

MISSISSIPPI DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION NO. 907-651-4

CODE (SP)

DATE: 11/15/2010

SUBJECT: Magnetometer Detection System

Section 907-651, Magnetometer Detection System, is hereby added to and made a part of the 2004 Edition of the Mississippi Standard Specifications for Road and Bridge Construction as follows:

SECTION 907-651 – MAGNETOMETER DETECTION SYSTEM (VDS)

907-651.01--Description. This work consists of furnishing all components and materials required to enable a wireless, battery powered magnetometer detection system that detects vehicles on a roadway using battery powered magnetometers with wireless communications to transmit detection information to the controller. The system shall detect vehicles on a roadway using only changes in the earth's magnetic field and provide detection outputs to a traffic controller or similar device. This specification sets forth the minimum specifications for the system.

The Wireless Battery Powered Magnetometer Vehicle Detection System (VDS) shall consist of one or more Vehicle Sensor Nodes (VSN) per lane, one or more Access Points (AP) mounted on the side of the roadway, one or more Access Boxes, wireless repeaters (RP) mounted on the side of the roadway as needed, Contact Closure Interface Card(s) (CCI), CAT5E Outdoor Ethernet Cable, Epoxy Sealant for installation, and applicable operating software. Software shall operate on a conventional portable PC. The VDS shall also include any incidental items necessary for a complete and operable unit in place and accepted. Communications between the VSN and the AP shall be wireless.

907-651.02--Materials.

907-651.02.1--Functional Capabilities. The VSN shall detect a vehicle by measuring a change in the earth's magnetic field near the VSN caused by the vehicle, i.e. magnetometer type detection. The VSN shall transmit detection information within 150ms of a detected event. The VSN shall communicate time-stamped ON and OFF vehicle detection events. The VSN shall automatically re-transmit a detected event at least 8 times if no acknowledgment is received from the AP. The VSN shall automatically recalibrate in the event of a detector lock. If radio connection is lost due to stopped vehicles near VSN, each VSN shall be capable of re-establishing radio link with supporting AP or RP in less than 2 seconds. Each VDS system shall consist of one or more VSN's per lane located as identified on the intersection plans. Communications between the VSN and the AP shall be wireless.

The Radio Frequency (RF) link among the AP, RP, and VSN shall conform to the following:

- The RF link shall utilize an IEEE approved wireless communications protocol.
- Communications is allowed only in an unlicensed band.

- The VSN and RP shall be reconfigurable by a user over the wireless interface to avoid interference from other users of the communications band. A minimum of 16 channels shall be provided for this purpose.
- The RF link budget shall be 93dB or greater.
- The AP to VSN (or RP to VSN) RF range shall be at least 150 feet for an AP/RP installed at 24 feet above the roadway and at least 100 feet at 18 feet above the roadway.
- The RP to AP RF range shall be at least 750 feet when both units are installed 18 feet above the roadway.

Each VSN shall transmit a unique identifying code. The single VSN shall be configurable to approximate the detection zones of 6' x 6' and 6' x 50' inductive loops. Sensitivity of the VSN shall be adjustable as may be required to detect bicycles and/or motorcycles. The VSN shall respond within 100 seconds when the AP is powered on. When no AP is present or powered on, the VSN is not required to detect vehicles. The AP shall have the capability to transmit detection information to a centralized server over a cellular data connection, or an Ethernet connection, or a serial link. The AP shall have the capability to transmit detection information to a 170, 2070, or NEMA TS1 and TS-2 traffic controllers to provide real time detection information via a standard contact-closure based input shelf. The VSN, RP and AP shall be capable of accepting software and firmware upgrades.

907-651.02.2--VSN Hardware. The VSN shall consist of a magnetometer, a microprocessor, a wireless transmitter and receiver, battery, an "enclosure case", and epoxy sealant for installation. The VSN components shall be contained within a single housing. The VSN housing shall meet NEMA 6P and IEC IP68 standards. The VSN components shall be fully encapsulated within the housing to prevent moisture from degrading the components. The VSN shall be able to operate at temperatures from -37°F to +176°F. The VSN housing shall be capable of being installed in a 4-inch cored hole that is 2.25" deep. The VSN shall be designed to operate from its battery for a minimum of ten years of life under normal traffic conditions.

907-651.02.3--AP Hardware. The AP shall be the communication hub of the sensor network. The AP shall be able to communicate to up to 48 VSN's. The AP shall be powered via 48V DC, 3W or via non-isolated external 10 to 15V DC, 2W power. Power shall be provided by the Contact Closure Interface Card (s) (CCI). The AP shall have at least one powering option that provides 1500V isolation and 5KV surge protection. The AP shall operate in the -37°F to +176°F temperature range. The AP shall meet NEMA 4X and IEC IP67 standards. The AP shall be no larger than 12" H x 8" W x 4" D. The AP shall weigh no more than four pounds (4 lbs.). The AP shall communicate to the controller via the Contact Closure Interface Card(s). The AP shall be able to communicate back to a computer/server via Ethernet.

907-651.02.4--Repeater Hardware. If required, a RP shall be provided. The RP shall extend the effective communication range of the sensor to the AP an additional 750 feet. The RP communicating directly to an AP shall support at least ten (10) sensors while an RP communicating to an AP via an intermediate RP shall support at least (six) 6 sensors. The RP shall be battery powered. The RP battery shall be field replaceable. The RP shall operate in the -37°F to +176°F temperature range. The RP shall meet NEMA 4X and IEC IP67 standards. The RP shall be no larger than 5" H x 4" W x 4" D. The RP shall weigh no more than four pounds (4 lbs.). The RP shall be designed to operate from its battery for a minimum of eight (8) years of life under normal traffic conditions.

907-651.02.5--Contact Closure Interface Card Hardware. The Contact Closure Cards and Extension Cards, collectively called Contact Closure Interface Card(s) (CCI), shall provide detector outputs to the controller. The CCI and card(S) shall communicate with the AP via an Ethernet cable. The CCI card(s) shall directly plug in to the standard 170/2070 Input Files and NEMA detector racks. Each CCI card shall provide up to 4 channels of detections from a signal AP's supported sensors, where each channel comprises an optically isolated contact closure relay. The CCI card(s) shall be able to provide pulse or presence detection outputs. The CCI card(s) shall provide for up to 31 seconds of delay. The CCI card(s) shall provide up to 7.5 seconds of extension.

The front panel of the CCI card(s) shall provide:

- Status LED's displaying
 - Detection Channel Status
 - Line Quality
 - Fault Monitor
- Configuration DIP switches to enable
 - Presence or Pulse mode
 - Delay
 - Extension
- Rotary Switch to program time functions for delay and extension functions
- Two Ethernet style RJ45 connectors

The CCI card(s) shall be powered by 11 to 26 VDC. The CCI card(s) shall provide power to the AP over the Ethernet cable. The CCI card(s) shall be surge protected to GR-1089 standards. The CCI card(s) shall operate -37°F to +176°F temperature range. The CCI card(s) shall operate in up to 95% humidity (non-condensing).

907-651.02.6--Access Box. The Access Box shall provide a communication link between the AP and CCI card(s). The Access Box shall provide the ability for remote communications. The Access Box shall have three (3) Ethernet style RJ45 connectors. The Access Box shall not exceed 2-3/8" x 1-1/2" x 7/8" in size.

907-651.02.7--Configuration Software. The VDS shall include the software necessary to configure the VSN. The VDS shall include the software necessary to configure the RP. The VDS shall include the software necessary to configure the AP. The VDS shall include the software necessary to store and retrieve detection data.

907-651.03--Construction Requirements.

907-651.03.1--Installation. The flush mount sensors shall be installed in the roadway using the following procedure. The roadway shall be core drilled to provide a 4-inch diameter hole, 2.25" deep. A small layer of sand or pea gravel sufficient to cover the bottom of the hole shall be applied. The sensor shall then be placed on top of this layer of sand in the correct orientation. The sensor shall be fully encapsulated with the epoxy to the lip of the cored hole. The AP and RP shall be installed within range of the sensors as specified by the manufacturer.

907-651.03.2--Removal. The direction of traffic flow shall be permanently marked on top of the sensor prior to removal. The sensor and its epoxy coating shall be removed from the roadway by coring a 5" diameter hole to a depth of 2.25" with the sensor and epoxy being contained in the center of the core. The core shall then be extracted from the roadway using a pry bar as needed and retained for reinstallation upon completion of roadwork.

907-651.03.3--Reinstallation. Cores containing previously removed sensors shall be reinstalled by coring a 5" hole in the roadway to a depth of 2.25". The core shall be placed inside the hole in the correct orientation. The sensor shall be fully encapsulated with the epoxy to the lip of the cored hole. The sensors shall be configured as needed to provide vehicle detection and operate with existing system AP, RP's, and cabinet components.

907-651.03.4--Limited Warranty. The supplier shall provide a limited two-year warranty on the detection system. During the warranty period, technical support shall be available from the supplier via telephone within 24 hours of the time a call is made by a user, and this support shall be available from factory-authorized personnel or factory-authorized installers. During the warranty period, standard updates to the software shall be available from the supplier without charge.

907-651.03.5--Maintenance and Support. The supplier shall maintain a sufficient inventory of parts to provide support and maintenance of the system. These parts shall be available for delivery within 30 days of receipt of a purchase order by the supplier at the supplier's then current pricing and terms of sale.

The supplier shall maintain an ongoing program for customer support for the system. This support shall be via telephone, email or personnel sent to the installation upon receipt of an purchase order at the suppliers then current pricing and terms of sale for technical support services.

Installation and/or training support shall be provided by a factory authorized representative. All documentation shall be provided in the English language.

907-651.04--Method of Measurement. Magnetometer detection system will be measured as a unit quantity per each system installation. Measurement shall include controller modifications, connectors, wiring, software, other components for which there is no pay item, and other incidental items necessary to complete the work.

Magnetometer detection system component, of the type specified, will be measured as a unit quantity per each. Measurement shall include any needed modifications, hardware, connectors, wiring, and other incidental items necessary to complete the work for the component.

Magnetometer detection system component removal and reinstallation will be measured as a unit quantity per each. Measurement shall include all work necessary to completely remove and reinstall an existing component, of the type specified.

907-651.05--Basis of Payment. Magnetometer detection system and magnetometer detection system components, measured as prescribed above, will be paid for at the contract unit price per each installed, which price shall be full compensation for furnishing all materials, for installing,

connecting and testing, and for all equipment, labor, tools, and incidentals necessary to complete the work.

Magnetometer detection system component removal and reinstallation, measured as prescribed above, will be measured as a unit quantity per each, which price shall include all work necessary to completely remove and reinstall an existing component, of the type specified. It shall also include any necessary epoxy sealant, controller modifications, connectors, wiring, software programming, and any other incidental items necessary to complete the work.

Payment will be made under:

- 907-651-A: Magnetometer Detection System - per each
- 907-651-B: Magnetometer Detection System Component, _____ - per each
- 907-651-C: Magnetometer Detection System Component Removal and Reinstallation, _____ - per each