

**STATE OF OHIO
DEPARTMENT OF TRANSPORTATION**

**SUPPLEMENTAL SPECIFICATION 996
WORK ZONE QUEUE DETECTION WARNING SYSTEM MATERIALS**

July 15, 2016

996.01 Description

996.02 Work Zone Queue Detection Warning System Class I Materials

996.03 Work Zone Queue Detection Warning System Class II Materials

996.01 Description. This Supplemental Specification sets forth the requirements for Work Zone Queue Detection Warning Systems (WZQDWS). All WZQDWS components shall be NCHRP 350 or MASH compliant and comply with the Ohio Manual of Uniform Traffic Control Devices (OMUTCD). WZQDWS shall consist of two separate classes based on the complexity of the WZQDWS.

WZQDWS shall be a system consisting of traffic sensors, portable changeable message signs (PCMS), communications equipment, control equipment and software. The WZQDWS shall be a portable, automated system that calculates real-time vehicular speeds at several locations on a freeway and displays the appropriate messages on portable changeable message signs at upstream locations. The WZQDWS shall provide both user defined messages on the portable changeable message signs as well as user defined speed thresholds that activate the messages being displayed.

WZQDWS Class I shall be a turnkey system consisting of the following components at a minimum: portable changeable message signs (PCMS); traffic sensors capable of collecting real-time speed, occupancy, and volume on a lane by lane basis; and software to analyze sensor data and push messages to PCMS.

WZQDWS Class II shall be a turnkey system consisting of the following components at a minimum: portable changeable message signs (PCMS), traffic sensors capable of collecting real-time speed, and software to analyze sensor data and push messages to PCMS.

996.02 Work Zone Queue Detection Warning System Class I Materials. The WZQDWS Class I shall consists of the following components: PCMS, Portable Non-Intrusive Traffic Sensors, and WZQDWS Software (A-C below). All trailer mounted devices shall be permanently delineated per C&MS 614.03.

A. PCMS. All PCMS must be able to connect to the WZQDWS and populate a preprogrammed message based on real time traffic data. All PCMS must be on the Department's Approved List.

B. Portable Non-Intrusive Traffic Sensors. The portable non-intrusive traffic sensors must meet, at a minimum, the following:

1. Be a non-intrusive type, unless otherwise approved;
2. Provide an auto-configuration application;
3. Be capable of counting individual vehicles and reporting speeds ranging from 5 miles per hour up to 99 miles per hour;

4. Provide vehicle volume, average speed, and average occupancy data at intervals of 20 seconds ranging from 20 seconds up to 2 minutes, as selected by the user;
5. Detect traffic in a minimum of six lanes in one direction of traffic simultaneously on a lane by lane basis;
6. Provide both serial and Ethernet ports.
7. Maintain accurate performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog, and changes in temperature and light;
8. Not rely on temperature compensation circuitry and be capable of continuous operation over an ambient temperature range from -40 degrees Fahrenheit (F) to +167 degrees F, and a relative humidity range from 5 percent to 95 percent (non-condensing); and
9. Traffic volume data must be accurate within 5 percent of actual for any direction of travel in nominal conditions. Individual lane accuracy must be within 5 percent of actual during nominal conditions. Nominal conditions exist when traffic is flowing at speeds greater than 10 miles per hour, with less than 10 percent truck traffic per lane and at least 30 percent of each vehicle visible above roadway barriers for true sensor detection. Average traffic speed must be a measured quantity using phase information or another true measurement, and cannot be derived from a presence measurement as this has been shown to produce biases during congestion. Average traffic speed data must be accurate within 5 mph for any direction of traffic and for all conditions involving more than 16 cars per lane in an interval. Speed accuracy for individual lanes must be accurate within 10 mph for all traffic conditions and similar intervals. Speed accuracy must be verified with radar gun, or by video speed trap using the frame rate as a time reference.

C. WZQDWS Software. The WZQDWS software must meet, at a minimum, the following:

1. Use volume, occupancy, and vehicle speed over a polling period as defined in C.3. below to detect queuing of traffic;
2. Be capable of communicating independently and simultaneously with all devices in the system, including PCMS and sensors;
3. Be capable of polling data at an interval of 20 or 60 seconds, as selected by the user;
4. Be capable of automatically setting the PCMS message sequences based upon polled data to reflect the current traffic speed status to the nearest minute.
5. Account for short-term variations in traffic speed and prevent frequent, abrupt, and unnecessary changes in PCMS messages and web site updates;
6. Display and/or send an alert via e-mail or text when traffic is slowed or stopped and when the traffic returns to its normal operation, as defined in C.8. below;

7. Be capable of allowing trained personnel to change any PCMS message, either on-site or remotely, using an application that is password protected and accessible from an Internet browser;
8. Have default queue level thresholds based on vehicle speeds that are:
 - (a) Normal: 50 miles per hour or greater
 - (b) Slowing: 26 to 49 miles per hour
 - (c) Stopped: 25 miles per hour or less
9. Allow thresholds to be based on any combination of vehicle speed, volume, density and/or occupancy, based on conditions in the slowest or most congested lane.
10. Allow thresholds to be changed by an authorized user.
11. Provide a graphical user interface (GUI) that is accessible via an Internet web browser and meets the following requirements:
 - (a) All system functions and capabilities are accessible from the GUI;
 - (b) Secure logins are provided for all users;
 - (c) System administrators can add, delete, and change user login accounts and user functions;
 - (d) Automatic updates once per minute without page reloads; and
 - (e) Online help is provided for all functions.
12. Provide current system health information for corrective and preventative maintenance, including:
 - (a) The Global Positioning System (GPS) location of all system devices;
 - (b) Solar and battery voltage monitoring;
 - (c) Alarms for battery voltage thresholds and/or communication problems;
 - (d) Watch Dog Timer to prevent system lockups; and
 - (e) Automatic power cycling of local system components to correct system problems.
13. Data Management. All collected traffic, system health, and maintenance data are to be recorded and a copy made available upon request. This data shall be hosted and processed within the United States per State of Ohio Executive Order 2011-12K. This data includes, but is not limited to:
 - (a) Vehicle volumes;
 - (b) Vehicle speeds;
 - (c) Occupancies;
 - (d) PCMS message history;
 - (e) System health history;
 - (f) Solar and battery voltage history;
 - (g) Preventative maintenance activities; and
 - (h) Complete system operations history, including GPS device locations.
14. Software training and/or equipment training shall be provided to all Department authorized individuals including, but not limited to Department employees and contractor personnel.

996.03 Work Zone Queue Detection Warning System Class II Materials. The WZQDWS Class II shall consist of the following components: PCMS, Portable Non-Intrusive Traffic Sensors, and WZQDWS Software (A-C below). All trailer mounted devices shall be permanently delineated per C&MS 614.03.

A. PCMS. All PCMS must be able to connect to WZQDWS and populate a preprogrammed message based on real time traffic data. All PCMS must be on the Department's Approved List.

B. Portable Non-Intrusive Traffic Sensors. The portable non-intrusive traffic sensors must meet, at a minimum, the following:

1. Be a non-intrusive type, unless otherwise approved;
2. Provide an auto-configuration application;
3. Be capable of detecting individual vehicles and reporting speeds ranging from 5 miles per hour up to 99 miles per hour;
4. Provide average speed data at intervals of 20 seconds ranging from 20 seconds up to 2 minutes, as selected by the user;
5. Detect traffic in a minimum of three lanes in one direction;
6. Maintain accurate performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog, and changes in temperature and light;
7. Not rely on temperature compensation circuitry and be capable of continuous operation over an ambient temperature range from -40 degrees Fahrenheit (F) to +167 degrees F, and a relative humidity range from 5 percent to 95 percent (non-condensing); and
8. System Performance. Average traffic speed must be a measured quantity using phase information or another true measurement, and cannot be derived from a presence measurement as this has been shown to produce biases during congestion. Average traffic speed data must be accurate within 5 mph for any direction of traffic and for all conditions involving more than 16 cars per lane in an interval. Speed accuracy must be accurate within 10 mph for all traffic conditions and similar intervals. Speed accuracy must be verified with radar gun, or by video speed trap using the frame rate as a time reference.

C. WZQDWS Software. The WZQDWS software must meet, at a minimum, the following:

1. Use vehicle speed over a polling period as defined in C.3. below to detect queuing of traffic;
2. Be capable of communicating independently and simultaneously with all devices in the system, including PCMS and sensors;
3. Be capable of polling data at an interval of 20 or 60 seconds, as selected by the user;

4. Be capable of automatically setting the PCMS message sequences based upon polled data to reflect the current traffic speed status to the nearest minute.
5. Account for short-term variations in traffic speed and prevent frequent, abrupt, and unnecessary changes in PCMS messages and web site updates;
6. Display and/or send an alert via e-mail or text when traffic is slowed or stopped and when the traffic returns to its normal operation as defined in C.8. below;
7. Be capable of allowing trained personnel to change any PCMS message, either on-site or remotely, using an application that is password protected and accessible from an Internet browser;
8. Have default queue level thresholds based on vehicle speeds that are:
 - (a) Normal: 50 miles per hour or greater
 - (b) Slowing: 26 to 49 miles per hour
 - (c) Stopped: 25 miles per hour or less
9. Allow thresholds to be based on vehicle speed.
10. Allow thresholds to be changed by an authorized user.
11. Provide a graphical user interface (GUI) that is accessible via an Internet web browser and meets the following requirements:
 - (a) All system functions and capabilities are accessible from the GUI;
 - (b) Secure logins are provided for all users;
 - (c) System administrators can add, delete, and change user login accounts and user functions;
 - (d) Automatic updates once per minute without page reloads; and
 - (e) Online help is provided for all functions.
12. Provide current system health information for corrective and preventative maintenance, including:
 - (a) The Global Positioning System (GPS) location of all system devices;
 - (b) Solar and battery voltage monitoring;
 - (c) Alarms for battery voltage thresholds and/or communication problems;
 - (d) Watch Dog Timer to prevent system lockups; and
 - (e) Automatic power cycling of local system components to correct system problems.
13. Data Management. Any collected traffic, system health, and maintenance data shall be hosted and processed within the United States per State of Ohio Executive Order 2011-12K.
14. Software training and/or equipment training shall be provided to all Department authorized individuals including, but not limited to Department employees and contractor personnel.