

Special Specification 6419

Lidar Wrong Way Driver System



1. DESCRIPTION

Furnish and install Lidar Wrong Way Driver System at locations shown on plans or as directed.

2. MATERIALS

2.1. General.

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items, except for measurement and payment:

- Item 618, "Conduit"
- Item 620, "Electrical Conductors"
- Item 622, "Duct Cable"
- Item 624, "Ground Boxes"
- *Item 628, "Electrical Services"
- Item 636, "Signs"
- Item 644, "Small Roadside Sign Assemblies"
- Item 656, "Foundations for Traffic Control Devices"
- Item 687, "Pedestal Pole Assemblies"
- Item 6006, "Electronic Components"
- **Item 6064, "Intelligent Transportation System (ITS) Pole with Cabinet"
- Item 6063, "Intelligent Transportation System (ITS) Solar Power System."

* Electrical Services will be measured and paid under Item 628, "Electrical Services."

** ITS Pole with cabinet will be paid under Item 6064, "Intelligent Transportation System (ITS) Pole with Cabinet."

3. EQUIPMENT

3.1. Functional Requirements.

Furnish a Light Detection and Ranging (Lidar) Wrong Way Driver (WWD) System that provides a highly visible, enhanced warning for the purpose of alerting the driver and proper authorities. Upon detection by a Lidar detector of a wrong way driver, the Management Alert System Unit must activate and communicate to other local alert signs on separate pedestal poles for the purpose of flashing synchronously and then cease operation after a programmable timeout. The tracking camera must automatically detect a wrong way driver on its own send video images to the Management Alert System Unit to be processed and relayed to proper authorities. The Management Alert System Unit must also send alerts through a Transmission Control Protocol/Internet Protocol (TCP/IP) Network to a web-browser user interface as well as e-mail and Short Message Service (SMS) alerts for all configured users.

3.2. Lidar Wrong Way Driver System Components.

The Lidar Wrong Way Driver System is composed of these principal items listed below.

- Use ITS pole and cabinet as shown on the plans. Wrong Way Driver System must fit in a single enclosure to house the Management Alert System Unit, receptacle, power supply, etc. and must comply with Item 6064 "Intelligent transportation system (ITS) Pole with Cabinet";
- A Central Processing Unit (CPU) to monitor sensor inputs, manage data, trigger actions, activate flashing signs, activate Dynamic Message Sign (DMS), activate motion tracking camera and report alerts to the Traffic Management Center;
- Light-Emitting Diode (LED) (Built-In) Wrong Way Warning Signs to catch wrong way drivers' attention;
- Warning Light Flashing Controller to control flashing of alert LEDs;
- Lidar Detector for official detection a wrong way driver;
- Tracking Camera for capturing images and video of the wrong way driver;
- Optional solar panels for powering lights and equipment;
- Contact Closure Transceiver to active and deactivate DMS with predefined messages; and
- Network Communications to communicate with the Department's Traffic Management Center (TMC).

Ensure all equipment and components listed are new and in operable condition without defect at time of delivery and installation. Install and mount components according to the plans or as directed.

3.3. Central Processing Unit.

Provide a management alert system unit housed in the system enclosure at a location shown on plans, or as directed. This unit is responsible for sending and receiving data from various types of sensors, analyze this data with preprogrammed algorithms, and send communications to various ITS equipment and existing monitoring systems for alerts, data, monitoring, and remote management of the Lidar Wrong Way Driver System. For the management alert system:

- use a Linux based operating system and provide an internet interface for remote monitoring and programming,
- process input communications from vehicle radar detectors, Lidar detectors, VIVDS cameras, and pavement sensors,
- link with flashing alert signs, Highway Advisory Radio (HAR), Dynamic Message Signs (DMS), email/text alerts, and the local Department Traffic Management Center (TMC),
- comply with National Electrical Manufacturers Association (NEMA) TS-22016 standards,
- provide a minimum of two RS-232 ports, four RS-485 ports, two Universal Serial Bus (USB) ports, two Gigabit (Gb) Ethernet ports, an analog-in and digital-out GPIO, an audio in/audio out port, and an High Definition Multimedia Interface (HDMI) video port,
- provide Global Positioning System (GPS) time and location synchronization,
- comply with the National Transportation Communications for ITS Protocol (NTCIP) 1201 v3,
- provide communication modes for cellular modem and 900 MHz radio,
- operate in temperature range between -25°F to 160°F and up to 95% humidity,
- configure this devices via Transmission Control Protocol/ Internet Protocol (TCP/IP) connection using a web browser using Representational State Transfer (REST) protocol,
- provide password protection and use Hypertext Transfer Protocol Secure (HTTPS) security,
- provide means of programming scripts to handle data from sensors, and
- provide alerts via email, SMS, Simple Network Monitoring Protocol (SNMP) traps.

3.4. LED (Built-In) Wrong Way and Do Not Enter Warning Sign.

Provide Wrong Way signs (R5-1a) and Do Not Enter signs (R5-1) with built-in high-powered LEDs mounted to a pole assembly that must comply with Item 636, "Signs" and Item 644, "Small Roadside Signs and Assemblies" at locations shown on the plans or as directed. The Do Not Enter and Wrong Way signs must be of appropriate size in accordance with Standard Highway Sign Designs for Texas (SHSD) and Texas Manual of Uniform Traffic Control Devices (TMUTCD). The sign must be composed of eight environmentally sealed, high power one-watt red LEDs along the perimeter of the sign, one in each corner and one spaced centered

between each corner. High powered LEDs must be visible at more than 1,000 ft. during the daytime and more than 1 mi. during the nighttime. All high-powered LEDs must be rated for 100,000 hr. life expectancy, have an operating temperature range of -40°F to 165°F, and be powered by a flash controller. Ensure wiring on backside of sign is environmentally sealed for protection against weather and tampering. Ensure the signs LEDs are dimmable by a photocell sensor input or 6V solar panel to reduce night glare.

3.5. **Warning Light Flashing Controller.**

Provide a warning light flashing controller housed in the system enclosure to flash LED (Built-In) Do Not Enter and Wrong Way Warning Signs upon activation. The flashing controller must be compatible with the management alert system. It must have the ability of being programmed to change the flash pattern, adjust the flashing duration, and adjust LED intensity using a windows-based software.

3.6. **Lidar Detector.**

Provide a Lidar detector as specified:

- lidar detector with a 360° horizontal by 45° vertical Field of View (FOV) with a max detection range of 360 ft. at 80% reflectivity and a maximum angular resolution of 0.18 in. horizontal and 0.35 in. in the vertical,
- provide detector compatible with the management alert system,
- provide minimum frame rate of 10 frames per sec,
- provide enclosure that meets Ingress Protection (IP) Code of IP67 or IP69 and meet a minimum operating temperature range of -22°F to 122°F,
- operate within a minimum range of ± 2 V of its nominal voltage, and
- use a laser wavelength of 865 nm. or 905 nm. and meet International Electrotechnical Commission IEC 60825 Class-1.

3.7. **Tracking Camera.**

Provide a tracking camera that is compatible with the management alert system at the location specified on the plans or as directed. This tracking camera must have built-in machine-learning logic to recognize specified target criteria and the unusual direction of motion such as a wrong way vehicle. Upon detecting motion contrary to the usual direction of motion, the camera's intelligent video analytics must be capable of triggering an alarm if object enters a preprogrammed alarm field. Once an alarm is triggered, using its tilt, pan, and zoom capabilities, the camera's visual imager must be able to track the vehicle keeping it focused and within view as it approaches, passes, or departs from the camera's point of view.

Provide a camera that uses noise suppression technology for color clarity in low levels of ambient light. For further clarity in low levels of ambient light the camera must have the ability to combine with a compatible IR detector to enhance image contrast be able to operate in low levels of ambient light using an additional IR detector for contrast and noise suppression technology for color clarity. In situations where the camera's view contains bright and dark areas, the camera must have technology to combine multiple images at varying shutter positions and exposure times to produce a single image removing over and under exposed areas. The tracking camera must comply to Impact Protection (IK) 10 rating for impact resistance and to the IEC 60068 standards for vibration and shock. It must also meet environmental protection IP68 for dust and immersion test. It must also comply with NEMA Type 6P enclosure rating and pass the American Society of Testing and Materials (ASTM) B117 salt spray test.

For camera's tilt, pan, and zoom operations ensure the:

- use of closed-loop feedback control system,
- use of brushless motors; and
- ensure pan of 360° continuous rotation and meet a maximum speed of to 120° per sec.

3.8. **Solar Power System.**

Refer to plans or as directed to determine if 120 VAC 60 Hz. power or solar power is required. New electrical services will not be paid for under this Item. Solar power systems must comply with Item 6063 "Intelligent Transportation System (ITS) Solar Power System."

3.9. **Network Communications.**

Communications to the Department's TMC must be through the Department's fiber optic ITS network utilizing a provided Ethernet port on the management alert system unit.

3.10. **Contact Closure Transceiver.**

Provide contact closure transceiver to establish a communication link via fiber optics from Wrong Way Driver Central Processing Unit (CPU) to a proposed or existing DMS and as shown on the plans. The transceiver must support full duplex communications utilizing one or two fiber optic strands. The transceiver must be capable of receiving control signals from Wrong Way Driver Central Processing Unit (CPU) converting these electrical signals to optically modulated signals in the uplink or downlink direction. The transceiver must be capable of receiving optically modulated signals from either uplink or downlink devices, converting these optical signals to control signals to activate a predefined message on the DMS. Full duplex asynchronous data transmission must be accommodated. The transmitted and received data rate must be able to change, at any time, within the above range without any mechanical adjustments to the transceiver.

The fiber optic transmitting and receiving devices must operate at a single optical wavelength of 1,310 nm. nominally. The transmitting device must be capable of operating over single-mode fiber optic strands. Output power to single-mode glass fiber at 1,310 nm. must be enough to accommodate a link loss budget of 20 dB or more at each wavelength. Receiver input must have a minimum sensitivity of 20 dB, below the transmitter output level and operate within the parameters of this specification.

Must have a minimum Mean Time Between Failure (MTBF) of 100,000 hr. at 122 minus ambient. The bit error rate of each data channel must not exceed 10 to the -9 power within optical budget.

4. **CONSTRUCTION**

4.1. **Installation.**

Before installation of any equipment, perform a site survey with manufacturer's representative of the proposed locations to determine the optimal positioning of the signs and the detector unit to achieve proper operation based on the manufacturer's recommendations. Adjust locations as approved by the Engineer if necessary. If required, remove any existing Do Not Enter and Wrong Way signs from their mounts to allow the installation of the new signs. Mount Do Not Enter and Wrong Way sign in accordance with Section 2B.41 Wrong-Way Traffic Control at Interchange Ramps of the Texas Manual of Uniform Traffic Control Devices (TMUTCD), or as shown on the plans, or as directed.

Install equipment in accordance with this Item and the lines, grades, details and dimensions as shown on the plans or as directed. Maintain safe construction practices. Ensure the mechanical execution of work complies with the most current version of the National Electrical Code (NEC).

Provide any additional mounting hardware and cabling necessary to install and make operational all equipment. Provide only new and corrosion resistant materials. Consider all mounting hardware and cables as subsidiary to this Item with no direct payment.

Adjustments and addition of sign attachment hardware, mounting components and hardware for detector/solar panels, support brackets and appurtenances, such as conduit, etc., may be necessary for compatibility with specified positioning recommended by the manufacturer, as shown on the plans, or as directed. All adjustments and additional materials will not be paid for directly but will be subsidiary to this Item.

Replace any portion of the equipment that is damaged or lost during transportation or installation. Any unused or removed material deemed salvageable by the Engineer will remain on the property of the Department or be delivered to a designated site. Accept ownership of unsalvageable materials and dispose of in accordance with federal, state and local regulations.

Contractor must complete vendor-provided training on the installation of all equipment before any work begins. Contractor must provide documentation that they have completed the required training from the equipment manufacturer before installation of the equipment. The Contractor must have the manufacturer's representative on site to assist with the installation of all equipment before any work begins.

Contractor must coordinate with equipment manufacturer to ensure the Wrong Way Driver equipment is properly positioned and the Wrong Way driver detection zones are accurate. Ensure that all equipment is functioning properly and communicating with manufacturer's equipment software. Testing must begin once proper system functionality is proven.

4.2. **Mechanical Components.**

Ensure that all fasteners, including bolts, nuts, and washers not already included with equipment and with a diameter less than 5/8 in. are Type 316 or 304 stainless steel and meet the requirements of ASTM F593 and ASTM F594 for corrosion resistance. Ensure that all bolts and nuts not already included with the equipment and over 5/8 in. in diameter are galvanized and meet the requirements of ASTM A307. Separate dissimilar metals with an inert dielectric material.

4.3. **Wiring.**

All wiring and electrical work supplying the equipment must meet the requirements of the most current version of the National Electrical Code (NEC). If additional cables are required, Contractor must furnish and install them at no additional cost to the Department. Provide conductors at least the minimum size indicated on the plans and insulated for 600V.

Cables must be cut to proper length before assembly. Provide cable slack for ease of removal and replacement. All cable slack must be neatly laced with lacing or straps in the bottom of the cabinet. Ensure cables are secured with clamps and include service loops.

4.4. **Electrical Service.**

Refer to Section 2.2.6 Solar Power System.

4.5. **Grounding.**

Ensure all Lidar Wrong Way Driver System devices, cabinets, and supports are grounded in accordance with the NEC, Electrical Details, and manufacturer recommendations.

4.6. **Training.**

Provide manufacturer approved end user training to the Department and their representatives.

Provide a minimum of 2 days of instruction in the operation and maintenance procedures. Train a maximum of 10 Department designated personnel. Cover the following training material as a minimum:

- hands-on operation of the sign,
- explanation of any system commands, their function and usage,
- required preventative maintenance procedures,
- equipment servicing procedures,
- sign troubleshooting and problem identification procedures, and
- use of diagnostic software.

Furnish a manufacturer approved training session agenda, and a complete set of manufacturer-approved training materials. Provide one copy of the course material for each person. Coordinate with the Department to provide a training room.

4.7. **Warranty.**

Provide Lidar Wrong Way Driver System warranty that includes the following.

All materials, all defects in material, design, and workmanship, and must cover 100% parts and labor for repair work, including diagnostics after 3 yr. from accepted installation date. The accepted installation date is defined as the date the Department determines the sign has passed installed testing requirements. If the vendor standard warranty period exceeds 36 mo. from accepted installation date, then the standard warranty period must be in effect. Submit in writing the terms of warranty.

Provide any labor, materials, shipping and other costs as outlined below for required warranty repair. At the Department's option, the Department may perform minor warranty repairs at the vendor's expense without voiding the warranty. Assume all required diagnostics, testing, and replacements necessary to resolve any problems at no cost to the Department.

5. **TESTING**

Lidar Wrong Way Driver System must be tested and certified under the direct on-site supervision of the manufacturer. Coordinate with the Department on scheduling a testing date at least 40 days before allow manufacturer to provide a written test plan to the Department at least 30 days before the scheduled testing date.

Follow this testing procedure: once the equipment has been installed and activated, the exit ramp must be closed to traffic. A test vehicle must then be driven the wrong way down the ramp a minimum of ten times. If the system calls to be integrated to the TMC then, once a maximum of ten successful detections and notifications of the wrong way vehicle are received at the TMC, as well as successful activation of LED flashing signs or beacons, the equipment must be accepted as fully tested and ready for operation. To be accepted the last five successful tests must be consecutive. If the system does not call to be integrated to the TMC then, once a maximum of ten successful detections of the wrong way vehicle and successful activation of LED flashing signs or beacons, the equipment must be accepted as fully tested and ready for operation. To be accepted the last five successful tests must be consecutive.

Conduct approved continuity, stand alone, and system tests on the installed field equipment with laptop equipment after each equipment location has been installed. Conduct a final acceptance test to demonstrate all control, monitor, and communication requirements for 60 days. The Engineer will furnish a Letter acknowledging the final acceptance testing commencement date stating the first day of the final acceptance test.

The completion of the final acceptance test occurs when less than two false calls have occurred from 100 vehicles passing thru this detection zone, the system downtime due to mechanical, electrical, or other malfunctions to equipment furnished or installed does not exceed 72 hr. and any individual points of failure identified during the test period have operated free of defects. Assume responsibility only for test failures directly related to the work in accordance with this Item. Upon completion of successful final acceptance testing, document the acceptance date and project identification information and provide 2 copies to the Engineer.

6. **MEASUREMENT**

This Item must be measured as each unit furnished, installed, made fully operational, and tested in accordance with these Special Specifications.

6.1. **Lidar Wrong Way Driver System.**

Provide Lidar Wrong Way Driver System composed of the items listed below:

- a Central Processing Unit (CPU) to monitor sensor inputs, manage data, trigger actions, activate flashing signs, activate DMS, activate motion tracking camera and report alerts to the Traffic Management Center,
- Warning Light Flashing Controller to control flashing of alert LEDs,
- Lidar Detector for official detection a wrong way driver,
- Tracking Camera for capturing images and video of the wrong way driver,
- optional solar panels for powering lights and equipment, and
- Network Communications to communicate with the Department's Traffic Management Center (TMC).

6.2. Wrong Way Driver LED Signs.

Provide Wrong Way Driver LED Signs composed of the items listed below:

- Light Emitting Diode (LED) (Built-In) Wrong Way Warning Signs to catch wrong way drivers' attention,
- Warning Light Flashing Controller to control flashing of alert LEDs, and
- sign poles and foundations.

6.3. Contact Closure Transceiver.

Provide Contact Closure Transceivers composed of a contact closure transceiver fully installed integrated and operational between Wrong Way Driver and DMS as shown on the plans or as directed.

7. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" must be paid for at the unit price bid for "Lidar Wrong Way Driver System," "Wrong Way Driver LED Signs," and "Contact Closure Transceiver."

This price is full compensation for furnishing and installing the complete installation and integration to the TMC of the Lidar Wrong Way Driver System as shown on the plans, all labor, tools, equipment, any required equipment modifications for electrical service, documentation, warranty, and incidentals necessary to complete the work including traffic handling during testing. In addition, equipment, labor and material not included on the plans but not limited to: conduit, cable, ground boxes, batteries, solar panels, cable to power source, enclosures, Do Not Enter R5-1 and Wrong Way R5-1a signs with LEDs, sign assemblies, sign poles, Lidar Detector, Tracking Camera, Warning Light Flashing Controller, system integration locally and to the TMC, pedestal poles, and pole foundations used in the installation of the Lidar Wrong Way Driver System must be included in this price of Lidar Wrong Way Driver System. Any items that has a bid code and not listed here will be paid for under the bid code for that item.