

4.0 Method of Measurement. Measurement for Optional Temporary Pavement Marking will be made to the nearest linear foot.

5.0 Basis of Payment. Payment for OPTIONAL TEMPORARY PAVEMENT MARKING as described in this provision will be made at the contract unit price for pay item 617-99.03 OPTIONAL TEMPORARY PAVEMENT MARKING, per linear foot.

Y. USE OF CROSSOVERS AND TRUCK ENTRANCES JSP-04-10

1.0 Description. The contractor is advised that at no time shall the contractor be allowed to use the existing median crossovers or install temporary crossovers to turn around during hauling operations or for the moving of equipment. The contractor is also prohibited from constructing any temporary entrances to the mainline of the interstate.

2.0 Basis of Payment No direct payment will be made to the contractor to recover the cost of equipment, labor, materials or time required to fulfill the above provision.

Z. DYNAMIC LATE MERGE SYSTEM (ZIPPER MERGE) JSP-16-07

1.0 General. The Work Zone Intelligent Transportation System (WZITS) shall be a portable, real-time, automated, solar powered system that provides dynamic late lane merge guidance along with queue warnings about stopped traffic ahead due to work zones. This system is to provide advance traffic condition information to motorists at key decision points due to construction activity. This system shall be in operation 24 hours per day, seven days per week, during the construction of the I-70 west bound bridge over Route E during the construction phase and the shoulder/median crossover work where there is only one westbound through lane available.

2.0 Description. This item shall consist of submittal and approval of a Work Zone Intelligent Transportation System plan, furnishing, installing, relocating, and operating a portable, automated, solar powered real-time work zone system (“Work Zone Intelligent Transportation System”) meeting the requirements noted herein, and providing a system manager to maintain the system during the duration of the project. The contractor shall assume responsibility for any damaged equipment due to crashes, vandalism, adverse weather, etc. that may occur during the system’s deployment.

2.1 The contractor shall furnish and maintain this system for measuring and delivering real-time messages for the work zone.

2.2 The contractor is responsible for coordinating any work in adjacent roadway construction projects.

2.3 The contractor will be responsible to relocate the devices as directed by the engineer. When the equipment is no longer required for this project, the contractor shall remove it and retain ownership.

3.0 System Requirements

3.1 The Work Zone Intelligent Transportation System shall be installed on I-70 in the westbound directions per the plans. It shall consist of the following as a minimum:

- 1 central computer system that can be accessed through a password protected internet connection
- Four (4) portable changeable message signs (CMS)
 - Four (4) CMS in the west bound lanes of I-70
- Four (4) portable non-intrusive traffic sensors
 - Four (4) traffic sensors in the west bound lanes of I-70

4.0 Smart Work Zone Plan

4.1 General. The contractor shall submit to the Engineer for approval a written and illustrated WZITS Plan **three (3)** weeks prior to mobilization of any component of the WZITS System. The WZITS Plan shall include the items required in this specification. The Contractor will not be allowed to start any construction activities that will affect traffic on the project until the WZITS Plan is approved by the Engineer.

4.2 Content of the WZITS Plan. The WZITS Plan shall include, as a minimum, the following items:

- A detailed plan showing the proposed locations of all WZITS devices and equipment description including make and model.
- A description of all proposed thresholds and proposed CMS messages to be implemented.
- The name and contact information of the WZITS System Manager.
- A detailed description of the proposed methods of communication between WZITS devices and WZITS Central Computer and between WZITS Central Computer and the KCSout Advanced Traffic Management System (ATMS) software:
 - The KCSout Traffic Management Center utilizes TransCore's TransSuite ATMS software package and at a minimum, the WZITS Central Computer shall provide the average speed for each radar trailer through a web service or XML feed that can be accessed over the internet.
 - At a minimum, the WZITS Central Computer shall update the average speed web service (or XML feed) every 5 minutes for each of the individual radar trailers.
- Proposed corrective method procedures including response times and notification process.

4.3 Approval of Plan. Approval of the WZITS Plan by the Engineer is required prior to the placement of any WZITS devices. Approval is conditional and will be predicated on satisfactory performance during construction. The Engineer reserves the right to require the Contractor to make changes in the WZITS Plan and operations, at no additional cost to the Commission, including removal of personnel, as necessary, to obtain the quality specified. The Contractor shall notify the Engineer in writing a minimum of **seven (7)** calendar days prior to any proposed changes in the WZITS Plan. Proposed changes are subject to approval by the Engineer.

4.4 Dynamic Late Merge (DLM) System: The WZ ITS system should be designed to provide the Dynamic Late Merge technology. The system shall detect a minimum of 2 distinct traffic conditions.

4.4.1 Free Flow:

Definitions of free-flow may vary by project, but typical traffic condition warrants may include:

- A trend of vehicle speeds at two points above an adjustable parameter. This parameter should be set for optimal results based on on-site monitoring and review as directed by the engineer. Typically, greater than 50 mph may be utilized as a guideline.
- A trend of vehicle volume between two points below an adjustable parameter. This parameter should be set for optimal results based on on-site monitoring and review as directed by the engineer. Typically, less than 1000 vehicles/hour may be utilized as a guideline.
- A trend including reduced vehicle speeds together with increased volume. These parameters should be set for optimal results based on on-site monitoring and review as directed by the engineer.

During Free Flow conditions, the DLM System shall display no lane use messages and therefore allow traffic to resume typical merging operations.

4.4.2 Congestion:

Definitions of congestion may vary by project, but typical traffic condition warrants may include:

- A trend of vehicle speeds at two points below an adjustable parameter. This parameter should be set for optimal results based on on-site monitoring and review as directed by the engineer. Typically, less than 20 to 35 mph may be utilized as a guideline.
- A trend of vehicle volume between two points above an adjustable parameter. This parameter should be set for optimal results based on on-site monitoring and review as directed by the engineer. Typically, greater than 1500 to 1700 vehicles/hour may be utilized as a guideline.
- A trend including reduced vehicle speeds together with increased volume. These parameters should be set for optimal results based on on-site monitoring and review as directed by the engineer.

When traffic conditions warrant a change to the late merge strategy, the DLM System shall display lane use messages on the CMS. The messages shall consist of two alternating displays as described below. The CMS shall be located in advance of the lane closure as determined by the engineer based upon estimated queue lengths and project geometry.

Approximate locations are as follows:

	West/Eastbound Mile Marker
Arrow Panel	44.2- ~ 0.4 miles East of Route E
Radar #1	44.4 (1100' East of Arrow Panel)
CMS #1	44.4 (1100' East of Arrow Panel)
Radar #2	44.8
CMS #2	44.8
Radar #3	45.8
CMS #3	45.8
Radar #4	46.8
CMS #4	46.8

Typical messages that will be displayed during congested conditions will be documented within the contractor WZITS plan. Possible messages include the following:

- CMS located at point of merge shall display:
 - **MERGE HERE – TAKE TURNS**
- Intermediate CMS located beyond estimated queue length at the time when DLM System activation will occur
 - **MERGE AHEAD – USE BOTH LANES**
- CMS located beyond estimated maximum queue length
 - **SLOW TRAFFIC AHEAD – USE BOTH LANES or**
 - **STOPPED TRAFFIC AHEAD – USE BOTH LANES**

5.0 Materials.

5.1 Changeable Message Signs. The Work Zone Intelligent Transportation System shall utilize MoDOT approved portable changeable message signs (CMS) in accordance with Missouri Standard Specifications for Highway Construction section 616 Temporary Traffic Control and 1063 Temporary Traffic Control Devices and Standard Plans for Highway Construction 616.10. Each CMS shall be capable of displaying eight characters on each of three rows. Each CMS power supply shall be properly sized to allow continuous operation for up to ten days during periods of darkness and inclement weather.

5.2 Each CMS shall be integrated with a radio/modem, and/or a traffic sensor or other equipment (e.g. controller) mounted on it and shall act as a single “device” for the purpose of communicating with similarly integrated “devices” and displaying real-time traffic condition information. Each device shall be capable of communicating through radios/modems with other device(s) at upstream or downstream locations. MoDOT staff must have the ability to override messages displayed on any CMS in the system. This feature must be password protected and on a website separate from MoDOT’s public website.

5.3 Portable Non-Intrusive Traffic Sensors. The Smart Work Zone System traffic sensors shall be side-fired microwave radar type whose accuracy is not degraded by inclement weather and visibility conditions including precipitation, fog, darkness, excessive dust and road debris. These sensors shall be capable of acquiring traffic data from up to **three (3)** lanes of traffic on a lane-by-lane basis.

5.4 Central Computer. The central computer shall provide the functionality described below:

General

- Provide a Graphical User Interface that is compliant with Windows standards.

- Communication between the central computer and any device shall be independent and *non-reliant* upon communications with any other CMS or sensor.
- Alerts to Contractor and MoDOT staff shall be provided via text or e-mail messaging.
- Alerts shall be sent in the event of device failure or traffic delays over 15 minutes.

Data Processing Software

- (a) The capability to collect and store sensor data.
- (b) The capability to compare traffic data collected from sensors to user-defined thresholds and automatically update one or more CMS's.
- (c) The capability to estimate travel times and automatically update one or more portable CMS's consistent with user-defined thresholds.
- (d) The capability to display alternate route messages consistent with user-defined thresholds.

Data Management

- (a) Storage of speed, volume, occupancy, CMS message history, and travel times as well as appropriate sensor status for each day.

Website

- (b) The Contractor will be responsible for hosting the website and obtaining domain names. Possible domain names and overall website design must be submitted to the Engineer for approval prior to it being made available.
- (c) The website shall contain an accurate map of the area affected by the work zone, including state highways or routes that may be used as alternates.
- (d) Icons or hyperlinked text should accurately depict the current location of the system components and give real-time information provided by each component. In the event components are moved to a new location, the website must reflect these changes to the system layout.
- (e) Historical data should be password protected and stored on the website for each day the system is in use, with date and time stamps included. The above data shall be available to MoDOT staff at all times for the duration of work zone activity. An electronic copy of all data, including date and duration of system malfunction, shall be provided to MoDOT staff after all work zone activity is completed and the WZITS has been removed.
- (f) The MoDOT staff and the Engineer shall have the capability to override messages, via password protection, from the website.
- (g) Device information shall be provided to MoDOT TMC staff through icons or hyperlinked text representing each device. Detectors should provide real-time speeds at the respective locations and CMS's should provide the current message of each sign.
- (h) The website shall be designed and operated to allow 20 users to access the site at one time.

6.0 System Manager. The contractor shall employ a system manager for the WZITS. The system manager shall be locally available to maintain system components, maintain the website, move portable devices as necessary, and respond to emergency situations. The system manager shall be responsible for coordinating the placement of devices in the project areas. It is the responsibility of the system manager to move system components that interfere with construction operations and relocate the components to another area. The system manager shall supply a local phone number and/or a toll free number to the engineer to contact the system manager or other system representative at any time.

7.0 Operational Test. Once the WZITS is installed, it shall undergo a five-day operational test. The operational test shall include a test of the system in operation during a lane closure to ensure that all WZITS equipment (including the changeable message signs, traffic sensors, central computer, communication devices, and website) is operating in a fully functional manner and in accordance with the Smart Work Zone Plan for a duration of at least five (5) calendar days. The contractor shall provide for complete operations support from the vendor during the operational test, and the contractor shall provide verification that the reported drive time through the work zone accurately reflects actual field conditions. If any equipment malfunctions occur for a combined period of four (4) hours or more during this operational test on any day, no credit will be given for that day for the operational test period, and the five-day operational test will reset.

7.1 The contractor shall maintain records of equipment stoppages and resumptions during the five-day operational test for submission to the engineer for his approval. In the event that ten percent or more of the time similar malfunctions occur that affect the proper operation of the WZITS, the engineer may declare a system component defective and require replacement of the equipment at no additional cost. When a system component defect is declared, the five-day operational test shall begin again after all defective equipment is replaced and the system is fully operational.

7.2 Report. The contractor shall submit a report to the engineer detailing the daily activity of the system during the operational test. The report shall indicate the date and time of any activity necessary to maintain operation of the WZITS during the operational test period. Each entry shall include the following information:

- (a) Identity of the equipment on which work was performed
- (b) Cause of equipment malfunction (if known)
- (c) A description of the type of work performed
- (d) Time required to repair equipment malfunction

Once the operational test report is received and approved by the engineer, the WZITS will be considered operational and the system will be accepted for use.

8.0 Method of Measurement. Work Zone Intelligent Transportation System (WZITS) shall be measured by one lump sum and shall be divided into the following payment schedule:

- (a) 35 percent will be paid when all of the WZITS equipment is delivered to the jobsite.
- (b) 25 percent will be paid when the engineer approves the Operational Test Report.
- (c) 20 percent will be paid after 30 calendar days of full system operation.
- (d) 20 percent will be paid after traffic is in its final position, the contractor's equipment has been removed from the project, and historical data has been provided to the engineer.

8.1 Deduction for Failed System. A percentage of the lump sum will be deducted should the system malfunction for three (3) or more consecutive calendar days or any total of five (5) calendar days in any one calendar month after the approval of the operational test. This deduction will be based on a ratio of calendar days of unsuccessful operation to total calendar days of operation following the approval of the operational test. This deduction will not reduce the total system payment to less than 60 percent of the lump sum.

9.0 Basis of Payment. Payment for submittal and approval of a Work Zone Intelligent Transportation plan, furnishing, installing, relocating, operating, maintaining, testing, monitoring,

providing a website, providing historical data, and removal of the Work Zone Intelligent Transportation System (WZITS), including all items required for proper operation of this installation, except required CMS boards and required static sign assemblies which will be paid for separately, will be completely covered by the contract unit price for Item Number 616-99.01, "Work Zone Intelligent Transportation System," per lump sum.

AA. ROLLING STOP

1.0 Description. This work shall consist of the traffic control necessary for the placement of girders for proposed Bridge No. A8627. A rolling stop is a form of traffic control used by contractors and maintenance personal for emergencies or roadway closures for short durations of time. The traffic control vehicles form a moving blockade which reduces traffic speeds and creates a large gap in traffic or clear area allowing very short term work to be completed.

2.0 Construction Requirements.

2.1 Before starting the rolling stop operation ensure there is at least one traffic control vehicle (with flashing lights and a truck mounted attenuator (TMA) per each slowed down lane. There should also be one vehicle to cover every point of access onto the 'rolling stop' segment of the roadway.

2.2 The traffic control vehicles leading the rolling stop must enter the roadway far enough from the work site to allow a clear area in front of them to develop. The traffic control vehicle will work into position so that each lane is controlled by a vehicle with proper flashing lights and TMA's

2.3 During the rolling stop operation the sight distance for the traveling public should be maintained so the drivers have the proper braking reaction and braking distance to stop their vehicles.

2.4 A separate traffic control vehicle, "chaser vehicle" shall follow the slowest or last vehicle ahead of the blockade. When that last vehicle passes the work site, the crew can begin the work operation.

2.5 All ramps and entrances to the roadway between the rolling stop blockade and the work site must be temporarily closed using traffic control personnel. Each of those ramps must remain closed until the "all clear" signal is given by the work site crew.

2.6 Proper communications are needed between the work site crew and the rolling stop blockade so that space and time adjustments can be made.

3.0 Basis of Payment. The cost of equipment, labor, materials or time to fulfill the above provision will be included in the unit bid price for item 612-30.00A, TRUCK OR TRAILER MOUNTED ATTENUATOR (TMA), per each.