than two phases (panels). A phase (panel) shall consist of no more than three lines of text. Each phase (panel) shall be understood by itself regardless of the sequence in which it is read.

Again, the average motorist at a high rate of speed can comprehend two message panels, and three lines of information for each panel. There will obviously be other times when exceptions must be made but using less than three panels is a good rule of thumb.



Message Unit

In each message there are units of information. A unit is one separate piece of data that the driver can recall and use to make a decision. A unit normally is one or two words but can be up to four words and usually occupies one line on a VMS phase. It is important to remember that it takes a motorist at least one second to read each unit of information. A motorist traveling at freeway speeds of 65 miles per hour (mpg) on average has 4 - 7 seconds to read a VMS message under ideal conditions. Each unit answers a question that a motorist might ask about an event and should be arranged in a logical order that effectively conveys the message to motorists. Generally, this order is the Problem, Location and Effect statement. For example, the following message has four units of information:

What happened?	I-25 Closed
Where?	At Exit 287 Wellington
Who is affected?	All Traffic
What must they do?	Must Exit

Message Length

The message-load for the above is four (4) units, that is reaching the limit for an average person to understand while traveling at a high speed. The message length is the number of words or characters in the message. The average motorist traveling at a high rate of speed can comprehend (eight) 8-word messages of four (4) to (eight) 8 characters per word, (excluding prepositions). Whenever possible, limit units to five (5) or less when operating speeds are more than 35 miles per hour (MPH). The number of panels or frames is another important variable in the construction of a clear message. Abbreviations may be utilized when creating or editing a VMS message. Certain words or abbreviations are evident to the driver. For instance, the use of "Street," "Avenue" or "Boulevard" can be understood as "St." "Ave." or "Blvd." Abbreviations are useful to help reduce the message length and to make the message fit within the limited VMS line capacity. To facilitate ease of understanding, avoid two consecutive abbreviations if possible and do not use three or more consecutive abbreviations. **Appendix B** contains a list of common abbreviations.

Message Familiarity

Message familiarity is another aid for motorists' ability to understand a message. Message familiarity reduces motorist reading and comprehension time, thereby enhancing delivery. When information displayed to motorists is unusual, longer comprehension time is required. Common language is necessary. Appendix A contains a list of typical VMS messages. This is a valuable resource as it helps standardize messages and help motorists comprehend quickly.

To further message comprehension, the following are suggestions taken from research conducted concerning messages drivers can comprehend quickly. The following should be understood before composing a VMS message.

- Drivers have difficulty corresponding calendar days to days of the week. For example, "TUES - FRI" is preferred over "OCT 1 - OCT 4."
- Drivers find the phrase "FOR 1 WEEK" ambiguous. It is preferable to use "WED - TUES."
- Most drivers felt the term "WEEKEND" meant the work would begin Saturday morning and be complete by Sunday evening. It is recommended times and days be used if the work begins on Friday and extends to Monday.
- The highway or route numbers should be displayed with the route or interstate designation. The number alone can be confusing to both local and drivers from other areas.
- When referring to an off ramp, the word "EXIT" is preferred.
- The verb "USE" should be selected to indicate a route that will carry the motorist to a destination.
- The term "CLOSED" is recommended after traffic control is in place.

- When using the word “AHEAD” (without referencing miles) to describe a location, the VMS should be upstream of the incident. Also, the VMS should be on the same route as the incident.
- The verb “FOLLOW” carries the inferred meaning that motorists will be guided by other signs along the route. “FOLLOW” should not be used unless detour signs are in place.
- Mile Markers shall only be used in reference to Chain Law locations, other messages shall have a common reference point such as 2 miles ahead, next 3 miles or a location such as “Georgetown.”

Generic messages such as Winter Driving Conditions shall be avoided, specific descriptions (i.e. Heavy Snow, Icy conditions) are preferred.

“Directive Messaging” or messages that “command action” such as “Slow down” should be used on a limited basis lest we dilute the message. While there are times when these are applicable, constantly using strong language leads to a less impactful result from the boards.

Occasionally, there may be a need to estimate roadway impacts to encourage travelers to use alternate routes or to re-evaluate their travel plans. Examples include stressing expected travel times by adding the qualifier “UP TO” such as “DELAYS UP TO ONE HOUR,” other times estimating extended delay times that can affect traffic significantly, but doing so also runs the risk of having the public lose confidence in future messaging. Reasonable estimates for delays, travel times or impacts should be used and only with the highest impact events or delay scenarios. Estimated ranges of 15- or 30-minute blocks should be used.

Full Matrix VMS Signs

Current and future efforts to modernize the VMS signs in the CDOT network are opening up new possibilities for how messages and information can be displayed with the addition of finer resolution “Full Matrix” VMS signs that are capable of displaying. The following are additional criteria to be used when colored message boards are available. Each TMC operator should understand which VMS have color capabilities to allow for these additional criteria to be utilized, when available.

- All Legends and backgrounds shall follow **MUTCD Table 2A-2**. **MUTCD** approved graphics can be used on Full Matrix VMS boards so long as the pixel resolution allows the graphic to be displayed clearly. (Examples of these messages can be found in Appendix X)
- The colors used for the legends and backgrounds on VMS shall be as provided in the table of “Common Uses of Sign Colors.” (See Table 2A-5 of the 2009 **MUTCD**, or equivalent table in superseding **MUTCD**). A single VMS phase may be used to display a standard static sign as allowed by the **MUTCD**. The image

shall be a reasonable approximation of the standard **MUTCD** sign. Text may be combined with an image of a standard **MUTCD** sign on a single VMS phase.

- Maximum of five different colors can be utilized for one message phase.
- Solid color backgrounds shall not be used when displaying traffic information messages due to the color contrast. Additionally, this could adversely affect the driver's vision and/or cause them to become distracted due to the contrast of the board. If the solid background is emitting light from the actual VMS unit, this is permitted.
- Display of graphics should only appear on full matrix signs and should be an exact duplicate of standard signs, symbols, shields in appropriate color. Approved graphics can either be displayed as a stand-alone message or can be displayed as a supplement to the text within the message.
 - Flashing flagger symbol on portable VMS in lieu of a live flagger
 - Graphics shall not be used if the size of the text will be compromised. Meaning that if the text becomes illegible or the visibility drops below the **MUTCD** guidance the graphic shall not be used.
- Color shall be applied consistently throughout the system; colors shall have the same meaning on each screen.

Message Sets

There are three types of elements to use when messages fall under the categories of Incidents and Traveler Information:

Advisory Signs

The advisory signs display real-time information about freeway status and advisories concerning the best course of action. These will mostly be used for incidents. The advisory sign message should consist of the following:

- A problem statement (accident, road closure, construction, adverse weather, etc.)
- An effect statement (delay, congestion, etc.)
- An attention statement (addressing a certain group or audience)
- An action statement (what to do)

The minimum information is the problem and action statements. The location of the problem is also sometimes useful in a diversion decision.

High Wind	< Problem Statement
Restriction	< Effect Statement
High Profile Vehicles	< Attention Statement
May Be Stopped	< Action Statement

Guide Signs

Guide signs are necessary if the traffic must be diverted due to an incident or construction. The guide signs must provide destination information and route affirmation and direction.

Advance Signs

There are times to inform drivers of incidents farther ahead of the current location. This up-to-date information has the following basic elements that can be communicated:

- Information alert
- Nature of information (best route, traffic conditions, etc.)
- Destination for which information applies
- Location of the information (“AHEAD” or specific distance)
- If there is a diversion situation with known alternative routes available:
 - Route markers of the major alternative routes.

OpenTMS MESSAGES

OpenTMS will produce messaging automatically for the operators for certain Event Types. The format that it is using is as follows:

- A roadway problem **LEFT LANE CLOSED**
- The approximate location **1 MILE AHEAD**
- The instruction to the motorist **MERGE RIGHT**

Message Priority

Typical VMS messages shall fall under the following message priority guidelines.

Table 4: VMS Prioritization Levels

1	Full Road Closure
2	Active Regulatory Restriction (e.g. Chain Law/Traction Law/Wind Restriction)
3	Lane Restriction (e.g. Crash, Stalled Vehicle, Debris, Emergency Road Work)
4	Active Weather/Road Condition Information (e.g. Wind Advisory, Storm Messaging)
5	“AMBER”/Silver/Blue/Medina Alert/Missing Endangered Person Advisory (MEPA) Utilized only when an email notification is received from the Colorado Bureau of Investigation (CBI) have established an “AMBER” Alert Policy in the event of child abduction. VMS procedure is detailed in that policy. CDOT will comply with VMS messaging as requested for other Alert types through CBI to the extent that viable and credible information is available. Message duration will be set at 3 hours unless directed otherwise from CBI.
6	Pre-Storm Messaging (e.g. Winter Weather)
7	Planned Events (e.g. Races)

8	<p>Sign Testing Acceptable messages should state “TEST MESSAGE” or “SIGN UNDER TEST.”</p> <ul style="list-style-type: none"> • The operator of a VMS board may use an SSM for testing purposes <p>To ensure that there are no missing pixels, and the message can be clearly understood, the operator shall closely monitor signs utilizing an SSM for testing.</p>
9	Public Service Announcements (e.g. Safety)
10	Travel Time Messages: Trip Travel Time messages generally post in conjunction with other messages when possible

Portable VMS

The above guidelines apply to all types of VMS, but because of its nature, the following additional guidelines are applicable to the portable VMS.

The proper placement of a portable VMS is critical to its effectiveness. The placement requirement must give the motorist adequate time to react to the message. The VMS must be located prior to major decision points, such as intersections or interchanges, where the driver may change their travel plans. (On the Interstate, or other access-controlled freeways, placement 1 mile prior to the interchange is recommended). Also, it must be placed prior to the present and expected traffic backups.

Placement requirements include:

- To provide 800 feet of sight distance.
- Where signs, poles, or other objects will not obstruct the VMS.
- On a level surface.
- Not within an intersection or interchange.
- Should not interfere with other traffic control devices.

If more than 2 VMS are to be used in sequence, they should be separated by at least 1,000 feet. The sign should be placed off the shoulder of the roadway, behind the guardrail, if

possible, and where it will be accessible to maintenance vehicles even if a traffic queue develops or grows.

To be comfortable to read, the VMS panel should be turned slightly towards the driver's view, at approximately 5 to 10 degrees from perpendicular to the road's centerline. Reading the VMS becomes more difficult as the angle is increased from the normal field of vision. It is recommended to drive by the VMS after installation to be sure the sign is readable from the road.

If the portable VMS is set up along the roadway and a message will not yet be needed for a period of 4 hours or more, the sign panel should be turned away from traffic, parallel to the road's centerline. No blank signs should be facing the drivers for extended periods.

Message Modification

It is understood that each highway event has its own unique attributes and that pre-formatted message content may not be suitable in all cases. By nature, VMS devices are designed to have the flexibility to adapt message content to the given circumstance while allowing operators the ability to insert a certain amount of creativity into the message. This becomes most evident when working with outside agencies and public awareness campaigns where there may be a desire to leverage certain popular culture or "catch phrases" or non-standard message content.

While it is possible to change, adapt or modify messaging on signage, certain criteria should still be met when deviating from standard message content. CDOT adheres to **MUTCD** standards for signage located in its right-of-way, this applies to electronic devices as well. When messaging for events such as crashes, warnings, weather alerts or other highway impacts, great care should be taken to utilize standard and accepted message content. Message modification should be limited to abbreviations, editing to allow a message to fit a certain sign size, modifications for readability or to allow multiple messages for multiple events onto a single sign.

Content for PSA, Informational or Campaign Messaging may deviate from **MUTCD** standards to a degree. Regardless, certain standards still apply: VMS are not to be used for any event advertising, including Professional sports (including congratulatory messaging), fairs, gatherings, political rallies or causes etc. When using VMS for campaign or PSA information, content should be related to highway/roadway/ congestion safety and have a clear intent as to the meaning of the message.

Changes to the VMS Guideline Document

Modification to the VMS Guidelines document shall be handled by management in charge of Statewide Operations in conjunction with regional authorities. Edits or additions should be agreed upon by the parties affected.

References:

- Changeable Message Sign Operation and Messaging Handbook, 2004, Federal Highway Administration.
- Dudek, C.L., N. Trout, S. Booth, and G. Ullman, *Improved Dynamic Message Sign Messages and Operations*, FHWA/TX-01/1882-2, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, 77843-3135, October 2000.
- Manual on Uniform Traffic Control Devices (MUTCD), for Streets and Highways, 2009 Edition.
- Synthesis 383: Changeable Message Sign Displays During Non-Incident, Non-Roadwork Periods, 2008, National Cooperative Highway Research Program (NCHRP).
- Traffic Control Devices Handbook, 2001, Institute of Transportation Engineers

Appendix A

Typical CDOT VMS Messages

Avalanche Control

VMS Message: AVALANCHE OPERATIONS EXPECT DELAY

Avalanche Control

VMS Message: AVALANCHE CONTROL POSSIBLE AT ANY TIME

Avalanche Control

VMS Message: AVALANCHE CONTROL (Location)

Avalanche Control

VMS Message: AVALANCHE CONTROL AHEAD

Chains

VMS Message: SINGLE AXLE CMV MUST CHAIN MM XXX

Chains

VMS Message: SINGLE AXLE CMV MUST CHAIN MM XXX USE CHAIN STATION X MILES AHEAD

Chains

VMS Message: ALL CMV MUST CHAIN MM XXX

Chains

VMS Message: ALL CMV MUST CHAIN MM XXX USE CHAIN STATION X MILES AHEAD

Chains

VMS Message: 1 DRIVE AXLE CMV MUST CHAIN (small signs only)

Chains

VMS Message: ALL VEHICLES CHAINS REQUIRED

Chains

VMS Message: ALL VEHICLES MUST USE CHAINS OR SNOWTIRES

Chains

VMS Message: CHAIN UP STATION MM ____

Chains

VMS Message: COM VEHICLES ONLY CHAINS REQUIRED

Chains

VMS Message: TRACTION LAW (location) TO (location)

Chains

VMS Message: TRACTION LAW TO (location)

Chains

VMS Message: TRACTION LAW IN EFFECT ALL VEHICLES MUST USE CHAINS OR SNOWTIRES

Chains

VMS Message: TRUCKS MUST CARRY CHAINS WEST OF DENVER MM 259- MM 133

Chains

VMS Message: TRUCKS MUST CARRY CHAINS WEST OF DENVER OCT-MAY

Closure

VMS Message: ACCIDENT AHEAD ROAD CLOSED

Closure

VMS Message: CENTER LANE CLOSED AHEAD

Closure

VMS Message: EXIT CLOSED AHEAD

Closure

VMS Message: FRONTAGE ROAD CLOSED

Closure

VMS Message: I-25 AND US 287 CLOSED TO WYOMING

Closure
VMS Message: I-25 CLOSED AT EXIT 287 WELLINGTON ALL TRAFFIC MUST EXIT

Closure
VMS Message: I-25 OVERNIGHT CLOSURE: ____ TO ____ 11PM-5:30AM

Closure
VMS Message: I-76 CLOSED NEB BORDER

Closure
VMS Message: I-25 CLOSED TO CHEYENNE, WY

Closure
VMS Message: LEFT LANE CLOSED

Closure
VMS Message: LEFT LANE CLOSED AHEAD

Closure
VMS Message: LEFT SHOULDER CLOSED AHEAD

Closure
VMS Message: RAMP CLOSED

Closure
VMS Message: RAMP CLOSED AHEAD

Closure
VMS Message: REST AREA CLOSED

Closure
VMS Message: RIGHT LANE CLOSED

Closure
VMS Message: RIGHT LANE CLOSED AHEAD

Closure
VMS Message: RIGHT SHOULDER CLOSED AHEAD

Closure
VMS Message: ROAD CLOSED

Closure
VMS Message: ROAD CLOSED ____ MILES AHEAD

Closure
VMS Message: ROAD CLOSED AHEAD

Closure
VMS Message: ROAD TEMPORARILY CLOSED

Closure
VMS Message: TUNNEL CLOSED AHEAD

Closure
VMS Message: US 287 CLOSED MM 355 INTO WYOMING

Construction
VMS Message: BRIDGE WORK AHEAD

Construction
VMS Message: CONSTRUCTION AHEAD EXPECT DELAYS

Construction
VMS Message: CONSTRUCTION NEXT ____ MILES

Construction
VMS Message: CRACK FILLING AHEAD

Construction
VMS Message: FLAGGER AHEAD

Construction
VMS Message: FRESH TAR ON ROAD

Construction
VMS Message: MEDIAN WORK AHEAD

Construction
VMS Message: METAL PLATES AHEAD

Construction
VMS Message: MOBILE PATCHING AHEAD

Construction
VMS Message: MOWERS AHEAD

Construction
VMS Message: **MOWING OPERATIONS NEXT _____ MILES**

Construction
VMS Message: **NIGHT WORK AHEAD**

Construction
VMS Message: **PAINT CREW AHEAD**

Construction
VMS Message: **PAVING OPERATIONS AHEAD**

Construction
VMS Message: **ROAD PAVING AHEAD**

Construction
VMS Message: **ROAD WORK AHEAD EXPECT DELAYS**

Construction
VMS Message: **ROAD WORK NEXT _____ MILES**

Construction
VMS Message: **ROAD WORKERS AHEAD**

Construction
VMS Message: **SHOULDER WORK AHEAD**

Construction
VMS Message: **SLOW MOVING VEHICLE**

Construction
VMS Message: **SNOW BLOWERS AHEAD**

Construction
VMS Message: **SNOW REMOVAL AHEAD**

Construction
VMS Message: **SURVEY CREW AHEAD**

Construction
VMS Message: **SWEEPING AHEAD**

Construction
VMS Message: **TRUCKS CROSSING**

Construction
VMS Message: **WATCH FOR TRUCKS**

Construction
VMS Message: **WET PAINT**

Construction
VMS Message: **WORKERS IN TUNNEL**

Directional
VMS Message: **CRASH AHEAD ALL TRAFFIC MUST EXIT**

Directional
VMS Message: **CRASH AHEAD BE PREPARED TO STOP**

Directional
VMS Message: **CRASH AHEAD EXPECT DELAYS**

Directional
VMS Message: **CRASH AHEAD MERGE LEFT**

Directional
VMS Message: **CRASH AHEAD MERGE RIGHT**

Directional
VMS Message: **ALL RAMPS OPEN**

Directional
VMS Message: **ALL TRAFFIC EXIT**

Directional
VMS Message: **ALL TRAFFIC EXIT LEFT**

Directional
VMS Message: **ALL TRAFFIC EXIT RIGHT**

Directional
VMS Message: **ALL TRAFFIC MUST STOP**

Directional
VMS Message: **BUMP AHEAD**

Directional
VMS Message: CHECK FUEL BEFORE ENTERING

Directional
VMS Message: CONGESTED AREA AHEAD

Directional
VMS Message: CURVE AHEAD

Directional
VMS Message: DETOUR

Directional
VMS Message: DIP AHEAD

Directional
VMS Message: DO NOT PASS

Directional
VMS Message: EXIT HERE

Directional
VMS Message: EXPECT DELAY

Directional
VMS Message: FORM ONE LINE LEFT

Directional
VMS Message: FORM ONE LINE RIGHT

Directional
VMS Message: FORM TWO LANES LEFT

Directional
VMS Message: FORM TWO LANES RIGHT

Directional
VMS Message: HEAVY TRAFFIC AHEAD

Directional
VMS Message: HEAVY TRAFFIC TO DENVER

Directional
VMS Message: HEAVY TRAFFIC TO MOUNTAINS

Directional
VMS Message: KEEP LEFT

Directional
VMS Message: KEEP RIGHT

Directional
VMS Message: LANE CLOSURES AHEAD EXPECT DELAYS

Directional
VMS Message: LANE CONTROL AHEAD

Directional
VMS Message: LANE ENDS

Directional
VMS Message: LANE NARROWS AHEAD

Directional
VMS Message: LANES MERGE AHEAD

Directional
VMS Message: LEFT 2 LANES CLOSED

Directional
VMS Message: LIMITED SIGHT DISTANCE

Directional
VMS Message: LOOSE GRAVEL AHEAD

Directional
VMS Message: LOOSE GRAVEL ON ROAD

Directional
VMS Message: MAX SPEED ____ MPH

Directional
VMS Message: MERGE AHEAD

Directional
VMS Message: MERGE LEFT

Directional
VMS Message: **MERGE RIGHT**

Directional
VMS Message: **MERGE RIGHT**

Directional
VMS Message: **MERGE RIGHT**

Directional
VMS Message: **MERGING TRAFFIC AHEAD**

Directional
VMS Message: **MINIMUM SPEED ____ MPH**

Directional
VMS Message: **NO PASSING**

Directional
VMS Message: **NO PASSING**

Directional
VMS Message: **NO SHOULDER**

Directional
VMS Message: **NO WIDE LOADS**

Directional
VMS Message: **ONE LANE BRIDGE AHEAD**

Directional
VMS Message: **ONE LANE TRAFFIC**

Directional
VMS Message: **PASS LEFT**

Directional
VMS Message: **PASS RIGHT**

Directional
VMS Message: **PAVEMENT ENDS**

Directional
VMS Message: **PEDESTRIAN CROSSING**

Directional
VMS Message: **PILOT CAR AHEAD**

Directional
VMS Message: **PREPARE TO MERGE**

Directional
VMS Message: **RIGHT LEFT 2 LANES CLOSED**

Directional
VMS Message: **ROAD NARROWS AHEAD**

Directional
VMS Message: **ROCKS ON ROAD**

Directional
VMS Message: **ROUGH ROAD AHEAD**

Directional
VMS Message: **SHARP CURVE AHEAD**

Directional
VMS Message: **SHOULDER DROP OFF**

Directional
VMS Message: **SHOULDER DROP OFF AHEAD**

Directional
VMS Message: **SIGNAL AHEAD**

Directional
VMS Message: **SIGNAL NOT WORKING**

Directional
VMS Message: **SINGLE LANE AHEAD**

Directional
VMS Message: **SLOW TRAFFIC**

Directional
VMS Message: **SOFT SHOULDER AHEAD**

Directional
VMS Message: **SPEED LIMIT STRICTLY ENFORCED**

Directional
VMS Message: **STAY IN LANE**

Directional
VMS Message: **STAY IN LANE**

Directional
VMS Message: **STAY IN LANE**

Directional
VMS Message: **STEEP GRADE**

Directional
VMS Message: **STOP AHEAD**

Directional
VMS Message: **TWO LANE TRAFFIC AHEAD**

Directional
VMS Message: **TWO-WAY TRAFFIC**

Directional
VMS Message: **TWO-WAY TRAFFIC AHEAD**

Directional
VMS Message: **UNEVEN PAVEMENT AHEAD**

Directional
VMS Message: **UNMARKED LANES AHEAD**

Directional
VMS Message: **USE DETOUR**

Directional
VMS Message: **USE DETOUR ROUTE**

Directional
VMS Message: **USE LEFT LANE**

Directional
VMS Message: **USE RIGHT LANE**

Directional
VMS Message: **VEHICLES CROSSING**

Directional
VMS Message: **WATCH FOR ROCKS ON ROAD**

Directional
VMS Message: **WATCH FOR ROCKS ON ROAD**

Directional
VMS Message: **WATCH FOR STOPPED TRAFFIC**

Directional
VMS Message: **YIELD**

Directional
VMS Message: **YIELD AHEAD**

Fire
VMS Message: **CONTROLLED BURN IN AREA SMOKE MAY BE VISIBLE**

Fire
VMS Message: **CONTROLLED BURN DO NOT CALL 911**

Fire
VMS Message: **EXTREME FIRE DANGER LOCAL BANS IN EFFECT**

Fire
VMS Message: **EXTREME FIRE DANGER NO OPEN BURNING BURNING NO FIREWORKS**

Fire
VMS Message: **HIGH FIRE DANGER LOCAL BANS IN EFFECT**

Fire
VMS Message: **STAGE 2 FIRE RESTRICTIONS NO SHOOTING/BURNING**

Information
VMS Message: **TRAVEL INFORMATION COTRIP.ORG**

Information
VMS Message: **WIRELESS TRAVEL ALERTS COTRIP.ORG**

Information

Information
VMS Message: TRAVEL TIME INFO COTRIP.ORG

Information
VMS Message: KNOW BEFORE YOU GO COTRIP.ORG

Information
VMS Message: COLORADO ROAD INFO COTRIP.ORG/CALL 511

Information
VMS Message: TRUCKER INFORMATION COTRIP.ORG/CALL 511

Information
VMS Message: TRUCKS MUST CARRY CHAINS WEST OF DENVER MM 259- MM 133

Information
VMS Message: TRUCKS MUST CARRY CHAINS I-70 MM 259- MM 133

Information
VMS Message: TRUCKS MUST CARRY CHAINS I-70 MM 259-133 SEPT 1-MAY 31

Information
VMS Message: TRUCKERS: WINTER IS COMING GOT CHAINS?

Information
VMS Message: STATE LAW: KEEP RIGHT EXCEPT TO PASS

Information
VMS Message: STATE LAW: MOVE ACCIDENTS FROM TRAFFIC

Information
VMS Message: STATE LAW: MOVE OVER FOR STOPPED EMERGENCY VEHICLES

Speed Reduction
VMS Message: ROAD AND WEATHER INFO CALL 511

Speed Reduction
VMS Message: SPEED REDUCTION AHEAD

Speed Reduction
VMS Message: SLOWER SPEEDS ADVISED

Speed Reduction
VMS Message: REDUCE SPEED

Speed Reduction
VMS Message: REDUCE SPEED NOW

Trucks
VMS Message: BRIDGE WEIGHT LIMIT AHEAD

Trucks
VMS Message: LOW BRIDGE AHEAD

Trucks
VMS Message: LOWER RUNAWAY TRUCK RAMP OCCUPIED

Trucks
VMS Message: RUNAWAY TRUCK RAMP

Trucks
VMS Message: RUNAWAY TRUCK RAMP CLOSED

Trucks
VMS Message: RUNAWAY TRUCK RAMP OCCUPIED

Trucks
VMS Message: TRUCKS USE LEFT LANE

Trucks
VMS Message: TRUCKS USE LOW GEAR

Trucks
VMS Message: TRUCKS USE RIGHT LANE

Trucks
VMS Message: LANES SHIFT AHEAD

Weather (Warning)
VMS Message: BLIZZARD WARNING

Weather (Warning)
VMS Message: BLIZZARD WATCH

Weather (Warning)
VMS Message: HIGH WIND WARNING

Weather (Warning)
VMS Message: HIGH WIND WATCH

Weather (Warning)
VMS Message: TORNADO WARNING

Weather (Warning)
VMS Message: TORNADO WATCH

Weather (Warning)
VMS Message: WINTER STORM WARNING

Weather (Warning)
VMS Message: WINTER STORM WATCH

Weather
VMS Message: BLOWING SNOW AHEAD

Weather
VMS Message: BRIDGES MAY BE ICY

Weather
VMS Message: DENSE FOG AHEAD

Weather
VMS Message: DRIFTING SNOW ON ROAD

Weather
VMS Message: FLOODED ROAD AHEAD

Weather
VMS Message: FOG AND ICY CONDITIONS MAY EXIST

Weather
VMS Message: FOGGY CONDITIONS MAY EXIST

Weather
VMS Message: GUSTY WINDS AHEAD

Weather
VMS Message: POOR VISIBILITY FOG/SNOW/DUST AHEAD

Weather
VMS Message: HEADLIGHTS ON FOG AHEAD

Weather
VMS Message: HIGH WIND ADVISORY HIGH PROFILE VEHICLES USE CAUTION

Weather
VMS Message: HIGH WIND RESTRICTION HIGH PROFILE VEHICLES MAY BE STOPPED

Weather
VMS Message: HIGH WIND RESTRICTION HIGH PROFILE VEHICLES DO NOT PROCEED

Weather
VMS Message: ICY CONDITIONS MAY EXIST

Weather
VMS Message: POOR VISIBILITY AHEAD

Weather
VMS Message: REDUCED VISIBILITY AHEAD

Weather
VMS Message: REDUCED VISIBILITY BLOWING SNOW

Weather
VMS Message: ROAD ICY AND SNOWPACKED

Weather
VMS Message: ROAD ICY IN SPOTS

Weather
VMS Message: ROAD MAY BE ICY IN SPOTS

Weather
VMS Message: ROAD SNOWPACKED

Weather
VMS Message: ROAD SNOWPACKED AND ICY IN SPOTS

Weather
VMS Message: ROAD SNOWPACKED IN SPOTS

Weather
VMS Message: SNOWSLIDE AHEAD

Weather
VMS Message: WATER ON ROAD

Weather
VMS Message: SNOW/ICY CONDITIONS X MILES AHEAD

Weather
VMS Message: SNOW/ICY CONDITIONS NEXT X MILES

Weather
VMS Message: WINTER WEATHER WARNING/ADVISORY THROUGH (day)

Weather
VMS Message: WINTER WEATHER WARNING/ADVISORY TONIGHT/TOMORROW

Weather
VMS Message: WINTER WEATHER WARNING/ADVISORY THROUGH (day)

Weather
VMS Message: TRACTION LAWS LIKELY

Weather
VMS Message: TRACTION/CHAIN LAWS LIKELY

Programs
VMS Message: THE HEAT IS ON DON'T DRINK AND DRIVE

Programs
VMS Message: OVER THE LIMIT UNDER ARREST

Programs
VMS Message: THE HEAT IS ON HOLIDAY DUI PATROLS

Programs
VMS Message: CLICK IT OR TICKET PLEASE BUCKLE UP

Programs
VMS Message: SEATBELTS SAVE LIVES CLICK IT OR TICKET

Special Events
VMS Message: THE HEAT IS ON DON'T DRINK AND DRIVE

Special Events
VMS Message: STOCK SHOW PARKING EXIT XXX

Special Events
VMS Message: STATE FAIR PARKING EXIT XXX

Special Events
VMS Message: STATE FAIR SHUTTLE EXIT XXX

Special Events
VMS Message: EVENT PARKING EXIT XXX

Special Events
VMS Message: EVENT SHUTTLE EXIT XXX

Special Events
VMS Message: PARADE PARKING EXIT XXX

Special Events
VMS Message: BICYCLE RACE (DATE) INFO COTRIP.ORG

Special Events
VMS Message: BICYCLE RACE (DATE) INFO CALL 511

Appendix B

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05 The spacing between characters in a word should be between 25 to 40 percent of the letter height. The spacing between words in a message should be between 75 and 100 percent of the letter height. Spacing between the message lines should be between 50 and 75 percent of the letter height.

06 Except as provided in Paragraph 18, word messages on changeable message signs should be composed of all upper-case letters. The minimum letter height should be 18 inches for changeable message signs on roadways with speed limits of 45 mph or higher. The minimum letter height should be 12 inches for changeable message signs on roadways with speed limits of less than 45 mph.

Support:

07 Using letter heights of more than 18 inches will not result in proportional increases in legibility distance.

Guidance:

08 The width-to-height ratio of the sign characters should be between 0.7 and 1.0. The stroke width-to-height ratio should be 0.2.

Support:

09 The width-to-height ratio is commonly accomplished using a minimum font matrix density of five pixels wide by seven pixels high.

Standard:

10 **Changeable message signs shall automatically adjust their brightness under varying light conditions to maintain legibility.**

Guidance:

11 The luminance of changeable message signs should meet industry criteria for daytime and nighttime conditions. Luminance contrast should be between 8 and 12 for all conditions.

12 Contrast orientation of changeable message signs should always be positive, that is, with luminous characters on a dark or less luminous background.

Support:

13 Legibility distances for negative-contrast changeable message signs are likely to be at least 25 percent shorter than those of positive-contrast messages. In

addition, the increased light emitted by negative-contrast changeable message signs has not been shown to improve detection distances.

Standard:

- 14 **The colors used for the legends and backgrounds on changeable message signs shall be as provided in Table 2A-5.**

Guidance:

- 15 If a black background is used, the color used for the legend on a changeable message sign should match the background color that would be used on a standard sign for that type of legend, such as white for regulatory, yellow for warning, orange for temporary traffic control, red for stop or yield, fluorescent pink for incident management, and fluorescent yellow green for bicycle, pedestrian and school warning.

Standard:

- 16 **If a green background is used for a guide message on a CMS or if a blue background is used for a motorist services message on a CMS, the background color shall be provided by green or blue lighted pixels such that the entire CMS would be lighted, not just the white legend.**

Support:

- 17 Some CMS that employ newer technologies have the capability to display an exact duplicate of a standard sign or other sign legend using standard symbols, the Standard Alphabets and letter forms, route shields and other typical sign legend elements with no apparent loss of resolution or recognition to the road user when compared with a static version of the same sign legend. Such signs are of the full-matrix type and can typically display full-color legends. Use of such technologies for new CMS is encouraged for greater legibility of their displays and enhanced recognition of the message as it pertains to regulatory, warning, or guidance information.

Guidance:

- 18 If used, the CMS described in the preceding paragraph should not display symbols or route shields unless they can do so in the appropriate color combinations. For a single-phase message where the Standard Alphabets and other legend elements of standard designs are used, the lettering style, size, and line spacing should comply with the applicable provisions for the type of message displayed as provided elsewhere in this Manual. For two-phase messages, larger legend heights should be used as described previously in this Section because of the need for such messages to be legible at a greater distance. Regardless of the number of phases, the CMS should comply with the legibility and visibility provisions of Section 2L.03.

Section 2L.05 Message Length and Units of Information

Guidance:

- 01 The maximum length of a message should be dictated by the number of units of information contained in the message, in addition to the size of the CMS. A unit of information, which is a single answer to a single question that a driver can use to make a decision, should not be more than four words.

Support:

- 02 In order to illustrate the concept of units of information, Table 2L-1 shows an example message that is comprised of four units of information.
- 03 The maximum allowable number of units of information in a CMS message is based on the principles described in this Section, the current highway operating speed, the legibility characteristics of the CMS, and the lighting conditions.

Standard:

- 04 **Each message shall consist of no more than two phases. A phase shall consist of no more than three lines of text. Each phase shall be understood by itself regardless of the sequence in which it is read. Messages shall be centered within each line of legend. Except for signs located on toll plaza structures or other facilities with a similar booth-lane arrangement, if more than one CMS is visible to road users, then only one sign shall display a sequential message at any given time.**
- 05 **Techniques of message display such as fading, rapid flashing, exploding, dissolving, or moving messages shall not be used. The text of the message shall not scroll or travel horizontally or vertically across the face of the sign.**

Guidance:

- 06 When designing and displaying messages on changeable message signs, the following principles relative to message design should be used:
 - A. The minimum time that an individual phase is displayed should be based on 1 second per word or 2 seconds per unit of information, whichever produces a lesser value. The display time for a phase should never be less than 2 seconds.
 - B. The maximum cycle time of a two-phase message should be 8 seconds.
 - C. The duration between the display of two phases should not exceed 0.3 seconds.
 - D. No more than three units of information should be displayed on a phase of a message.
 - E. No more than four units of information should be in a message when the traffic operating speeds are 35 mph or more.
 - F. No more than five units of information should be in a message when the traffic operating speeds are less than 35 mph.
 - G. Only one unit of information should appear on each line of the CMS

H. Compatible units of information should be displayed on the same message phase.

Table 2L-1. Example of Units of Information

Where?	AT EXIT 12	1
What is advised?	USE ROUTE 46	1

Note: The following is an example of a two-phase message that could be developed from the four information units shown in this table:

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Option:

- 07 A unit of information consisting of more than one word may be displayed on more than one line. An additional changeable message sign at a downstream location may be used for the purpose of allowing the entire message to be read twice.

Guidance:

- 08 If more than two phases would be needed to display the necessary information, additional changeable message signs should be used to display this information as a series of two distinct, independent messages with a maximum of two phases at each location, in accordance with the provisions of Paragraph 4.
- 09 When the message on a CMS includes an abbreviation, the provisions of Section 1A.15 should be used.

Section 2L.06 Installation of Permanent Changeable Message Signs

Guidance:

- 01 A CMS that is used in place of a static sign (such as a blank-out or variable legend regulatory sign) should be located in accordance with the provisions of Chapter 2A. The following factors should be considered when installing other permanent changeable message signs:
 - A. Changeable message signs should be located sufficiently upstream of known bottlenecks and high crash locations to enable road users to select an alternate route or take other appropriate action in response to a recurring condition.
 - B. Changeable message signs should be located sufficiently upstream of major diversion decision points, such as interchanges, to provide adequate distance over which road users can change lanes to reach one destination or the other.

- C. Changeable message signs should not be located within an interchange except for toll plazas or managed lanes.
- D. Changeable message signs should not be positioned at locations where the information load on drivers is already high because of guide signs and other types of information.
- E. Changeable message signs should not be located in areas where drivers frequently perform lane-changing maneuvers in response to static guide sign information, or because of merging or weaving conditions.

Support:

- 02 Information regarding the design and application of portable changeable message signs in temporary traffic control zones is contained in Section 6F.60.

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Section 6F.60 Portable Changeable Message Signs

Support:

- 01 Portable changeable message signs (PCMS) are TTC devices installed for temporary use with the flexibility to display a variety of messages. In most cases, portable changeable message signs follow the same provisions for design and application as those given for changeable message signs in Chapter 2L. The information in this Section describes situations where the provisions for portable changeable message signs differ from those given in Chapter 2L.

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- 02 Portable changeable message signs are used most frequently on high-density urban freeways, but have applications on all types of highways where highway alignment, road user routing problems, or other pertinent conditions require advance warning and information.
- 03 Portable changeable message signs have a wide variety of applications in TTC zones including: roadway, lane, or ramp closures; incident management; width restriction information; speed control or reductions; advisories on work scheduling; road user management and diversion; warning of adverse conditions or special events; and other operational control.
- 04 The primary purpose of portable changeable message signs in TTC zones is to advise the road user of unexpected situations. Portable changeable message signs are particularly useful as they are capable of:
 - A. Conveying complex messages,
 - B. Displaying real time information about conditions ahead, and
 - C. Providing information to assist road users in making decisions prior to the point where actions must be taken.

- 05 Some typical applications include the following:
- A. Where the speed of vehicular traffic is expected to drop substantially;
 - B. Where significant queuing and delays are expected;
 - C. Where adverse environmental conditions are present;
 - D. Where there are changes in alignment or surface conditions;
 - E. Where advance notice of ramp, lane, or roadway closures is needed;
 - F. Where crash or incident management is needed; and/or
 - G. Where changes in the road user pattern occur.

Guidance:

- 06 The components of a portable changeable message sign should include: a message sign, control systems, a power source, and mounting and transporting equipment. The front face of the sign should be covered with a protective material.

Standard:

- 07 **Portable changeable message signs shall comply with the applicable design and application principles established in Chapter 2A. Portable changeable message signs shall display only traffic operational, regulatory, warning, and guidance information, and shall not be used for advertising messages.**

Support:

- 08 Section 2L.02 contains information regarding overly simplistic or vague messages that is also applicable to portable changeable message signs.

Standard:

- 09 **The colors used for legends on portable changeable message signs shall comply with those shown in Table 2A-5.**

Support:

- 10 Section 2L.04 contains information regarding the luminance, luminance contrast, and contrast orientation that is also applicable to portable changeable message signs.

Guidance:

- 11 Portable changeable message signs should be visible from 1/2 mile under both day and night conditions.

Support:

- 12 Section 2B.13 contains information regarding the design of portable changeable message signs that are used to display speed limits that change based on operational conditions or are used to display the speed at which approaching drivers are traveling.

Guidance:

- 13 A portable changeable message sign should be limited to three lines of eight characters per line or should consist of a full matrix display.

14 Except as provided in Paragraph 15, the letter height used for portable changeable message sign messages should be a minimum of 18 inches.

Option:

15 For portable changeable message signs mounted on service patrol trucks or other incident response vehicles, a letter height as short as 10 inches may be used. Shorter letter sizes may also be used on a portable changeable message sign used on low-speed facilities provided that the message is legible from at least 650 feet.

16 The portable changeable message sign may vary in size.

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Guidance:

17 Messages on a portable changeable message sign should consist of no more than two phases, and a phase should consist of no more than three lines of text. Each phase should be capable of being understood by itself, regardless of the order in which it is read. Messages should be centered within each line of legend. If more than one portable changeable message sign is simultaneously legible to road users, then only one of the signs should display a sequential message at any given time.

Support:

18 Road users have difficulties in reading messages displayed in more than two phases on a typical three-line portable changeable message sign.

Standard:

19 **Techniques of message display such as animation, rapid flashing, dissolving, exploding, scrolling, traveling horizontally or vertically across the face of the sign, or other dynamic elements shall not be used.**

Guidance:

20 When a message is divided into two phases, the display time for each phase should be at least 2 seconds, and the sum of the display times for both of the phases should be a maximum of 8 seconds.

21 All messages should be designed with consideration given to the principles provided in this Section and also taking into account the following:

A. The message should be as brief as possible and should contain three thoughts (with each thought preferably shown on its own line) that convey:

1. The problem or situation that the road user will encounter ahead,
2. The location of or distance to the problem or situation, and
3. The recommended driver action.

B. If more than two phases are needed to display a message, additional portable changeable message signs should be used. When multiple portable changeable message signs are needed, they should be placed on the same side of the roadway and they should be separated from each other by a distance of at least 1,000 feet on freeways and expressways, and by a distance of at least 500 feet on other types of highways.

Standard:

- 22 **When the word messages shown in Tables 1A-1 or 1A-2 need to be abbreviated on a portable changeable message sign, the provisions described in Section 1A.15 shall be followed.**
- 23 **In order to maintain legibility, portable changeable message signs shall automatically adjust their brightness under varying light conditions.**
- 24 **The control system shall include a display screen upon which messages can be reviewed before being displayed on the message sign. The control system shall be capable of maintaining memory when power is unavailable.**
- 25 **Portable changeable message signs shall be equipped with a power source and a battery back-up to provide continuous operation when failure of the primary power source occurs.**
- 26 **The mounting of portable changeable message signs on a trailer, a large truck, or a service patrol truck shall be such that the bottom of the message sign shall be a minimum of 7 feet above the roadway in urban areas and 5 feet above the roadway in rural areas when it is in the operating mode.**

Guidance:

- 27 **Portable changeable message signs should be used as a supplement to and not as a substitute for conventional signs and pavement markings.**
- 28 **When portable changeable message signs are used for route diversion, they should be placed far enough in advance of the diversion to allow road users ample opportunity to perform necessary lane changes, to adjust their speed, or to exit the affected highway.**
- 29 **Portable changeable message signs should be sited and aligned to provide maximum legibility and to allow time for road users to respond appropriately to the portable changeable message sign message.**
- 30 **Portable changeable message signs should be placed off the shoulder of the roadway and behind a traffic barrier, if practical. Where a traffic barrier is not available to shield the portable changeable message sign, it should be placed off the shoulder and outside of the clear zone. If a portable changeable message sign has to be placed on the shoulder of the roadway or within the clear zone, it should be delineated with retroreflective TTC devices.**
- 31 **When portable changeable message signs are used in TTC zones, they should display only TTC messages.**

- 32 When portable changeable message signs are not being used to display TTC messages, they should be relocated such that they are outside of the clear zone or shielded behind a traffic barrier and turned away from traffic. If relocation or shielding is not practical, they should be delineated with retroreflective TTC devices.
- 33 Portable changeable message sign trailers should be delineated on a permanent basis by affixing retroreflective material, known as conspicuity material, in a continuous line on the face of the trailer as seen by oncoming road users.

Table 2A-5. Common Uses of Sign Colors

Regulatory	Black, Red, White	Black, Red*, White
Permissive	Green	White
Pedestrian	Black	Yellow*, Fluorescent Yellow Green
Guide	White	Green
State Route	Black	White
County Route	Yellow	Blue
Street Name	White	Green
Reference Location	White	Green
Evacuation Route	White	Blue
Recreational	White	Brown, Green
Incident Management	Black	Orange*, Fluorescent Pink
ETC - Account Only	Black	Purple****

* Fluorescent versions of these background colors may also be used.

** These alternative background colors would be provided by blue or green lighted pixels such that the entire CMS would be lighted, not just the legend.

*** Red is used only for the circle and slash or other red elements of a similar static regulatory sign.

**** The use of the color purple on signs is restricted per the provisions of Paragraph 1 of Section 2F.03.

Table 2A-5. Changeable Messaging Sign Colors

Regulatory	Red***, White	Black
Temporary Traffic Control	Yellow, Orange	Black
Motorist Services	White	Black, Blue**
School, Pedestrian, Bicycle	Yellow, Fluorescent Yellow Green	Black

* Fluorescent versions of these background colors may also be used.

** These alternative background colors would be provided by blue or green lighted pixels such that the entire CMS would be lighted, not just the legend.

*** Red is used only for the circle and slash or other red elements of a similar static regulatory sign.

**** The use of the color purple on signs is restricted per the provisions of Paragraph 1 of Section 2F.03.

Appendix C

Lane Use Signs (LUS) Operational Guidelines

Purpose

This provides an overview of operational guidance for Lane Use Signs (LUS).

Background

Lane Use Signs are overhead electronic roadway signs used to indicate open or closed lanes or to direct drivers to open lanes by way of directional chevrons.



LUS, mounted on over-lane gantries, are currently utilized along some urban portions of I-25 and I-70, U.S.36, Express Lanes and Tunnels facilities.

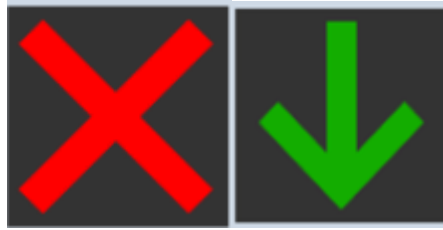
Sign Operations

Message Standards: As per the 2009 MUTCD, Chapter 4M, “Lane Control Signals”, these signs are activated when there is a lane restriction ahead. These restrictions could include closures due to a crash, debris, road work, etc. In alignment with standard advance warning MUTCD standards, these signs are activated. Example: Closest gantry typically reflects lanes that are closed and open. The next upstream gantry reflects advisory lane change movement.

- **Operations/Maintenance:** The Operation Centers execute messaging. Sign control is achieved through “Corridor control” software built into the OpenTMS platform. Intelligent Transportation Services branch is responsible for infrastructure and system maintenance.
- **Usage Guidelines:** Upon the verification of a lane impact (closure or blockage), Operations staff will activate the automated software which in turn will activate two upstream gantries (when available) to alert traffic. Logic built into the software will recommend applicable signage based on the impacted location and lane selected by the operator

Traffic Management personnel can manually change the recommended signage or add additional signage as needed based on conditions and changes.

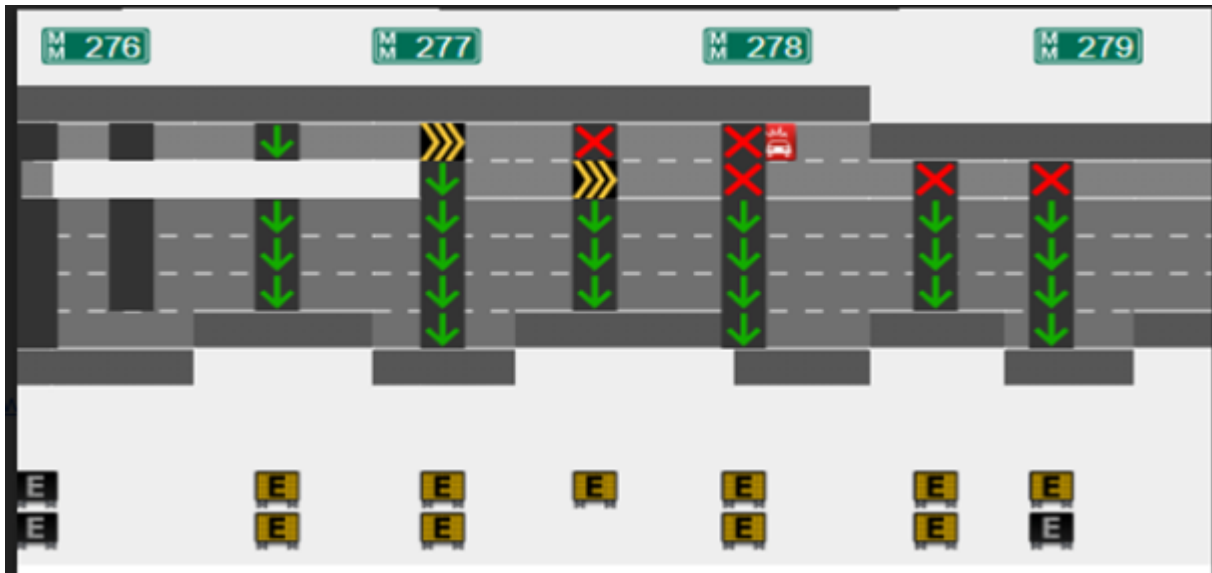
- **Gantry 1 (closest to the lane impact):** LUS indicate which lanes are blocked (Red X) and which lanes are open (Green arrow).



- **Gantry 2, Upstream:** LUS will indicate open lanes and using chevron messaging, which lanes traffic should move out of. Operations should confirm the system chooses the appropriate chevron as applicable to the situation.



- **Additional LUS:** Additional LUS gantries may be added upstream as needed. Upstream signage should not use the Red X closure sign for a single lane closure, as lane capacity should be maximized leading up to the impacted area. Multiple lane closures may require staggered Red X signs in combination with chevrons upstream to move traffic across multiple lanes.
- **Upstream Variable Message Signs (VMS):** When available, upstream VMS should be utilized to indicate a crash or lane blockage exists ahead, and if needed, and indication that traffic should prepare to merge or reduce speed.



- **Evolving situations:** Operations staff should monitor impacted lanes, upstream traffic and the automated system for needed changes. Operations will update and augment messaging and/or include additional LUS as needed based on observed changes or situations.
- **HOV or Express Toll lanes:** Many managed corridors include an HOV or Managed lane adjacent to the general purpose (GP) lanes. These lanes are managed by CTIO resources but use of the tolled/HOV facilities may be necessary during crashes or closures. Generally law enforcement will determine if the managed lanes are to be used as an official detour.
 - **Express/HOV Lane:** In the event of a lane closure outside of the Express/HOV lane that is NOT impacting the managed lane, no changes are required to lane signage. Tolling operations should be notified of the event
 - **Express/HOV lane used as detour:** When it is determined that the Express lanes are to be used to move traffic either by Law Enforcement or Operations, LUS signage over the managed lane shall be modified to reflect that tolling is suspended.



- **Cautionary speed reduction signage:** Instrumented corridors utilize automated cautionary speed signage using either existing LUS or

additional secondary electronic signage. As congestion and reduced speeds are detected downstream of the gantries, cautionary speed messaging will automatically display as amber on black. System is automated and no user input is available.

