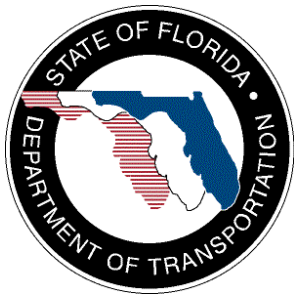


# **GUIDELINES FOR THE USE OF DYNAMIC MESSAGE SIGNS ON THE FLORIDA STATE HIGHWAY SYSTEM**

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Final Version**



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# GUIDELINES FOR THE USE OF DYNAMIC MESSAGE SIGNS ON THE FLORIDA STATE HIGHWAY SYSTEM

## 1. Introduction

- 1.1. Purpose of Guidelines The operational guidelines presented here are intended to ensure that dynamic message sign (DMS) messages are used to provide information to motorists *en route* in an appropriate and consistent manner. Section 2A.07 of the Manual for Uniform Traffic Control Devices (MUTCD) states that “except for safety or transportation-related messages, changeable message signs should not be used to display information other than regulatory, warning, and guidance information related to traffic control.” This document describes format and content of messages that should be considered by managers of Florida’s Transportation Management Centers (TMC) in the operation of DMS.
- 1.2. Dynamic Message Sign This refers to dynamic, changeable or variable message signs (VMS), defined as programmable traffic control devices that display messages composed of letters, symbols/graphics or both. They are used to provide information about changing highway conditions in order to improve operations, reduce accidents, and inform travelers. These signs may inform drivers to change travel speed, change lanes, divert to a different route, or simply to be aware of a change in current or future traffic conditions.

## 2. List of Acronyms

This section will present the acronyms that are used throughout this document:

AMBER .....	America’s Missing: Broadcast Emergency Response
LEO .....	Law Enforcement Officer
CMS .....	Changeable Message Signs
DMS .....	Dynamic Message Signs
DOT .....	Department of Transportation
FDOT .....	Florida Department of Transportation
FHWA .....	Federal Highway Administration
HOV .....	High-Occupancy Vehicle
ITS .....	Intelligent Transportation Systems
MUTCD .....	Manual on Uniform Traffic Control Devices
RWIS .....	Roadway Weather Information System
TMC .....	Transportation Management Center
VMS .....	Variable Message Signs

### **3. Definitions**

This section defines the key word used throughout this document.

- 3.1. Transportation Management Center TMCs are physical locations used to monitor traffic conditions, respond to traffic incidents and coordinate Intelligent Transportation Systems (ITS) programs. TMCs are where incoming information from detection devices, other sensors such as roadway weather information systems (RWIS), etc., and cameras can be distributed to motorists in real-time through 511 Traveler Information as well as on DMS. TMCs also allow coordinated responses to freeway incidents and rush hour traffic congestion. The TMCs are the nerve centers of Florida's ITS.
- 3.2. Recurring Conditions These are conditions caused by daily peak period traffic demands that exceed roadway capacity. Peak period traffic is commonly considered to be early in the morning and late in the evening according to commuter schedules.
- 3.3. Non-recurring conditions These are unplanned special events that temporarily reduce roadway capacity and reliability to the point that motorists experience unexpected delay. Even though non-recurring congestion can occur at any time, it is most likely to observe these conditions during the off-peak travel periods. Off-peak predominantly refers to the daytime hours between the peak morning and evening travel periods. Non-recurring congestion may be also visible during the mid-day travel period because traffic volumes are still significant enough that any unpredicted event could reduce the normal flow of traffic.
- 3.4. Incident This refers to unexpected events which cause normal, free-flowing traffic to suddenly slow or cease all together. The impact of traffic incidents on the normal flow of travel can be measured by at least three factors: 1) the number of affected travel lanes; 2) the severity of the incident; and/or 3) the degree to which the incident captures the interest of passing motorists.
- 3.5. Incident Management This refers to integrating a combination of facilities, equipment, personnel, procedures, and communication operating within a common organizational structure, designed to reduce the impact of incidents, and improve the safety of drivers.
- 3.6. Emergency These are unexpected events such as hurricanes, hazardous weather conditions, terrorism attacks, etc. that can significantly impact travelers on their route.

- 3.7. Delay This is the additional travel time experienced by travelers caused by unexpected and expected events such as incidents, roadwork, etc.
- 3.8. Message format This refers to the arrangement of units on a DMS to compose the message.
- 3.9. Message content These are words to be included on a display to give information to motorists according to the type of message. This essentially describes what is wrong ahead, the location of the problem and a recommended driver action.
- 3.10. Unit of Information This refers to the brief answer to a question a motorist might ask. A unit of information is usually one to three words.

#### **4. Dynamic Message Sign Benefits**

The following are benefits of using DMS as a way to provide traveler information *en route* to motorists:

- a) Improve safety;
- b) Reduce trip time;
- c) Save costs;
- d) Help motorists make more educated decisions regarding route choice;
- e) Reduce fuel consumption;
- f) Reduce emissions;
- g) Improve the public's perception of the usefulness of the DMS;
- h) Save lives through emergency response; and,
- i) Reduce secondary collisions.

#### **5. Application of Dynamic Message Signs**

DMS play an important role as traffic control devices to improve safety and operations of roadways. Several examples of different situations where DMS should be used to provide useful information to travelers are outlined below.

##### **5.1. Permitted Message Types**

- a) **Emergency:** This is when unplanned events require extreme traffic diversions. Some examples are road closures as a consequence of severe crashes, evacuations from the Florida Division of Emergency Management due to hurricanes, hazardous weather conditions, terrorism attacks, etc.

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- b) Incident Management: DMS as traffic control at incident scenes can reduce delays and protect motorists' safety. Incidents are considered as unexpected events such as traffic crashes, disabled vehicles, and spilled cargo. Roadway closures due to construction or maintenance can also be classified as incidents.

Driver responses to incident information can be:

- Change planned route or divert;
  - Exit roadway at suggested location (e.g., to access a special event);
  - Change lanes early;
  - Reduce speed (e.g., to accommodate slippery road conditions);
  - Stop vehicle in designated place (e.g., to avoid a severe road condition); and,
  - Proceed without stopping (e.g., to avoid exiting to a closed service).
- c) Traffic Management: Traffic management applications deal with using DMS to manage traffic congestion when demand exceeds capacity for a considerable period of time. This can include also ramp metering, high occupancy vehicle (HOV) lanes, construction, and maintenance.
- d) Construction or Maintenance Activities: These are temporary roadway closures due to road work or maintenance effects on traffic. DMS are used to inform drivers and influence their behavior. Special applications of DMS in work zones can be new detours, change in detours, special speed control measures, or simply information of upcoming roadwork.
- e) Weather Condition: Weather related messages are allowed on DMS as non-incident messages since they impact driver visibility and safety (e.g., icy roadway, fog, high winds, broken pavement, etc.)
- f) Special Events: Events such as ball games, parades, concerts, etc. are special events that may be allowed to be displayed. These types of events are displayed to accommodate through trip drivers when their travel is affected by the event and to manage traffic going to the event.
- g) Safety Campaigns: The Florida Department of Transportation (FDOT) allows display of messages with public information related to safety if they have a positive effect on highway safety and congestion areas or they are a supplement of a specific national or statewide highway safety campaign on the same topic.
- h) Display of Travel Time: Travel time, as default messages for the FDOT, are to be displayed during peak and off-peak periods in the absence of incidents, or other conditions that require the driver to react immediately.

- i) Display of AMBER Alerts: The America's Missing: Broadcast Emergency Response (AMBER) Plan Program is a voluntary program through which emergency alerts are issued to notify the drivers by using DMS about abductions of children.
- j) Display of LEO Alerts: The Law Enforcement Officer (LEO) Alerts are messages that law enforcement has requested when a police officer has been injured or killed and DMS are used to disseminate this information to drivers in case they have any valuable information.
- k) Test Messages: This message may be used to perform sign maintenance checks and during the "burn in" period of a new DMS.
- l) Blank Sign: In the absence of accurate travel time information, at locations where travel time information would not be useful, or when not being preempted with other messages listed above.

## **5.2. Prohibited Message Types:**

The following are message types that are prohibited from display on DMS.

- a) General Public Information: General messages that are not related to transportation or specific emergency conditions requiring actions or response from drivers are discouraged.
- b) Advertisements: Public advertisements are prohibited from being displayed on DMS as stated in the MUTCD, Section 2A.07.<sup>1</sup>

## **6. Message Characteristics**

The main characteristics of the messages to be displayed on the DMS are outlined below. The primary reference for this section is the *Guideline for Changeable Message Signs: A White Paper* prepared by Conrad L. Dudek for the Federal Highway Administration (FHWA)<sup>1</sup>.

### **6.1. Message Load**

Given the guideline of messages exposure rates of one sec/word or two sec/unit of information the following are general guidelines of the amount of information that should be in a message.

- Maximum of eight words at speeds of 55 miles per hour (mph);

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<sup>1</sup> *Manual on Uniform Traffic Control Devices (MUTCD)*, Federal Highway Administration (FHWA), November 2003, 2A-2 – 2A-3.

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- Maximum of seven words at speeds of 65 mph; and,
- Maximum of six words at speeds of 75 mph.

The reports by Dudek and Huchingson 1986 and Dudek 2001 and 2002 also offer additional guidelines for message loads:

- No more than four units of information when the operating speeds are 35 mph or more;
- No more than five units of information when the operating speeds are less than 35 mph; and,
- No more than three units of information should be displayed in a single frame.<sup>2</sup>

These guidelines are based off of research done on the comprehension rate of travelers.

### 6.2. Message Format

The message format refers to how the words should be arranged to compose the total message. It is important to consider this factor since it affects the time for travelers to comprehend the message and react. Sometimes messages are too long to be displayed in one frame; therefore, they need to be shown in two frames. This is the maximum number of frames per the MUTCD, Section 2E-21<sup>3</sup>.

Dynamic Message Signs messages for incidents including emergencies, construction or maintenance closures have basically three main components:

- Problem
- Location of problem
- Recommended driver action<sup>4</sup>

While these are the desirable message formats it may not always be possible to provide information for each of these elements.

### 6.3. Message Content

Outlined below is an example of what information may need to be displayed on a DMS. The main objective is to avoid driver confusion and to provide the needed information in the most effective way. Proper word usage is also discussed as it is important to use words that are familiar to the traveler and will ensure retention of the message.

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<sup>2</sup> Dudek, C.L. "Guidelines for Changeable Message Sign messages: A White Paper." December 2002, 4.

<sup>3</sup> *Ibid.*, 2E-20.

<sup>4</sup> Dudek, C.L. "Guidelines for Changeable Message Sign messages: A White Paper." December 2002, 5.



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Generally information to be included on messages is as follows:

Question	Statement
What happened	Problem
Where	Location
What is the effect on traffic	Effect
For whom is the message intended	Attention
What is advised	Action <sup>5</sup>

As allowed by the MUTCD, messages may be displayed using two phases to convey the necessary information to the motorist. The general information noted above applies to the following event types:

- a) Emergency;
- b) Incident Management;
- c) Traffic Management;
- d) Roadway Closures for construction or maintenance activities;
- e) Weather Condition;
- f) Special Events;
- g) Safety Campaigns;
- h) Display of Travel Time;
- i) Display of AMBER Alerts;
- j) Display of LEO Alerts;
- k) Test Messages; and,
- l) Blank Sign.

As noted in the MUTCD, Section 2E.21, “Techniques of message display such as fading exploding, dissolving or moving messages shall not be used”.<sup>6</sup> While graphics can be displayed on full matrix DMS they can result in reduction of letter size in association with the message, lessening driver comprehension of the intended message and are not commonly used within the United States (U.S.). Based on the current shape and color requirements in the MUTCD it is not recommended that graphics be displayed on the average DMS.<sup>7</sup>

These guidelines will need to be updated if and when the FDOT purchases full color matrix DMS as a standard.

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<sup>5</sup> Agah, Manny P.E. “Guidelines on the Use of Permanent Variable Message Signs.” March 2002, 6.  
<sup>6</sup> *MUTCD*, November 2003, 2E-20.  
<sup>7</sup> Dudek, C.L. “Guidelines for Changeable Message Sign messages: A White Paper.” December 2002, 53.

#### 6.4. Message Time

It is not the purpose of this document to provide message design information. However, viewing time is associated with message viewing distance and there may not always be enough viewing time for travelers to read a DMS message. Some of the factors that effect viewing time are noted below:

- Speed of Travel;
- Placement of the DMS (over travel lanes versus side of the road);
- Lighting Conditions;
- Roadway Geometrics;
- Environmental (Fog, Rain, etc.); and,
- Number of trucks.

Messages should be displayed at exposure rates of one sec/word or two sec/unit of information where a unit of information is a data item in a message that a motorist could use to make a decision.<sup>8</sup>

### 7. **DMS Message Priority**

According to the FDOT policy, the priority order for DMS messages is:

- a) Conditions which require motorists to take action or alter their driving;
- b) Traffic incidents, hazardous and/or uncommon road conditions, work zone activities, and severe weather conditions;
- c) America's Missing: Broadcast Emergency Response (AMBER) Alerts;
- d) Law Enforcement Officer (LEO) Alerts;
- e) Traveler information related to special events, emergencies, and incidents impacting mobility and safety; and,
- f) Blank Sign: In the absence of accurate travel time information, at locations where travel time information would not be useful, or when not being preempted with other messages listed above.

Note that the default state when a DMS is not in use is to display travel times if possible.

### 8. **Florida Department of Transportation Policy**

It is the policy of the FDOT to designate the use of DMS on the State Highway System for managing travel, controlling and diverting traffic, identifying current and anticipated roadway and environmental conditions, or regulating access to specific lanes or the entire roadway. This policy also states that “**default display on Dynamic Message Signs shall be travel time display.**”

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<sup>8</sup> *Ibid.*, 4.

8.1. Travel Time Templates

According to some studies, travelers prefer travel time displays when no incidents are presented. Moreover, these guidelines are intended to provide templates of travel time display to encourage statewide consistency.

Travel times on DMS are displayed when not preempted with messages with higher priorities. It is well known that travelers have to rely on the DMS as traffic control devices; therefore, accuracy of information is very important. Travel time in a range basis as shown in the following template is considered appropriate to avoid a loss in credibility with travelers.

<b>Destination</b>
<b>Distance</b>
<b>Time Range</b>
<b>US 27</b>
<b>7MI</b>
<b>8-12 MINUTES</b>

At this time it is not the intention of these guidelines to specify what time range length should be displayed. A lower default limit of five minutes has been established for travel time displays but an upper limit has not been set. As travel time displays are put into effect on a regular basis throughout Florida these concepts will need to be revisited to ensure consistency in displays between the Districts.

9. **Abbreviations**

A list from the MUTCD (2003) that contains abbreviations considered as acceptable is shown in Table 1; abbreviations considered acceptable, but only with a prompt word are shown in Table 2; additional acceptable abbreviations from Dudek's *Guideline for Changeable Message Signs: A White Paper* are shown in Table 3; and abbreviations considered as unacceptable as shown in Tables 4 and 5.<sup>9 10</sup>

**Table 1: MUTCD Acceptable Abbreviations<sup>11</sup>**

<b>Word Message</b>	<b>Standard Abbreviation</b>
Afternoon / Evening	PM

<sup>9</sup> MUTCD, November 2003, 1A-15.

<sup>10</sup> Dudek, C.L. "Guidelines for Changeable Message Sign messages: A White Paper." December 2002,

<sup>11</sup> MUTCD, November 2003, 1A-15.

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Alternate	ALT
Avenue	AVE, AV
Bicycle	BIKE
Boulevard	BLVD
Cannot	CANT
CB Radio	CB
Center	CNTR
Circle	CIR
Civil Defense	CD
Compressed Natural Gas	CNG
Court	CT
Crossing (other than highway-rail)	XING
Diesel Fuel	D
Do Not	DONT
Drive	DR
East	E
Eastbound	E-BND
Electric Vehicle	EV
Emergency	EMER
Entrance, Enter	ENT
Expressway	EXPWY
Feet	FT
FM Radio	FM
Freeway	FRWY, FWY
Friday	FRI
Hazardous Material	HAZMAT
High Occupancy Vehicle	HOV
Highway	HWY
Highway-Rail Grade Crossing Pavement Marking	RXR
Hospital	H
Hour(s)	HR
Information	INFO
Inherently Low Emission Vehicle	ILEV
It Is	ITS
Junction / Intersection	JCT
Kilogram	Kg
Kilometer(s)	Km
Kilometers Per Hour	km/h
Lane	LN

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Left	LFT
Liquid Propane Gas	LP-GAS
Maintenance	MAINT
Meter(s)	m
Metric Ton	t
Mile(s)	MI
Miles Per Hour	MPH
Minute(s)	MIN
Monday	MON
Morning / Late Night	AM
Normal	NORM
North	N
Northbound	N-BND
Parking	PKING
Parkway	PKWY
Pedestrian	PED
Place	PL
Pounds	LBS
Right	RHT
Road	RD
Saturday	SAT
Service	SERV
Shoulder	SHLDR
Slippery	SLIP
South	S
Southbound	S-BND
Speed	SPD
Street	ST
Sunday	SUN
Telephone	PHONE
Temporary	TEMP
Terrace	TER
Thursday	THURS
Tons of Weight	T
Traffic	TRAF
Trail	TR
Travelers	TRAVLRS
Tuesday	TUES
Two-Way Intersection	2-WAY
Two-Wheeled Vehicles	CYCLES
US Numbered Route	US
Vehicles	VEH
Warning	WARN
Wednesday	WED

West	W
Westbound	W-BND
Will Not	WONT

**Table 2: MUTCD Abbreviations That Are Acceptable Only with a Prompt Word<sup>12</sup>**

<b>Word Message</b>	<b>Acceptable Abbreviation</b>	<b>Prompt Word</b>
Access	ACCS	Road
Ahead	AHD	FOG*
Blocked	BLKD	Lane*
Bridge	BRDG	[name]*
Chemical	CHEM	Spill
Condition	COND	Traffic*
Congested	CONG	Traffic*
Construction	CONST	Ahead
Downtown	DWNTN	Traffic*
Exit	EX, EXT	Next*
Express	EXP	Lane
Frontage	FRNTG	Road
Hazardous	HAZ	Driving
Interstate	I	[number]
Local	LOC	Traffic
Lower	LWR	Level
Major	MAJ	Accident
Minor	MNR	Accident
Oversized	OVRSZ	Load
Prepare	PREP	To Stop
Pavement	PVMT	Wet*
Quality	QLTY	Air*
Roadwork	RDWK	Ahead
Route	RT	Best*
Township	TWNSHP	Limits
Turnpike	TRNPK	[name]*
Upper	UPR	Level

\* These prompt words should precede the abbreviation

<sup>12</sup> *Ibid.*, 1A-16.

**Table 3: Additional Acceptable Abbreviations**  
*(Ref Hustad and Dudek 1999, Durkop and Dudek 2001)* <sup>13</sup>

<b>Word</b>	<b>Phrase</b>	<b>Acceptable Abbreviation</b>
Accident	Accident at Major Accident Minor Accident	ACCDT AT MAJ ACCDT MNR ACCDT
Closed	Lane Closed	LN CLSD
Lane	Lane Closed	LN CLSD
Level	Lower Level	LOWER LVL LOWR LVL
Level	Upper Level	UPPER LVL
Lower	Lower Level	LWR LEVEL
Major	Major Accident	MAJ ACCDT
Minor	Minor Accident	MNR ACCDT
Parking	Parking Lot	PRK LOT
Pavement	Wet Pavement	WET PVMT
Route	Detour Route	DETOUR RTE
Upper	Upper Level	UPR LEVEL UPPR LEVEL
Weight	Weight Limit	WT LIMIT

The MUTCD (2003) describes the unacceptable abbreviations as shown in Table 4. However, numbers of abbreviations were found to be unacceptable by Dudek’s paper (2002) even when used in a context of a CMS message. According to this study, they were understood by less than 85 percent of the surveyed drivers. These unacceptable abbreviations are shown in Table 5.

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<sup>13</sup> Dudek, C.L. “Guidelines for Changeable Message Sign messages: A White Paper.” December 2002, 38.

**Table 4: Unacceptable Abbreviations<sup>14</sup>**

Abbreviation	Intended Word	Common Misinterpretation
ACC	Accident	Access (Road)
CLRS	Clears	Colors
DLY	Delay	Daily
FDR	Feeder	Federal
L	Left	Lane (merge)
LT	Light (Traffic)	Left
PARK	Parking	Park
POLL	Pollution (Index)	Poll
RED	Reduce	Red
STAD	Stadium	Standard
WRNG	Warning	Wrong

**Table 5: Unacceptable Abbreviations  
(Ref Hustad and Dudek 1999, Durkop and Dudek 2001)<sup>15</sup>**

Word	Phrase	Unacceptable Abbreviation
Alternative	Alternative Routes	<del>ALT-RTS</del>
Congestion	Major Congestion	<del>MAJ-CONG</del>
County Road	County Road [number]	<del>CR [number]</del> <del>CO-RD [number]</del>
Eastbound	Eastbound Traffic	<del>EB TRAFFIC</del>
High Occupancy Lane	High Occupancy Lane	<del>HOV LANE</del>
Incident	Incident At	<del>INCID AT</del> <del>INCIDT-AT</del>
Interchange	Interchange 14	<del>INTCH 14</del>
Northbound	Northbound Traffic US 180 Northbound	<del>NB TRAFFIC</del> <del>US 180-NB</del>
Road Work	Road Work	<del>RD-WK</del>
Route	Detour Route	<del>DETOUR RT</del>
Southbound	Southbound Traffic US 75 Southbound	<del>SB TRAFFIC</del> <del>US 75 SB</del>
Vicinity	Vicinity Of	<del>VIC OF</del>
Westbound	Westbound Traffic US 180 Westbound	<del>WB TRAFFIC</del> <del>US 180 WB</del>

<sup>14</sup> MUTCD, November 2003, 1A-17.

<sup>15</sup> Dudek, C.L. "Guidelines for Changeable Message Sign messages: A White Paper." December 2002, 39.



**10. Reference and further reading**

- 10.1. Dudek, C.L. Guidelines for Changeable Message Sign messages: A White Paper. December 2002.
  - 10.2. Agah, M. Guidelines on the Use of Permanent Message Signs. Arizona Department of Transportation. March 2002.
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(<http://www.fhwa.dot.gov/legsregs/directives/policy/securmemo.htm>)
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