

**SPECIAL PROVISIONS  
FOR  
SECTION 750-G: VEHICLE DETECTION SYSTEM (VDS)**

The 2014 Edition of the New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction shall apply in addition to the following:

**1.0 DESCRIPTION.**

This specification shall govern all work associated with the furnishing and installing of vehicle detection systems (VDS).

**1.01 National Transportation Communications for ITS Protocol (NTCIP).**

All communications between hardware and software devices shall be conformant with the standards and compliant with this project. That acceptance must be obtained at least 30 days prior to deployment of the equipment described herein. NTCIP communications compliance overrides other communications protocols described within this specification.

**2.0 MATERIALS LIST AND DRAWINGS.**

All materials furnished, assembled, fabricated or installed under this item shall be new.

A list of materials which the Contractor proposes to install for the VDS together with the drawings and other data shall be submitted to the Project Engineer for approval by the ITS Bureau chief and or the ITS Engineer or their designees.

**3.0 FUNCTIONAL REQUIREMENTS.**

VDS's shall provide vehicle detection data in the form of vehicle presence, volumes, counts, speed and occupancy for up to 10 lanes of traffic simultaneously with the performance requirements of these special provisions. VDS's shall provide a separate zone per lane that detects vehicles as close as 6 ft and as far as 250 ft from the VDS sensor. VDS's shall monitor traffic lanes in the presence of barriers, railings, guardrails, median, gores, partially occluded vehicles and other obstacles.

VDS's shall be installed a minimum of 15 ft from the nearest lane (that is assuming that you are placing it on a breakaway post) and at a minimum height of 16 ft and a maximum height of 25 ft (or per manufacturer recommendations) and detect vehicles traveling at speeds between 7 mph and 100 mph with the following accuracy:

- A. Average 5 minute volumes for all lanes combined with better than 95 percent accuracy compared to vehicles observed in video images for the same period.
- B. Average 30 second volumes in every lane with better than 90 percent accuracy compared to vehicles observed in video images for the same period.
- C. Average 30 second speed for all lanes combined with better than 95 percent accuracy when compared to radar speed gun readings for the same period.
- D. Average 5 minute occupancy for all lanes combined with better than 85 percent accuracy when compared to dual inductive loop detection performance.
- E. Report greater than 95 percent occupancy accuracy compared to vehicles observed in video images for the same period whenever lanes are congested and vehicles are stationary for up to 15 minutes.

#### **4.0 CONFIGURATION**

VDS's shall consist of an VDS sensor unit and include mounting hardware, power supplies, surge suppression, and modules needed to interface and integrate to NMDOT's communications infrastructure as well as all necessary cables, connectors and wiring to connect the detector to the controller and cabinet. The Contractor shall provide software, firmware and equipment to set-up, calibrate, operate and control the unit, including system diagnostics and data collection as specified by NMDOT ITS. It must be compatible with NMDOT control software. The work includes an initial site analysis, as well as work to set-up and configure the system, to calibrate the device performance and verify detector accuracy as well as train NMDOT personnel.

VDS's shall be user programmable from the Traffic Management Center (using central control software and/or manufacturer's software) as well as in the field with a Windows XP or Vista compatible laptop computer. The Contractor shall provide software that observes the vehicular traffic and automatically places detection lanes and sets the sensor sensitivity. VDS's shall be designed so that a trained State employee can configuration and calibrate the VDS in less than 15 minutes per lane once the VDS sensor unit is installed.

#### **5.0 TECHNICAL REQUIREMENTS.**

VDS's shall meet all applicable state and federal requirements and associated certifications, as applicable (i.e. FCC certifications for low-power, unlicensed, continuous radio transmitter operation).

#### **6.0 SYSTEM COMPONENTS.**

When applicable (i.e. microwave systems, laser, acoustic, or radar) VDS's shall include an enclosed sensor that, as a minimum, include a directional transmitter, antenna and receiver, a processor, memory and communication interface (switches and/or modem as specified). The VDS enclosure shall be weatherproof with a NEMA 3R rating, and, when applicable, the sensor mounted and directed perpendicular to the flow of traffic lanes at the locations shown on the plans.

**7.0 COMMUNICATIONS.**

VDS's shall have a serial and ethernet communication port that supports the National Transportation Communication for ITS Protocol (NTCIP), the point to point protocol (PPP) and the Ethernet protocol. The VDS shall be addressable and shall download count, speed and occupancy data to the TMC server/computer. The protocol shall support sensor unit setup from a local Windows XP or Vista compatible laptop or from the TMC with either serial, ethernet, or wireless or applicable communications. VDS's shall include the necessary equipment to wire several VDS units into a multi-point configuration.

**8.0 HOUSING AND POWER REQUIREMENTS.**

The Contractor shall provide a NEMA 3R rated enclosure as specified by NMDOT for housing the applicable communications equipment, VDS unit power supply or transformer and for terminating all field wiring and AC service connections. Equipment in the enclosure shall be mounted using standard hardware.

**8.01** VDS's power supplies and transformers shall operate from 95 to 135 V (ac).

**8.02** The power supply or transformer shall meet the following minimum requirements:

	Power Supply	Transformer
Power Cord	Standard 120V(ac), 3 prong cord, at least 1 meter in length (may be added by Contractor)	Standard 120V(ac), 3 prong cord, at least 1 meter in length (may be added by Contractor)
Type	Switching mode type	Class 2
Rated Power	Twice (2x) full system load	Twice (2x) full system load
Operating Temperature	From -35°C to +74°C	From -35°C to +74°C
Operating Humidity Range	From 5 percent to 95	From 5 percent to 95
Input Voltage	From 90 V to 135 VAC	From 90V to 135 VAC
Input Frequency	60 Hz +/- 1 Hz	60 Hz +/- 1 Hz
Inrush Current	Cold start, 25 A max. at 115 V	N/A
Output Voltage	As required by the VDS	As required by the VDS
Overload Protection	From 105 percent to 150 percent in output pulsing mode	Power limited at >150 percent
Over Voltage Protection	From 115 percent to 135 percent of rated output voltage	N/A
Setup, Rise, Hold Up	800ms, 50ms,15ms at 115VAC	N/A
Withstand Voltage	I/P-0/P:3kV, I/P-FG:1.5kV, for 60 sec.	I/P-0/P:3kV, I/P-FG:1.5kV, for 60 sec
Working Temperature	Not to exceed 70°C@30% load	Not to exceed 70°C@30% load
Safety Standards	UL 1012, TUV EN60950	UL 1585
EMC Standards	EN55022 Class B, EN61000-4-2, 3, 4, 5 and EN61000-3-2, 3	N/A

**8.03** Field terminated circuits shall include transient protection that complies with all applicable IEEE Standard.

**8.04** VDSs shall automatically restore normal operation following a power failure within 3 minutes and not require manual intervention. The VDS shall maintain the configuration and calibration information in memory while powered off for at least 90 days.

## **9.0 MEMORY AND BACKUP**

VDS's shall be able to locally record and store vehicle count, speed and occupancy data for each lane in 10 second to 60 minute intervals for seven continuous days.

## **10.0 CONSTRUCTION**

**10.01** The Contractor shall be responsible for the compatibility of components and for making necessary calibration adjustment to deliver the performance required in these special provisions.

**10.02** When applicable, the Contractor shall assure that the VDS will not cause harmful interference to radio communication in the area of the installation. The VDS units shall be installed such that each unit operates independently and that VDS units not interfere with other VDS units or other equipment in the vicinity.

**10.03** The Contractor is responsible for site visits and analysis of each proposed location to assure that the detector placement will comply with the manufacturer's published installation instructions. The Contractor shall confirm detector placement with the manufacturer before installing any equipment.

**10.04** The Contractor shall provide equipment required to setup, calibrate, verify performance and maintain the VDS. This shall include but not limited to providing a bucket truck and traffic control when working within the NMDOT R/W.

**10.05** The Contractor shall provide programming software needed to support the VDS. The software shall be installed in the appropriate equipment and used for the acceptance testing.

**10.06** The Contractor shall verify the performance of each VDS unit and submit the data and other supporting materials to the Engineer at the conclusion of each test. The accuracy of each VDS unit shall be determined and documented so that each unit may be approved or rejected separately by the Engineer. Failure to submit the materials at the conclusion of testing invalidates the test. The submitted data serves as acceptance evidence only and shall not be used for calibration. The calibration shall have been completed prior to testing and verification.

## **11.0 ACCEPTANCE TESTING**

In addition to these requirements, the Contractor shall be required to demonstrate compliance with special provision "ITS System Acceptance Testing". Where there is a difference between the two requirements the more conservative requirement must be met.

In addition to the accuracy analysis performed by the Contractor, the Contractor shall provide equipment, software, documentation, support equipment, and any other materials, personnel and devices that may be required for acceptance testing by the Engineer. The Contractor shall notify the Engineer 30 days before the

VDS unit is ready for acceptance testing. Testing shall be scheduled to be accomplished before the end of the normal work shift.

Accuracy of the VDS system shall be verified by comparing the VDS vehicle counts to recorded video image counts or actual counts as specified by NMDOT, for the same period. If using video image counts, the video camera shall be located and oriented so that traffic is visible in all lanes. Video images shall be time stamped and analysis periods recorded to a DVD or CD media for viewing on a PC. The Contractor shall provide a means for synchronizing the test start and test ending times or provide software that displays time stamped VDS data along with the video images of the moving vehicles. The Contractor shall make a copy of the recording medium for the Department's use.

The accuracy test shall take place during a period of maximum traffic flow or when the traffic flow rate exceeds a minimum 1500 vehicles per hour in any lane. The recording period shall be a minimum of 30 minutes and count a minimum of 100 vehicles in every lane. The total vehicle count for every lane shall be used including the first and last partial vehicles for each lane. Errors in the start and finish of the VDS and manual counts are included in the performance criterion specified in these special provisions.

VDS unit count shall be compared to vehicle counts under traffic conditions of the prior paragraph. Vehicles licensed for use on State roads shall be counted by the VDS. The data accuracy shall be determined by the formula  $100\{1-[(TC-MC)/TC]\}$  where TC= Traffic Count derived from the media recording, MC = VDS reported count over the same period of time, and where the resulting fraction is expressed as an absolute value. The observed VDS count accuracy for every lane shall be at least 90 percent and at least 95 percent for all lanes combined.

The Engineer will review the accuracy data findings and accept or reject the results within 7 days. Determination of vehicle anomalies or unusual occurrences will be decided by the Engineer. Data or counts that are not accepted by the Engineer shall be considered errors and count against the VDS unit's calibration. If the Engineer finds that the VDS does not meet performance requirements, the Contractor will have seven days to re-calibrate and re-test the unit and re-submit new test data. Following three failed attempts, the Contractor shall replace the VDS detector with a new unit

## 12.0 DOCUMENTATION

Provide manufacturer's cut sheets and product specifications to the NMDOT ITS Engineer or designee for review and approval at least 30 days prior to ordering the materials.

**12.01** The following shall be provided before the completion of the contract:

- A. Certificate of Compliance-** A Certificate of Compliance for VDS shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The certificate shall also include a report on the final installed configuration of the individual VDS's. The report shall be reviewed and approved by the manufacturer.

- B. **Site Analysis Report** – Prior to VDS installation the Contractor shall review each detection site and provide a written analysis recommending the optimum sensor placement for meeting the performance requirements of this special provision. The analysis shall be reviewed and approved by the VDS manufacturer.
- C. **Lane Configuration**- The documentation shall include a diagram that illustrates how the beam is covering the traffic lanes as well as the corresponding VDS connector pins or wire terminals that correspond to the respective lanes. The lanes shall be identified in order, with lane 1 being the lane nearest to the center of the roadway.
- D. **Mounting and Wiring Information**- The Contractor shall provide to the Engineer for approval one set of detailed diagrams showing wiring and service connections for each VDS. The approved diagrams shall be covered separately on each side with clear self-adhesive plastic and placed in a heavy-duty plastic envelope. The envelope shall be attached securely to the inside of the cabinet door or at a location designated by the Engineer.
- E. **Communication Protocol** - The Contractor shall provide documentation that defines the VDS open communication protocol (NTCIP) and other information necessary for operating the system from a remote Windows XP and / or Vista based Personal Computer (PC).
- F. **Calibration Programming**- The Contractor shall provide calibration, tuning, alignment, programming and documentation on a Windows XP or Vista compatible Compact Disk (CD). The information shall be formatted so that the files can be matched with the equipment calibrated or aligned. This documentation shall contain files that allow the same configuration to be reloaded.
- G. **VDS Accuracy Analysis** – The Contractor shall submit to the Engineer a VDS accuracy analysis that conforms to requirements of these special provisions within 30 days of VDS testing. The original video recordings as well as DVD or CD copies of the video images covering the analysis periods shall be included.
- H. **Acceptance Testing Documentation**- The Contractor shall provide documentation required to utilize the support equipment. The documentation shall be organized so that the Engineer will be able to perform acceptance testing using the documentation without assistance from the Contractor.
- I. **Acceptance Testing Schedule**– The contractor shall submit a testing schedule to the Engineer for approval 30 days prior to acceptance testing of the VDS. If the testing period extends beyond the normal working shift or if the Contractor fails to provide the necessary material for the testing within one hour of the scheduled testing start time, the Engineer may cancel testing for the day.

**12.02 Data Collection.** Contractor shall provide following data included in GPS shape file of the system installed. GPS data shall be collected in WGS84 and decimal degrees format. In addition, the Contractor shall contact ITS Engineer to obtain the excel file template of documenting required data.

Project CN, Lat, Long, Manufacturer, Sensor Type, Comm, Direction Detection, Lanes Detected No, Mount Type, sensor function, Model No, Serial No, Meter Info

### **13.0 WARRANTY.**

All equipment shall have a minimum warranty period of five (5) years from the date of acceptance. The warranty period will begin after the VDS is accepted. The VDS will be accepted only when full functionality, as

defined in the specifications herein, has been demonstrated. Each warranty shall include actual parts and labor for any warranty work performed at the manufacturer's facility. If a repair requires more than three (3) working days to complete during the warranty period, temporary replacement equipment shall be installed until the original equipment may be reinstalled.

A copy of each written warranty shall be included and submitted by the Contractor and approved by the Project Manager prior to construction. The NMDOT shall be designated as the holder of each component warranty. Any replacement or repair of the system shall be done to the satisfaction of the NMDOT Project Manager or NMDOT designee during the warranty period.

Each manufacturer shall be available via toll-free telephone support with emergency voice mail/paging features for after hours contact, toll-free nationwide paging, and a complete supply of repair parts and access to manufacturer's technicians to perform additional contracted services. In addition, the manufacturer representative will be required to provide on-site diagnostics and system support if problems cannot be remedied by phone.

**36\*. Indicate the number of students and length of the training required for this project.**

**15.0 METHOD OF MEASUREMENTS.**

Method of measurement will be for each. Vehicle Detection System complete in place.

**16.0 BASIS OF PAYMENT.**

The accepted quantities of a Vehicle Detection System will be paid for at the contract unit price per each.

**Pay Item**

**Pay Unit**

Vehicle Detection System (VDS)

Each

- Fifty percent (50%) of the bid price for this item will be paid upon successful installation and completion of the approved on-site stand alone.
- Twenty percent (20%) of the bid price will be paid upon successful installation and completion of the approved TMC stand alone test
- Twenty percent (20%) of the bid price will be paid upon successful installation and integration and completion of the integrated system acceptance tests for all systems.
- Ten percent (10%) of the bid price will be paid upon successful completion of the 180 calendar day operational test period.

**Work Included in Payment.** When a Vehicle Detection System is called for in the Contract, the accepted quantity complete in place will be considered full compensation for furnishing all materials, labor, tools,

equipment, testing, documentation, appurtenances, and training necessary to complete the work as directed by the Project Manager, and/or the ITS Engineer.

The documentation of the system shall be provided by and at the expense of the contractor. All documents shall be provided to the Project Manager at least 30 days in advance of final acceptance. The documentation shall be approved by the Project Manager prior to final acceptance of the Vehicle Detection System.

The testing of the system components as an integrated unit shall be done by and at the expense of the Contractor under the direct supervision of the Project Manager and or the ITS Engineer or their designee.

The Training for the VDS system shall be done by and paid for by the Contractor, when specified.