ITEM 683.2001 03 – ACOUSTIC VEHICLE DETECTOR ASSEMBLY

DESCRIPTION.
This item shall consist of furnishing and installing Acoustic Vehicle Detector Assemblies at the locations shown in the contract documents or as directed by the Engineer.

MATERIALS.
The Acoustic Vehicle Detector Assembly shall consist of the following:

- A self-contained Roadway Traffic Sensor, “Model SAS-1 Passive Acoustic Vehicle Detector” manufactured by SmarTek Systems, which detects and monitors roadway traffic. The sensor shall be a true presence detector, which can provide volume, lane occupancy, and speed information on at least five (5) discrete detection zones from a side-fire location or overhead structure.
- Sensor Lead-In Cable, Mounting Bracket, Junction Box and field equipment cabinet interface.
- Local Monitoring and Set-Up software, for installation and maintenance tasks.
- Central Operations Software, to integrate data from the field site into the NYSDOT Region 3 traffic management system software.
- Stand-Alone Acoustic Vehicle Detector Software, to be used at the discretion of NYSDOT in any interim period that may occur before the data from the Acoustic Vehicle Detector Assembly’s and Central Operations Software become an integral part of the NYSDOT Region 3 traffic management system software.

The Acoustic Vehicle Detector Assembly shall allow the integration of five additional sensor units in the future.

All necessary incidental components, cables, junction box, power supply and hardware, shall be supplied to provide a fully operational Acoustic Vehicle Detector Assembly installation. All equipment and component parts furnished shall be new, be of the latest design, and manufacture. All parts shall be of high quality workmanship, and no part or attachment shall be substituted or applied contrary to the manufacturer’s recommendations and standard practices.

(a) Roadway Traffic Sensor

(1) Functional Requirements
The Roadway Traffic Sensor shall be mountable from a side fire location or overhead structure, and shall meet the following functional requirements:

- Capable of monitoring a minimum of five (5) discrete detection zones
- Zone width and location can vary, as per the roadway’s requirements, and shall be defined through manufacturer-supplied “set-up” software.
• Capable of detecting vehicles in a far zone that is a of 22 meters (near edge of zone) from the Roadway Traffic Sensor.
• Capable of detecting vehicles 0.6 meters from the near travel lane.
• Connect to the field cabinet via hard-wired Sensor Lead-In Cable and Home Run Cable with combined maximum run of 450 meters.
• The Roadway Traffic Sensor shall communicate to the field cabinet via RS-422 protocol.
• A Cabinet Termination Circuit Card shall be mounted inside the field cabinet to terminate the Sensor Lead-In Cable and convert RS-422 to RS-232.
• Operate in all prevalent traffic conditions, from 0 to 128 kmph. Over this range the unit shall be tuned to meet the following accuracy requirements:
  - Volume: 5% of Actual Count (up to 4 lanes from the sensor)
  - Occupancy: Within 10%
  - Speed: At > 32 km/h within 10% of true speed as measured by a lidar gun (or portable counting station capable of measuring speed)
  - At < 32 km/h (e.g. “stop and go”) unit reports speed consistently.
• Maximum power consumption: 1.5 W.
• Retain all changeable parameters and settings upon loss and subsequent restoration of power.
• Reporting interval settable within the range of 1 to 220 seconds.
• Complete protocol descriptions shall be supplied with the submittal for the unit. These protocol descriptions shall be adequate for the purpose of developing software to retrieve the information from the sensor.
• Not interfere with other equipment.
• Maximum weight: 4 kg
• Nominal dimensions for the unit shall be no greater than 400 mm (L) X 250 mm (W) X 150 mm (D), approximately

(2) Environmental Requirements

This equipment shall meet all its specified requirements during and after being subjected to any combination of the following conditions:
• The ambient temperature range shall be between -20°C and +75°C.
• The storage temperature range shall be between -25°C and +85°C.
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- Relative humidity from 5 to 100%.
- Vibration – meets NEMA TS2-2.1.9, or equivalent as approved by the Engineer.
- Shock – meets NEMA TS2-2.1.10, or equivalent as approved by the Engineer.

The enclosure shall be a weatherproof cabinet of cast aluminum, stainless steel, or polycarbonate meeting as a minimum the NEMA requirements for a 3R Type enclosure.

The design shall be inherently temperature compensated to prevent abnormal operation over the specified temperature and environmental range. The unit shall not require programming changes to compensate for different environmental conditions encountered from season to season.

(3) Power Requirements

- The unit shall operate anywhere between 12 and 24 VDC – supply voltage at sensor.
- Power shall be obtained from the Cabinet Termination Circuit Card located within Field Cabinet.
- The Sensor Lead-In Cable connecting the unit to the Cabinet Termination Circuit Card shall supply power using conductors of at least #22 AWG.
- Each unit shall be able to recover automatically after a power failure.

(b) Cabinet Termination Circuit Card

(1) Functional Requirements

The Cabinet Termination Circuit Card shall be a mountable card located within the field equipment cabinet that connects to the Roadway Traffic Sensor via the Sensor Lead-In Cable and Home Run Cable. The Cabinet Termination Circuit Card shall comply with the following functional specifications:

- A pluggable terminal block shall be used to connect the Cabinet Circuit Termination Card to the Roadway Traffic Sensor through the Sensor Lead-In Cable and Home Run Cable.
- Provide electronic circuitry to convert traffic data streams sent from the Roadway Traffic Sensor via RS-422 protocol to RS-232 protocol suitable for input to a Terminal Server that is also located within the field equipment cabinet.

(2) Power Requirements

- The terminal block plugged into the Cabinet Termination Circuit Card shall be powered by 12-24 VDC 10 W power supply. The power supply will be connected
to one of cabinet’s 120VAC power sources that is remotely controllable by the IP Power Distribution Unit.

- The Cabinet Termination Circuit Card shall provide a single stage of solid-state surge protection, and an additional stage of gas tube surge protection for all data and power lines. Surge protection shall comply with IEEE Standard 587-1980 Category C.

(e) Mounting Bracket
The Roadway Traffic Sensor shall be supplied with a mounting bracket. The basic mounting bracket for the Roadway Traffic Sensor shall consist of a 51 mm diameter aluminum tube and a cast aluminum flange. The flange shall be matched to the structure that the Roadway Traffic Sensor is mounted to (e.g. curved to fit structures of differing diameters, or flat to fit rectangular structures, or concrete walls). The flange shall be attached to the structure via stainless steel strapping or bolts. The aluminum tube shall screw into the flange, and be locked in place with a set screw. The Roadway Traffic sensor shall slide over the tube before its stainless steel straps are tightened.

(d) Sensor Lead-In Cable
A single composite interface cable (Sensor Lead-In Cable), of no less than 15 meters length and Home Run Cable of no less than 61 meters length, shall be provided with each Roadway traffic Sensor. This Sensor Lead-In Cable shall provide DC power to the top-of-pole sensor as well as the RS-422 data lines required to interface to the Cabinet Termination Circuit Card. The Sensor Lead-In Cable shall contain a minimum of six (6) pairs of stranded #22 AWG conductors – with a foil shield running the length of the cable and a drain wire.

(e) PC Monitoring and Setup Software
A PC based diagnostic software package shall be provided that can be utilized to set up the Roadway Traffic Sensor and monitor operation to verify the performance and settings of the Roadway Traffic Sensor. The Monitor and Setup software shall run under Windows XP. The software shall permit the Contractor to establish the detection zones and make all fine tuning adjustments necessary to ensure the accuracy and sanctity of the detection zones. The software shall also display presence, in real-time, within the programmed detector zones and shall report the accumulated data over the user-defined reporting interval for all programmed zones including volume, average occupancy, and average speed.

(f) Acoustic Vehicle Detector Central Operation Software
The Contractor shall ensure that the Acoustic Vehicle Detector Assembly’s operation software is compatible with NYSDOT Region 03’s traffic management system.
(g) **Standalone Acoustic Vehicle Detector Software**

The Contractor shall ensure that the Standalone Acoustic Vehicle Detector Software is an application that is capable of running independently on its own server, and providing readouts after each reporting interval for volume, occupancy, and speed for any Roadway Traffic Sensor at any Acoustic Vehicle Detector Assembly site.

**CONSTRUCTION DETAILS.**

The Contractor shall prepare a shop drawing, that details the complete Acoustic Vehicle Detector Assembly. All components supplied, including the mounting hardware shall be shown. These drawings shall detail the exact placement of each Acoustic Vehicle Detector Assembly unit showing the height the unit is mounted at, the proposed detection zone and hardware mounting methods. These drawings shall also include details of the installation of the Sensor Lead-In Cable from the Roadway Traffic Sensor to the junction box and Home Run Cable from the junction box to the terminal block that plugs into the Cabinet Termination Circuit Card within the equipment cabinet, including provisions for strain relief. Upon request, the Contractor may be required to perform a field demonstration of the assembly at a particular site, which would be intended for approximating the conditions under which the sensor will need to operate for the project.

Factory trained personnel shall mount the mounting bracket at the optimum height on the assigned pole. Via the use of a bucket truck or secured ladder, the assembly shall be physically pointed to provide optimum coverage for the travel lanes indicated on the plans to be covered. Once mechanically aimed, the “Monitor and Set-Up Software” shall be utilized by the Contractor to pinpoint optimum zone width settings.

The Contractor shall connect the sensor lead-in cable to the home run cable in a junction box located at the base of the pole on which the Roadway Traffic Sensor is mounted.

The Contractor shall provide a laser speed (lidar) gun for the purpose of measuring speed on the approach. The lidar gun shall be a Kustom Pro Laser III or equivalent lidar gun as approved by the Engineer. The Contractor shall ensure speed is calibrated precisely against the average of readings taken from the lidar gun over the period of time chosen as the reporting interval (e.g. 30 seconds) utilizing the lidar gun from a bucket truck raised to a height that will prevent any occlusion that might be caused by passing trucks. The lidar gun shall take readings from a side-fired position in a manner that is similar to the Acoustic Vehicle Sensor. If, for example, the reporting interval is chosen to be 30 seconds, the Contractor is to aim the gun at each passing vehicle in a particular lane (or zone), measure the speed, and at the end of the interval, average the speeds for the vehicles that have passed. The Contractor shall then compare the measured reading against the reading displayed by the “Monitor and Set-Up Software” for the lane, and calibrate the sensor accordingly. This procedure shall be repeated until sensor calibrations and lidar gun readings converge to within the requirements specified in this special spec.
Contractor determines that a detector site cannot be tuned to the required specifications, the Contractor shall notify the Engineer immediately. The Contractor shall utilize the lidar gun from a bucket truck to ensure he will be able to obtain readings from all vehicles passing through all lanes. The lidar gun, and procedure for utilizing the lidar gun for measuring speed (including location of aim on passing vehicles) will be approved by the Engineer prior to the calibration process.

Once programming is completed, a test shall be conducted verifying volume measurements against manual counts and speed measurements against lidar gun observations at all locations. The unit shall operate within the tolerances included in the material specifications for volume, occupancy, and speed.

The Contractor shall install and configure the central software at the TMC. Installation shall be coordinated with the Engineer to minimize the impact on TMC operations.

Warrantee

All components to be supplied under this specification shall be warranted for a minimum of two-years from the conclusion of the System Acceptance Test. This warranty shall include repair and/or replacement of all failed components via a factory authorized depot repair service. All items sent to the depot for repair shall be returned within two weeks of the date of receipt at the facility. The depot location shall be in the United States. Repairs shall not require more then two weeks from date of receipt and the provider of the warranty shall be responsible for all return shipping costs. The depot maintainer designated for each component shall be authorized by the original manufacturer to supply this service. A warranty certificate shall be supplied for each component from the designated depot repair site indicating the start and end dates of the warranty. The certificate shall be supplied at the conclusion of the System Acceptance Test and shall be for a minimum of two years after that point. The certificate shall name NYSDOT as the recipient of the service. NYSDOT shall have the right to transfer this service to other private parties who may be contracted to perform overall maintenance of the facility.

Testing

Operational Standalone Test

The Contractor shall perform the Acoustic Vehicle Detector Assembly Operational Standalone Test by comparing manual counts against software readouts (utilizing acoustic vehicle detector software to be supplied by the manufacturer) that are taken from a notebook computer at the field location. The Contractor shall perform the counts for no less than 100 separate 30-second intervals during peak weekday periods, and for no less than 100 separate 30-second intervals during non-peak periods for each Acoustic Vehicle Detector Assembly’s detection zones (all zones). The manual and software counts shall not deviate from one another by no more than 5%
The Contractor shall use a lidar gun to determine the average speed of vehicles passing through the detection zones during these same 30-second intervals. If any of the zones are subject to erroneous readings because of occlusion caused by trucks passing between the zone and the lidar gun, the Contractor shall utilize a bucket truck in order to aim the lidar gun at the zone from a sufficient height to prevent the occlusion. The average speed determined from the lidar gun readings shall not deviate from the software readout for average speed by more than 10% for each detection zone, when the average speed exceeds 32 km/h according to the lidar gun. If the average speed determined by the lidar gun is less than 32 km/hr, the Contractor shall not use the interval as part of the test. Another interval of testing shall be performed when traffic is moving at a speed greater than 32 km/hr.

The Contractor shall provide a Test Procedure and Test Procedure Check list for review and approval to the Engineer. The Operational Stand Alone Test shall be conducted based on the approved Test Procedure and Test Procedure Check List.

Central Operation Test The Contractor shall perform the Acoustic Vehicle Detector Central Operation Test at the NYSDOT Region 3 Traffic Operations Center subsequent to the establishment of communications between the Acoustic Vehicle Detectors in the field and the Traffic Operations Center. Each Acoustic Vehicle Detector Assembly shall be tested utilizing the Acoustic Vehicle Detector Central Operations Software installed on a desktop computer situated at the NYSDOT Region 3 Traffic Operations Center and connected to the communications network. As part of the this test, the Contractor shall verify that traffic data is being received from every Acoustic Vehicle Detector Assembly in the field.

System Acceptance Test When all construction and installations have been completed, and the Central Operations Test has been passed by all Contract Items, then all ITS elements, and the communications network shall be tested, in order to perform the overall System Acceptance Test. The System Acceptance Test shall be considered to have been passed after 6 months of operation of the ITS equipment from the Traffic Operations Center without any failures.

METHOD OF MEASUREMENT.
This item will be measured for payment by the number of Acoustic Vehicle Detector Assembly’s installed, activated, tested, and accepted.

BASIS OF PAYMENT.
This unit price bid for each Acoustic Vehicle Detector Assembly shall include all equipment, material, testing, documentation, and labor detailed in the contract documents.

Progress payments will be made as follows:
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<table>
<thead>
<tr>
<th>Test Type</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Approval of Shop Drawings</td>
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<tr>
<td>Operational Standalone Test</td>
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<tr>
<td>Central Operation Test</td>
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<tr>
<td>System Acceptance</td>
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